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Improving the Safety and Security of Freight and Passenger Rail in Pennsylvania

Conducted Pursuant to SR 2006-824

November 2008



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To the Members of the General Assembly:

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House Resolution 824 of 2006 directs the Legislative Budget and Finance Committee to undertake a review of (1) the need to improve the safety and security of the Commonwealth's rail infrastructure and (2) the Commonwealth's statutory and regulatory authority as it relates to the oversight of freight and passenger rail transportation in the Commonwealth.

Due to the specialized nature of this study, the Committee contracted with the RAND Corporation, which has conducted several related studies in this area, for assistance in developing the report.

The RAND report is contained herein. As with all LB&FC reports, the release of this report should not be construed as an indication that the Committee or its individual Committee members necessarily concur with its findings and recommendations.

EXECUTIVE DIRECTOR

PHILIP R. DURGIN

CHIEF ANALYST

JOHN H. ROWE, JR.

Sincerely,

Philip R. Durgin
Executive Director

TECHNICAL
R E P O R T

Improving the Safety
and Security of Freight
and Passenger Rail in
Pennsylvania

David S. Ortiz, Brian A. Weatherford,
Michael D. Greenberg, Liisa Ecola

Sponsored by the Pennsylvania Legislative Budget and Finance Committee



Transportation, Space, and Technology

A RAND INFRASTRUCTURE, SAFETY, AND ENVIRONMENT PROGRAM

This research was sponsored by the Pennsylvania Legislative Budget and Finance Committee and was conducted under the auspices of the Transportation, Space, and Technology Program (TST) within RAND Infrastructure, Safety, and Environment (ISE).

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Preface

On October 24, 2006, the Pennsylvania House of Representatives adopted House Resolution 824, which calls for a “review of the existing Federal and State statutory and regulatory authority as it relates to the oversight of freight and passenger rail transportation systems” in Pennsylvania. The Legislative Budget and Finance Committee (LBFC) was charged with the responsibility of carrying out the review and subsequently contracted with the RAND Corporation to perform it.

This report reviews Pennsylvania’s statutory and regulatory authority over rail and identifies possible actions that Pennsylvania might take to improve rail safety and security. These actions are based on a description of the physical rail system in Pennsylvania and its operating characteristics; a qualitative analysis of risk components to determine the issues of primary importance with respect to both safety and security; a review of recent studies and actions regarding rail security; and an overview of actions taken by other states.

The results should be useful for informing current and future decisionmaking by LBFC members regarding Pennsylvania’s rail safety and security. The study should also be of interest to freight and passenger rail carriers, employees, rail customers and passengers, and concerned citizens.

The research and analysis presented in this report are based on and expand prior RAND work regarding security in transportation systems, reported in the following publications:

- *The State of U.S. Railroads: A Review of Capacity and Performance Data*, by Brian A. Weatherford, Henry H. Willis, and David S. Ortiz, TR-603-UPSF, 2008.
- *Securing America’s Passenger-Rail Systems*, by Jeremy M. Wilson, Brian A. Jackson, Mel Eisman, Paul Steinberg, and K. Jack Riley, MG-705-NIJ, 2007.
- *Maritime Terrorism: Risk and Liability*, by Michael D. Greenberg, Peter Chalk, Henry H. Willis, Ivan Khilko, and David S. Ortiz, MG-520-CTRMP, 2006.

The RAND Transportation, Space, and Technology Program

This research was conducted under the auspices of the Transportation, Space, and Technology (TST) Program within RAND Infrastructure, Safety, and Environment (ISE). The mission of RAND Infrastructure, Safety, and Environment is to improve the development, operation, use, and protection of society’s essential physical assets and natural resources and to enhance the related social assets of safety and security of individuals in transit and in their workplaces and communities. The TST research portfolio encompasses policy areas including transporta-

tion systems, space exploration, information and telecommunication technologies, nano- and biotechnologies, and other aspects of science and technology policy.

Questions or comments about this report should be sent to the project leader, David Ortiz (David_Ortiz@rand.org). Information about the Transportation, Space, and Technology Program is available online (<http://www.rand.org/ise/tech>). Inquiries about TST research should be sent to the following address:

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Contents

Preface	v
Figures	ix
Tables	xi
Summary	xiii
Acknowledgments	xxv
Acronyms and Abbreviations	xxvii
CHAPTER ONE	
Introduction	1
Background	2
Methodology, Scope of Analysis, and Organization of This Report	3
CHAPTER TWO	
Rail Freight and Passenger Rail in Pennsylvania	7
Rail Freight Profile	7
Passenger Rail Profile	14
National Rail Passenger Corporation (Amtrak)	16
South Eastern Pennsylvania Transportation Authority	16
Port Authority Transportation Corporation	18
New Jersey Transit	18
Port Authority of Allegheny County	18
Other Passenger Rail in Pennsylvania	19
The Economic Impact of Railroads	19
CHAPTER THREE	
The Legal Framework for Rail Oversight: The United States and Pennsylvania	21
Federal Railroad Laws: A Primer	22
State Railroad Laws in Pennsylvania	24
Federal Homeland Security Laws: A New Dimension in Rail Oversight	25
Legal Considerations for State Oversight of Rail Safety and Security	26
CHAPTER FOUR	
Risk Factors Affecting Rail Safety and Security in Pennsylvania	29
Threats to Rail Systems	30
The Terrorist Threat to Passenger Rail and Rail Freight	30
Rail Accidents in Pennsylvania, 1998–2007	32

Vulnerability of Rail Systems in Pennsylvania to Terrorist Attacks..... 35
 Consequences..... 37
 Direct Consequences of Passenger Rail and Rail Freight Accidents in Pennsylvania 37
 Potential Direct Consequences of Terrorist Attacks on Passenger Rail and Rail Freight 39
 Indirect Consequences of Safety and Security Incidents in Pennsylvania 40
 Key Causes and Factors Influencing Vulnerability and Consequences..... 41

CHAPTER FIVE

Review of Recent Activity to Improve Rail Safety and Security..... 43
 Major Federal Initiatives 43
 Programs Addressing TIH Risk..... 43
 Advanced Signaling Technology..... 44
 Pennsylvania’s Actions to Improve Rail Safety and Security..... 45
 State Rail Safety Participation Program..... 45
 Commonwealth Critical Infrastructure Protection Program..... 46
 Class I Security Plans, Circular OT-55, and Community Training and Assistance 46
 Class I Rail Incident-Response Training in Pennsylvania..... 50
 State Examples..... 52
 The New Jersey Office of Homeland Security..... 52
 The California Public Utilities Commission..... 53
 Best Practices in Passenger Rail Security..... 55

CHAPTER SIX

Findings and Possible State-Level Actions to Improve Rail Safety and Security..... 59
 Findings 59
 Possible State-Level Actions to Improve Rail Safety and Security 61
 Concluding Thoughts 62

APPENDIXES

A. Maps of Pennsylvania Rail Corridors..... 65
B. Annotated Bibliography..... 67
C. Pennsylvania House Resolution 824..... 77

References..... 81

Figures

A.1. Pennsylvania Rail Corridors.....	65
A.2. Southeastern Pennsylvania Rail Corridors.....	66

Tables

2.1.	Miles of Freight Railroad Operated	8
2.2.	Freight Shipments Originating in Pennsylvania, by Mode	9
2.3.	Commodity Movements in Pennsylvania, 1992–2002	12
2.4.	Hazardous-Materials Shipments in the United States and Pennsylvania in 2002	13
2.5.	Estimated Hazardous-Materials Shipments in Pennsylvania in 2006.....	14
2.6.	Major Rail Corridors in Pennsylvania.....	15
2.7.	Amtrak Stations in Pennsylvania	17
2.8.	Annual Operating Statistics for SEPTA Rail Transit Lines	18
4.1.	Data Sources for Analysis of Risk Factors for Rail Safety and Security.....	30
4.2.	Terrorist Tactics in Rail Incidents Since the 1920s, Worldwide	31
4.3.	Weapons Used in Attacks on Rail Systems	31
4.4.	FRA Accident/Incident Reporting Requirements	33
4.5.	Rail Accidents and Incidents in Pennsylvania, 1998–2007.....	33
4.6.	Train Accidents Involving Hazardous Materials in Pennsylvania, 1998–2007, as Reported by FRA.....	34
4.7.	Average Annual Passenger Rail Incidents in Pennsylvania, 2002–2007, as Reported by FTA	34
4.8.	Passenger Rail Infrastructure Components and Analogous Rail Freight Infrastructure Components.....	36
4.9.	Deaths and Injuries from Rail Accidents and Incidents in Pennsylvania, 1998–2007 ...	38
4.10.	Direct Economic Damages of Train Accidents and Incidents in Pennsylvania, 1998–2007.....	38
4.11.	Types of Train Accidents and Incidents in Pennsylvania and Major Causes, 1998–2007.....	41

Summary

On October 24, 2006, the Pennsylvania House of Representatives adopted House Resolution (H.R.) 824, which calls for a “review of the existing Federal and State statutory and regulatory authority as it relates to the oversight of freight and passenger rail transportation systems” in Pennsylvania. The resolution reflects the significant role that railroad transportation plays in Pennsylvania; the concern for the safety and security of railroad employees, passengers, and the general public; and the potential economic effects of a significant disruption to rail services in the state. Such disruptions could result from an accident, such as the October 2006 derailment of ethanol-filled tank cars and the resulting fires in New Brighton, Pennsylvania, or a deliberate attack, such as the March 2004 commuter-train bombings in Madrid, in which nearly 200 people died.

The Pennsylvania Legislative Budget and Finance Committee (LBFC) asked RAND to respond to the study request in H.R. 824. This report presents the results of that study. It first describes the physical extent of the rail system in Pennsylvania and characterizes the flows of freight and passengers on it. This places the subsequent analysis in context and enables us to quantify the consequences of some types of railroad incidents. Legal authority at the state level is then reviewed to identify actions Pennsylvania could take within that authority to improve rail safety and security. Key risk factors for both safety and security of freight and passenger railroad systems are analyzed to identify actions that could be taken to improve the security of rail facilities, terminals, tunnels, bridges, and other rail infrastructure. However, we were unable to precisely identify the specific use of security measures in place at each rail facility in the state or to assess the immediate need to improve them, because of private-sector security concerns. Finally, we analyze examples of federal, state, and private-sector safety and security practices for passenger and freight railroads, reviewing the training of railroad employees in safety, security, and terrorism response; the status of critical safety technology such as positive train control (PTC) systems; and the systems that protect cargo distributed by rail. Together, these analyses provide an initial assessment of actions Pennsylvania might take to improve rail safety and security.

Rail Transportation Services in Pennsylvania

Pennsylvania is home to several key railroad corridors, over which four Class I rail carriers operate.¹ Norfolk Southern and CSX Transportation operate major corridors running roughly

¹ The Surface Transportation Board (STB) defines a Class I railroad in the United States as one “having annual carrier operating revenues of \$250 million [in 1991 dollars] or more” after adjusting for inflation using a Railroad Freight Price

east-west through the state and along Lake Erie, and Canadian Pacific Railway and the Grand Trunk Corporation (a subsidiary of the Canadian National Railway) also operate in Pennsylvania. Regional and short-line carriers provide essential connectivity among customers and Class I main lines. These carriers include the Buffalo & Pittsburgh railroad, which operates along 500 miles of track, and the Reading Blue Mountain and Northern Railroad, which operates over more than 300 miles of track. The Northeast Corridor, running along the Delaware River in southeastern Pennsylvania, is Amtrak's busiest intercity passenger rail corridor and a key rail freight corridor too.² Amtrak also operates electrified service from Philadelphia to Harrisburg, and greater Philadelphia is served by the Southeastern Pennsylvania Transportation Authority (SEPTA), which operates light rail, rail rapid transit, and commuter rail systems.

Railroads in Pennsylvania also carry a significant amount of freight. In 2006, they carried 209 million tons of it. Rail freight originating in Pennsylvania and carried by rail consists largely of coal and primary metals. Three major rail freight corridors pass through Pennsylvania, providing essential regional and national connectivity. Major intermodal terminals are located at critical junctions and industrial areas, supporting both the regional and the national economy.

Of key concern with respect to safety in rail freight is the transport of hazardous materials. The hazardous materials most frequently shipped by rail are flammable liquids, gases, and corrosive materials. Shipments of toxic inhalation hazard (TIH) materials such as chlorine and anhydrous ammonia are of particular concern. An accident in 2005 in Graniteville, South Carolina, released chlorine gas, resulting in eight deaths, 500 injuries, and direct damage to equipment and track valued at more than \$7.8 million. Data regarding the exact quantity of hazardous materials transported through any specific area are not available to the general public. However, using commodity characteristics and modal shares from the most recent Commodity Flow Survey (CFS) of the Bureau of Transportation Statistics, we estimate that approximately 11 million tons—more than 200,000 carloads—of hazardous materials travel within or through Pennsylvania annually.³

Passenger rail traffic in Pennsylvania is concentrated in the southeastern part of the state. Amtrak's Northeast Corridor is the busiest passenger line in the United States, carrying more than 10 million passengers per year. In 2007, 3.7 million Amtrak passengers boarded or alighted from an Amtrak train at 30th Street Station in Philadelphia, the third busiest passenger rail station in the nation. The Keystone Corridor connects Philadelphia to Harrisburg and carries approximately 1 million passengers annually. (Amtrak service outside this area carries significantly fewer passengers.) SEPTA rail lines provide approximately 150 million passenger trips annually throughout greater Philadelphia, and the Port Authority Transportation Corpo-

Index developed by the Bureau of Labor Statistics (BLS). According to the Association of American Railroads (AAR), that threshold was \$346.8 million in 2006. The STB also uses two other classifications, Class II and Class III; the industry has a different classification system, classifying non-Class I rail carriers as regional or short-line, with short-line further divided into local and switching and terminal. The American Short Line and Regional Railroad Association (ASLRRA) defines these on its website.

² Amtrak is formally known as the National Rail Passenger Corporation.

³ AAR (2008) reported that in 2006, Class I railroads in Pennsylvania carried 4.5 million carloads weighing 209 million tons, for an average of approximately 47 tons per carload. This is less than the national average of 61 tons per carload (AAR, 2007, p. 37) and the 90-ton legislated maximum capacity of a chlorine tank car (The Chlorine Institute, 2007, p. 7).

ration links Center City Philadelphia to New Jersey, carrying approximately 40,000 passengers per day.

Passage of H.R. 824 was motivated by the likely consequences of a disruption of rail freight or passenger service in Pennsylvania to the state and its communities and to the nation. Any such disruption will adversely impact local users of those services, but the effect will be more significant in areas more heavily served by rail—coal-producing areas for rail freight, and greater Philadelphia for passenger transport. Broader effects of disruptions are harder to quantify. The rail freight system in Pennsylvania is very dense, providing the ability to reroute trains in the event of a disruption. Rerouting passenger traffic in the event of a disruption along the Northeast Corridor and from Philadelphia to Harrisburg would, however, be difficult because there are no parallel electrified routes and equipment changes would be necessary. Additionally, alternate routes carry high volumes of rail freight, and there is limited capacity available to accommodate passenger traffic (Weatherford, Willis, and Ortiz, 2008). Any disruption of passenger rail service in the area would substantially increase travel times, as passengers would have to be shifted to alternative modes. A more complete analysis of the effects of a disruption of passenger rail systems, including rail rapid transit, commuter, and intercity services, in Pennsylvania would have to consider the availability, capacity, speed, and cost of alternative modes to compensate for lost services.

Legal Framework for Rail Oversight

Legal oversight of rail is fundamentally a federal activity. The Surface Transportation Board (STB), the entity charged with overseeing rail regulation, has interpreted its powers broadly, sometimes preempting initiatives by local communities and states. A separate entity, the Federal Railroad Administration (FRA), is responsible for establishing and enforcing safety regulations. The Federal Railroad Safety Act of 1970 authorized FRA to partner with states to assist in enforcement of railroad safety laws. Thirty states, including Pennsylvania, now collaborate through FRA's State Rail Safety Participation Program. The Pennsylvania entity charged with this authority is the Pennsylvania Public Utility Commission (PPUC), which performs inspections on behalf of and in collaboration with FRA. The U.S. Department of Transportation (DOT) agency that has the authority to regulate the transport of hazardous materials by all modes is the Pipeline and Hazardous Materials Safety Administration (PHMSA).

Recent Pennsylvania laws regarding railroads have focused on economic development. The Rail Freight Preservation and Improvement Act of 1984 empowered the Pennsylvania DOT with some grant-making authority to assist struggling railroads. The State Railroad Infrastructure Act of 2004 established a state railroad bank and allows the Pennsylvania DOT Bureau of Rail Freight, Ports, and Waterways to provide economic development grants through the Rail Freight Assistance Program and the Rail Transportation Assistance Program.

Federal security regulations enacted after the terrorist attacks of September 11, 2001, have augmented federal oversight of rail to include security. General oversight and rail safety continue to reside in the U.S. DOT, but oversight of security now resides in the U.S. Department of Homeland Security (DHS) under the Transportation Security Administration (TSA). The Implementing Recommendations of the 911 Commission Act of 2007 include a number of provisions related to rail, including the development of a national rail-security strategy and risk assessment; institutional risk assessments by rail carriers; new programs for rail-security train-

ing, rail-security exercises, and tank-car security testing; and rail-security research and development. PHMSA, in collaboration with TSA, has recently promulgated a new rail hazardous-materials transport rule.

Key Risk Factors of Rail in Pennsylvania

Risk comprises threats, vulnerabilities that threats can exploit, and the resulting consequences. Rather than deriving a measure of risks to rail in Pennsylvania, we analyzed these three factors individually. In doing so, we identified opportunities for Pennsylvania to address risks to rail by reducing the threat, vulnerability, or consequences of both accidents and terrorist attacks.

Threat

The terrorist threat to rail systems is well documented. The vast majority of terrorist attacks on rail systems are bombings—involving large truck-sized bombs, smaller hand-carried devices (the most common type), and/or incendiary devices—followed by armed attacks, sabotage, arson, and unconventional attacks. The most notable unconventional terrorist attack was the 1995 release of a nerve agent in the Tokyo subway, which resulted in 12 deaths and thousands of injuries. According to a prior RAND analysis of threats to passenger rail systems (Wilson et al., 2007), there is a high threat of attacks using small explosives; a medium threat of attacks using large explosives, small incendiary devices, or other weapons, sabotage, and hoaxes; and a low threat of attacks using large incendiaries and unconventional weapons. We assume that these threats apply to both rail freight and passenger rail, though the vast majority of recorded attacks have been against passenger systems.

FRA collects data on accidents that exceed a certain level of damage.⁴ These accidents are characterized as train, grade crossing, or “other” (a large group that includes obstructions, explosions, and fires). Train accidents are further classified into derailments, collisions, and “other.” From 1998 through 2007, more than 3,000 rail freight accidents in Pennsylvania were reported to FRA, approximately half of which were classified as “other.” The rest are divided roughly equally between train accidents and grade-crossing incidents. Thirteen releases of hazardous materials by rail freight in Pennsylvania were reported to FRA during this period.⁵ In the same period, more than 4,000 accidents or incidents in passenger rail occurred in Pennsylvania, of which slightly more than 200 were train accidents, 33 were grade-crossing incidents, and the remainder were “other” incidents, typically resulting in minor injuries to passengers or employees.

According to FRA, which collects data on the causes of rail accidents, the dominant causes of accidents in Pennsylvania over the past decade have been track defects, followed by human factors, “miscellaneous,” motive power, and signals.

Reducing terrorist threats to rail requires effective law enforcement and intelligence gathering and analysis. The number of accidents can be reduced by proper enforcement of safety regulations, informed by analysis of accident causes.

⁴ The threshold level of damages in 2008 is \$8,500 in property loss, any injury to an employee or passenger, or any release of hazardous materials.

⁵ PHMSA has different reporting requirements. For consistency in our analysis, we used data from FRA.

Vulnerability of Rail Assets to Terrorist Attack

The presence of threat is a concern only when it is capable of exploiting a specific vulnerability; for example, crowded stations are vulnerable to bombings and armed attacks. Our analysis applies the concept of vulnerability to specific components of the rail infrastructure, including stations, track, tunnels, and bridges, based on the general accessibility of these components to would-be attackers. We have extended a measure of vulnerability of passenger rail systems developed in a RAND analysis of passenger rail infrastructure (Wilson et al., 2007) to rail freight infrastructure. That analysis concluded that trains and stations have relatively higher vulnerability than other infrastructure components, which have medium vulnerability. Extending the results to rail freight infrastructure, we conclude that dwelling locomotives and cars and yard and loading infrastructure have relatively higher vulnerability than track, bridges, and tunnels, which in turn are relatively more vulnerable than system operation and control infrastructure.

These general results may be applied to Pennsylvania by comparing the predominant infrastructure types and the likelihood of attack. The concentration of stations and passenger rail operations in greater Philadelphia, the Northeast Corridor, and the Keystone Corridor indicates that this area has relatively higher vulnerability than other areas. A relatively more capable emergency response may also be mounted at the local level in this area. Protecting dwelling trains and yard infrastructure requires collaboration among the carriers and federal, state, and local officials and has already been the focus of federal initiatives. Securing the large amount of rail freight infrastructure outside of urban areas would be very difficult; hence, identifying key assets to protect among them is an important first step in reducing vulnerability.

Consequences

Given the number of passengers in some parts of Pennsylvania's passenger rail system and the types of materials shipped via rail freight, certain accidents and purposeful attacks could have significant consequences. According to FRA data for both passenger rail and rail freight from 1998 through 2007, train accidents resulted in a single death and 98 injuries, and highway-rail grade-crossing accidents resulted in 45 deaths and 172 injuries. The majority of casualties occur in the "other" category of accidents and incidents, defined as events that result in personal injury. Including "other" accidents and incidents, an average of 43 deaths and approximately 1,000 injuries occur on Pennsylvania rail systems annually.

Most train accidents do not result in significant direct damage to equipment, track, and infrastructure. Direct damage, however, does not include the costs of rerouting trains around the disruption, delays, or medical services provided to victims. The overwhelming majority of accidents between 1998 and 2007 incurred less than \$100,000 in direct damage. Seven percent of the train accidents during this period resulted in direct damage valued at more than \$1 million.

According to Wilson et al. (2007), terrorist attacks on rail systems have each resulted in an average of four deaths and 13 injuries. This figure treats each individual terrorist incident as a single attack and excludes the 1995 nerve-gas attack on the Tokyo subway, which would skew the results. The median for attacks resulting in at least one casualty is one death and 10 injuries; if all attacks are included in the calculation, the median number of casualties is zero.

The consequences of certain prior accidents provide insights into the potential consequences of terrorist attacks. Average casualty rates from accidents indicate that a successful attack on rail freight would not necessarily be catastrophic. However, the derailment and rup-

ture of 20 tank cars of fuel ethanol in New Brighton, Pennsylvania, in 2006 caused a fire that burned for several days, and a 2002 derailment in Minot, North Dakota, resulted in the release of anhydrous ammonia gas, killing one person and injuring more than 300 people, 11 of them seriously. Direct damages to equipment were reported to be greater than \$3.0 million, and environmental remediation costs for that incident were reported to be more than \$10 million. A successful attack on a freight train carrying TIH materials through a densely populated area could easily result in consequences an order of magnitude greater: tens of deaths, hundreds of injuries, and tens of thousands of persons displaced.

Research has confirmed the large-scale damages that could result from the accidental or purposeful release of hazardous materials. There is also evidence showing that effective emergency response can significantly limit the scale of human consequences in such incidents.

Rail accidents and incidents occur routinely in Pennsylvania; there is on average about one per day for both rail freight and passenger rail. The majority of these events do not cause injury or significant damage, and there has never been, to our knowledge, a terrorist attack against rail in Pennsylvania. Researchers have analyzed historical data regarding rail accidents and incidents to estimate the potential human and economic costs of future accidents and incidents. However, the lack of prior experience with sudden massive releases of TIH in urban areas, as might occur in a successful terrorist attack, suggests that using these data to estimate the potential human and economic costs of terrorist attacks against rail is likely to understate them.

Recent Federal and State Initiatives Seeking to Improve Rail Security

At the federal level, U.S. DOT and TSA have sought to reduce the risk of terrorist attacks on rail freight. The initial and ongoing effort is the Toxic by Inhalation Hazard Risk Reduction Program, in which TSA assumes that the risk of hazardous-materials transport is directly proportional to the dwell time and volume of materials transported through densely populated areas.⁶ First implemented in New Jersey and New York and currently being implemented in Pennsylvania, the program seeks to establish secure storage areas for TIH materials and to expedite their movement through the system. More recently, PHMSA has directed rail freight carriers to transport TIH materials over the “safest and most secure commercially practicable routes.”

The New Jersey Office of Homeland Security (OHS) participated closely with TSA and the Class I carriers in the execution of the Toxic by Inhalation Hazard Risk Reduction Program. In this way, New Jersey was able to build capacity in hazardous-materials security and worked closely with the Class I carriers to identify grant funding that would assist in the consolidation of operations and the improvement of security in certain yards and facilities.

Since 1990, the National Transportation Safety Board (NTSB) and FRA have made implementing technology to prevent railroad accidents, PTC in particular, a priority. The Railroad Safety Enhancement Act of 2008 (P.L. 110-432) requires Class I railroads to implement PTC on lines carrying hazardous materials and lines carrying both freight and passengers by 2015. This technology has the potential to increase railroad safety but has not yet been

⁶ These assumptions are consistent with our risk-factor analysis and the existing literature on risks of transport of hazardous materials, which concludes that the likelihood of an attack on a dwelling car is high.

broadly deployed. To our knowledge, no rail freight demonstration projects of PTC exist in Pennsylvania; however, Amtrak implemented early-generation PTC systems along the Northeast Corridor and the Keystone Corridor. Class I railroads operating on these corridors have equipped their locomotives with the necessary technology to use these advanced signaling systems. Although they improve safety, PTC systems may also create new safety and security vulnerabilities if they malfunction or are compromised.

The Pennsylvania OHS has established the Commonwealth Critical Infrastructure Protection Program (CCIPP), a collaboration between the State Police, OHS, and the Pennsylvania Emergency Management Agency (PEMA). Rail transportation infrastructure is among the assets the program seeks to protect. Within CCIPP—a state-level complement to the National Infrastructure Protection Program—the State Police seek to prevent attacks through coordination with other law enforcement and intelligence agencies; OHS coordinates the program, and PEMA is responsible for response and recovery operations.

California is one state that has increased state-level oversight of rail and strengthened regulation of railroad security. In addition to its role in enforcing federal rail-safety regulations, the California Public Utilities Commission (CPUC) is developing capacity to improve rail security. CPUC was charged with enforcing the provisions of Assembly Bill 3023 and, ultimately, negotiating a settlement agreement with Class I carriers.⁷ As a result of the settlement agreement, officials from the California OHS (on behalf of CPUC) reviewed and commented on Class I rail-security plans. In the future, CPUC inspectors are to be federally certified in both safety and security, so that they may issue security enforcement recommendations under the auspices of federal law. Additionally, California actively seeks to bring state-level knowledge regarding rail safety and security to short-line carriers that may not have the resources to establish robust safety and security programs on their own.

Railroad Actions to Improve Security

In response to the terrorist attacks of 2001, AAR formed a task force to draft a security plan and procedures. The resulting plan includes (1) a nationwide database of critical railroad assets; (2) assessments of vulnerabilities of those assets and rail operations; (3) assessment of the terrorism threat; (4) calculations of risk; (5) identification of countermeasures to reduce risk; (6) a definition of alert levels; (7) delineation of actions to be taken at each alert level; and (8) functions of the AAR operations center and railroad alert network. The AAR security plan was first issued in December 2001 and has recently been revised. However, it is not available for review by the public.

Each Class I carrier has developed a corporate security plan based on the AAR model. These are the security plans that each carrier reviews with TSA. Class I carriers claim to have made security improvements as a result of developing and implementing their plans. For example, CSX operates remote video surveillance equipment at certain yards and facilities. Both CSX and Norfolk Southern have enhanced their background checks on employees and contractors and have identified assets that are to receive greater security resources as a func-

⁷ In 2006, California passed Assembly Bill 3023, which would have compelled rail freight carriers in the state to share security plans and file infrastructure protection plans with the state. A legal appeal resulted in a settlement agreement that allowed California officials to inspect Class I security plans but acknowledged federal authority over security.

tion of the security alert level. But representatives of railroad employees claim that the security actions taken by the Class I carriers are inadequate and that training has not kept up with the increased security requirements.⁸

AAR maintains guidelines on best practices for the safe transport of hazardous materials. These guidelines, which members are obligated to follow, specify the designation of “key trains” and “key routes,” depending on the volume and types of hazardous materials transported. Key trains are restricted to a top speed of 50 miles per hour. Along key routes, track inspections are to occur twice each year, and wayside defective-bearing detectors are to be installed and operated at intervals no greater than 40 miles. AAR guidelines permit local emergency responders to request information regarding the types and quantities of hazardous materials that are transported through their communities. The guidelines also promote the use of several services to report chemical spills and provide community education.

Class I carriers operating in Pennsylvania also provide emergency-response training to local first responders. At the request of the community or on its own initiative, CSX will provide training in the form of classroom sessions and self-study. Norfolk Southern also provides first-responder training and community-awareness services, generally under the auspices of the Transportation Community Awareness and Emergency Response consortium. Members of several communities that participated in CSX training indicated in interviews that the training was helpful and that it complemented their knowledge and skills. In particular, the Philadelphia Fire Department has a long-standing relationship with CSX, which has provided enhanced training for hazardous-materials specialists at the Emergency Response Training Center in Colorado. None of the communities that we contacted had experienced a hazardous-materials incident in recent years that would test the training or the communications protocols needed to mount an effective response.

Passenger Rail Security Best Practices

The literature on case studies of transit and passenger rail systems in the United States, Europe, and Japan identifies security best practices for passenger rail systems. The four primary categories of action to improve security are (1) design of stations, public areas, and trains to withstand explosive forces and provide a means of egress for the public and ingress for emergency response; (2) appropriate deployment of security technologies, such as closed-circuit television (CCTV) surveillance cameras; (3) a security and emergency-response organization with clear lines of communication that may be scaled to the required size for effective response; (4) planning and practicing of response to security incidents to refine systems and protocols.

Findings

1. Pennsylvania has a dense network of rail freight routes, though Class I railroads carry the vast majority of freight.

Four Class I railroads and nearly four dozen regional and short-line railroads provide rail freight services in Pennsylvania on a network covering more than 5,000 track miles, and alter-

⁸ Two reports specifically address this issue: Teamsters Rail Conference (2005) and National Labor College (2006).

nate parallel routes exist within Pennsylvania or neighboring states. The result of this density of active rail freight service providers is that disruptions within the system can be rerouted relatively easily along parallel routes on the Class I carrier's network, or if appropriate and available, along other railroads—Class I, regional, or short-line.

2. Pennsylvania's passenger rail services are concentrated in the southeastern corner of the state.

Passenger rail infrastructure and services in Pennsylvania are concentrated in the greater Philadelphia region. SEPTA operates a large urban-transit system consisting of light rail, rail rapid transit, and commuter rail components. Amtrak's Northeast Corridor, which runs through Philadelphia along the Delaware River, connecting Boston to Washington, D.C., is the busiest intercity rail corridor in the United States. Its Keystone Corridor provides rail service between Philadelphia and Harrisburg. These and other systems interchange at 30th Street Station in Philadelphia. Other passenger rail systems in Pennsylvania carry an order of magnitude fewer passengers annually than the major systems in the southeastern corner of the state.

3. There is a documented terrorist threat to rail systems, and infrastructure will always be vulnerable.

Documented attacks have occurred against all types of passenger rail systems. The most common mode of attack is bombing of stations or loaded passenger cars; there is a lesser threat of armed attacks. Sabotage and unconventional attacks have also occurred, however, including a purposeful derailment of the Amtrak Sunset Limited in 1995 and the release of sarin gas, a potent nerve agent, in the Tokyo subway in the same year. With the exception of the Tokyo attack, relatively few casualties, on average, result from terrorist attacks on rail systems.

A prior RAND study assessed the vulnerability of passenger rail by considering the practicality of attacks against specific infrastructure components. Generalizing this approach to rail freight, we conclude that much of the infrastructure is accessible to would-be attackers and is vulnerable. However, the consequences of accidents in rail freight, if taken as a guide to possible consequences due to attacks, are relatively minor. Safety incidents in rail freight generally do not result in casualties and do not incur significant direct damages to track or equipment. Incidents involving the release of hazardous materials, however, can have far more severe consequences. Were such an incident to be perpetrated with the intent of maximizing casualties, the results could be catastrophic.

4. The extent and diversity of railroad infrastructure and operations in Pennsylvania require an equally diverse approach to security.

The rail freight and passenger rail network in Pennsylvania serves both densely populated urban areas and sparsely populated and difficult-to-access rural areas. Ensuring safety and security within the urban areas requires coordination among a number of different agencies, jurisdictions, and carriers. In rural areas, identifying appropriately equipped and trained emergency-response capabilities may be difficult.

5. Effective response is essential for minimizing casualties and economic damage resulting from rail safety and security incidents.

Prior research has concluded that effective response is an important element in reducing the consequences of attacks or accidents. However, providing effective emergency-response ser-

vices can be difficult and requires appropriate resources, training, planning, interagency coordination, and practice. Exercises, both tabletop and in the field, are an important component of emergency-response training to ensure that lines of communication are clear and logistics practiced.

6. There is significant flexibility within existing legal authority for Pennsylvania to play an active role in shaping its rail safety and security.

Legal authority over rail infrastructure and operations is largely a federal activity. However, since states partner with FRA in enforcing key railroad-safety legislation, there are many opportunities for states to take an active role in overseeing rail safety and security. Within the current regulatory system, states perform many safety- and security-related functions, both in collaboration with federal agencies and on their own. New Jersey and California are two significant examples.

Possible State-Level Actions to Improve Rail Safety and Security

1. Use state rail development funding to improve rail transportation and safety and security.

The Pennsylvania Department of Transportation's (PennDOT) Rail Freight Assistance Program and Rail Transportation Assistance Program provide grants to bolster rail infrastructure as an economic-development tool, preserving rail services throughout the state. PennDOT could create a complementary program to fund safety and security improvements to regional and short-line railroads, possibly under the authority of the Rail Freight Preservation and Improvement Act. Straightforward improvements to track and supporting infrastructure of these railroads could have a significant effect on safety and security, for two principal reasons. First, smaller carriers tend to be undercapitalized and to operate on lower-rated track than the Class I carriers; thus they experience higher accident rates. Second, in the event of a significant disruption, such as one that would result from disabling a major bridge or tunnel, reconstituted regional or short-line routes may be able to improve the resilience of the rail freight system. Federal homeland-security grant programs already exist and may be a source of funding for such activities. Two examples of such programs are the Buffer Zone Protection Program⁹ administered by the Federal Emergency Management Agency (FEMA) and the Transit Security Grant Program¹⁰ administered by DHS.

2. Be prepared to provide a wide range of support services, depending on local needs.

Each of the Pennsylvania communities in which rail operations occur has unique abilities to plan for and mount a response to a rail safety or security incident. State officials, possibly from the Pennsylvania OHS, could assist communities in identifying key components of infrastructure and in applying for grant programs to bolster and improve them. In the event of an incident, state resources may augment local capabilities or may coordinate the entire response. Ensuring that such planning and response is effective requires close coordination of the rel-

⁹ For more information, see <http://www.fema.gov/government/grant/bzpp/index.shtm> (as of September 21, 2008).

¹⁰ For more information, see http://www.dhs.gov/xgovt/grants/gc_1178820367100.shtm (as of September 21, 2008).

evant state agencies—the State Police, PPUC, OHS, and PEMA, among others—with local communities, carriers, and system operators.

3. Coordinate simulations and exercises including personnel from local and state agencies, neighboring states, federal agencies, volunteer organizations, and the railroads.

The Commonwealth of Pennsylvania, possibly led by PEMA, could coordinate training exercises that simulate or rehearse for a serious hazardous-materials release or terrorist railroad incident. Such training would test lines of communication and allow participants to practice logistics, deployment, evacuation, and other response and recovery operations. This would provide state agencies with critical hands-on understanding of their roles in disaster response and would improve interagency communication. Ideally, these exercises would include both freight and passenger rail and would be conducted throughout the state. Participation among state agencies, local first responders, and railroad personnel and employees should improve communication and ultimately reduce the impacts of intentional or accidental railroad incidents.

4. Build state-level capacity in rail safety and security.

PPUC could seek to emulate the example of CPUC in carrying out its responsibilities under the State Rail Safety Participation Program and that of the New Jersey OHS in its collaboration with TSA on security matters. FRA and TSA have welcomed the increased involvement of these states. Moreover, state resources and expertise could be focused on areas not necessarily covered by FRA or TSA. For example, CPUC investigates all incidents that occur at grade crossings in the state, something that FRA does not do. The expertise gained at the state level could be transferred to regional and short-line railroads, which may not have the resources or the in-house expertise to implement certain safety and security practices.

Pennsylvania could develop a formal intelligence collection and analysis center, similar to the center established by New Jersey, which would maintain direct contact among Pennsylvania law enforcement, the federal government, local communities, and system operators, perhaps employing the CSX Network Operations Workstation (NOW) terminal and the car-location data offered by Norfolk Southern.

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Acronyms and Abbreviations

AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
ASLRRA	American Short Line and Regional Railroad Association
BNSF	Burlington Northern Santa Fe
BPRR	Buffalo & Pittsburgh Railroad
CAEPG	<i>Community Awareness Emergency Planning Guide</i>
CCIPP	Commonwealth Critical Infrastructure Protection Program
CCTV	closed-circuit television
CFS	Commodity Flow Survey
CHEMTREC	CHEMical TRansportation Emergency Center
CN	Canadian National
CP	Canadian Pacific
CPUC	California Public Utilities Commission
CSAO	Conrail Shared Assets
CSX	CSX Transportation
DHS	Department of Homeland Security
DOT	Department of Transportation
ERRI	<i>Emergency Response to Railroad Incidents</i>
FELA	Federal Employers' Liability Act
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration

GTW	Grand Trunk Corporation
H.R.	House Resolution
HTUA	high-threat urban area
ICC	Interstate Commerce Commission
IRC Act	Implementing Recommendations of the 911 Commission Act
LBFC	Legislative Budget and Finance Committee
MGT	million gross tons
MIPT	Memorial Institute for the Prevention of Terrorism
mph	miles per hour
NIPP	National Infrastructure Protection Program
NJT	New Jersey Transit
NOW	Network Operations Workstation
NS	Norfolk Southern Combined Railroad Subsidiaries
NTSB	National Transportation Safety Board
OHS	Office of Homeland Security
PAT	Port Authority of Allegheny County
PATCO	Port Authority Transit Corporation
PEMA	Pennsylvania Emergency Management Agency
PennDOT	Pennsylvania Department of Transportation
PHMSA	Pipeline and Hazardous Materials Safety Administration
PPUC	Pennsylvania Public Utility Commission
PTC	positive train control
RBMN	Reading Blue Mountain & Northern
RJCP	R. J. Corman
RLA	Railway Labor Act
SEPTA	Southeastern Pennsylvania Transportation Authority
SLRR	short-line railroad
STB	Surface Transportation Board
STRACNET	Department of Defense Strategic Rail Corridor Network
TEU	twenty-foot-equivalent unit

TIH	toxic inhalation hazard
TRANSCAER	TRANSpotation Community Awareness andEmergency Response
TSA	Transportation Security Administration
UP	Union Pacific

Introduction

Railroad transportation, both passenger and freight, is integral to the economy of the Commonwealth of Pennsylvania. The busiest passenger rail corridor in the United States passes through Philadelphia, and many thousands of workers in the Philadelphia region use a dense network of transit and commuter rail systems to safely and quickly move around the region every day. Pittsburgh residents also have a light-rail transit system. Long-distance travelers to and from most major Pennsylvania cities can travel via passenger rail operated by the National Railroad Passenger Corporation (Amtrak®). Pennsylvania is home to more railroads than any other state: Four Class I railroads, two large regional railroads, and approximately 45 local switching and terminal railroads operate over 5,000 miles of track.¹ Key commodities, such as coal, are carried by rail from Pennsylvania to destinations throughout the United States and to ports for export. Railroads also provide access to major seaports, inland waterways, and global markets. Several rail freight corridors through Pennsylvania each carry more than 100 million gross tons of freight annually and are among the nation's busiest. A significant disruption to this system could have serious local, state, regional, and national effects. With this in mind, the Pennsylvania General Assembly passed House Resolution (H.R.) 824, which calls for “a review of the existing federal and state statutory authority as it relates to the oversight of freight and passenger rail in Pennsylvania.” This report responds to H.R. 824,² which is reproduced in Appendix C.

House Resolution 824 calls for the review to consider the need to improve the security of rail infrastructure; the status of technology to reduce railroad accidents; the training of railroad employees in the areas of safety and security; the effects of continued containerization of freight on rail security in Pennsylvania; and passenger-security and cargo-protection systems.

¹ The Surface Transportation Board (STB) defines a Class I railroad in the United States as one “having annual carrier operating revenues of \$250 million or more” after adjusting for inflation using a Railroad Freight Price Index developed by the Bureau of Labor Statistics (BLS). According to the Association of American Railroads (AAR), that threshold was \$346.8 million in 2006. The STB also uses two other classifications, Class II and Class III, having a revenue threshold of \$27.8 million; the industry has its own classification system, classifying non-Class I rail carriers as regional or short-line, with short-line further divided into local and switching and terminal. The American Short Line and Regional Railroad Association (ASLRRRA) defines these on its internet site, http://www.aslrra.org/about_aslrra/faqs/ (as of September 17, 2008).

² A related bill, Senate Bill (S.B.) 1298, failed to pass the Pennsylvania House of Representatives and therefore was not enacted into law. That bill would have required the Pennsylvania Department of Transportation (PennDOT) and the Pennsylvania Emergency Management Agency (PEMA) to “jointly complete a railroad security assessment” that identifies key assets of the rail system in Pennsylvania and the vulnerabilities associated with the transportation of hazardous materials, and to prepare a railroad-security plan to minimize the risk of terrorist attacks on the rail system in Pennsylvania.

Given the prominence of rail in Pennsylvania, there is significant concern regarding the security of the rail system and actions that may be taken by the state to improve security. Attacks in Madrid (2004), London (2005), and Delhi (2007) highlight the vulnerability of rail systems to terrorist attacks. A successful attack on a passenger rail target in Pennsylvania could be a disaster; in addition to causing direct casualties, such an attack could disrupt passenger rail transportation throughout the U.S. Northeast. Of potentially greater concern is an attack on rail freight infrastructure or trains. Hazardous-materials railcars could be attacked and ruptured, releasing a toxic cloud. Or a large bomb could be covertly loaded onto a railcar (or an intermodal container) as freight and detonated to destroy infrastructure or a high-profile target adjacent to a rail line. A survey of railroad employees listed a number of concerns, including the fact that rail freight infrastructure was generally accessible to the public (Teamsters Rail Conference, 2005).

The remainder of this chapter provides background on rail safety and security as it pertains to Pennsylvania, describes the methodologies employed to perform our analysis, and provides an overview of the rest of the report.

Background

Oversight of U.S. railroads, both passenger and freight, is largely a federal responsibility, primarily because of the inherently interstate nature of many rail operations. With respect to safety, the Federal Railroad Administration (FRA) provides the primary oversight of Class I rail freight carriers and Amtrak. The Federal Transit Administration (FTA) provides oversight of commuter rail, subways, and other public-transit systems. However, the states do play a significant role in assisting FRA and FTA in carrying out their duties. FRA has memoranda of understanding with 30 states to assist in enforcement of rail-safety laws. Since the terrorist attacks on the United States in 2001, the Transportation Security Administration (TSA), which moved from the U.S. Department of Transportation (DOT) to the U.S. Department of Homeland Security (DHS), has led efforts to improve the security of rail transportation. These efforts have focused on the security of hazardous materials and security in passenger rail. An accurate characterization of security efforts to date is that they are in progress, with some notable achievements.

In fall 2001, AAR brought together its membership and security experts to draft a security plan (Hamberger, 2005). This plan, which was adopted in December 2001, became a model for subsequent plans developed by the Class I carriers.

The AAR draft security plan, and presumably the subsequently developed corporate rail-security plans, includes the following components:

1. A nationwide database of critical railroad assets
2. Assessments of vulnerabilities of those assets and rail operations
3. An analysis of the terrorism threat
4. Calculations of risk
5. An identification of countermeasures to reduce risk
6. Definitions of four alert levels that correspond to security actions:
 - Level 1: new normal day-to-day operations
 - Level 2: heightened security awareness

- Level 3: a credible threat of an attack on the United States or the railroad industry
 - Level 4: a confirmed threat of an attack against the railroad industry or an actual attack within the United States
7. The security actions to be taken at each alert level
 8. A description of the functions of the AAR operations center and railroad alert network.

TSA requires that the Class I carriers submit their plans to TSA for review. In general, the Class I carriers are reluctant to share their security plans with states, arguing that they comprehensively address railroad-security vulnerabilities that are proprietary and not of interest to state authorities and, moreover, that current laws do not require them to be shared with state officials. When railroads have agreed to allow review of security plans by state officials, it has been under circumstances controlled by the railroads. The existence of corporate security plans without knowledge of how these plans affect rail operations and emergency response in the state may or may not improve overall rail security, from Pennsylvania's point of view.

What can be done at the state level to improve the safety and security of rail in Pennsylvania? Within the current regulatory system, states already perform many safety- and security-related functions, both in collaboration with federal agencies (see Chapter Five) and on their own. In Pennsylvania, the Pennsylvania Public Utility Commission (PPUC) is the state agency that assists FRA in implementing federal rail-safety regulations. Additionally, the Southeastern Pennsylvania Transportation Authority (SEPTA[®]) and the Port Authority of Allegheny County (PAT) in Pittsburgh employ their own police forces to enforce law and transit-authority policy within their systems. Other states have worked directly with federal officials to gain expertise and to build their own rail-security capacity and may serve as examples for Pennsylvania. In New Jersey, much of this work has occurred through the state Office of Homeland Security (OHS). The New Jersey OHS has collaborated with federal officials and railroads in the evaluation of rail and hazardous-materials transport security and the mitigation of major risks. In doing so, New Jersey has developed expertise and was able to identify promising areas for federal grant funding for security infrastructure. In California, the California Public Utilities Commission (CPUC) is increasing its expertise in rail safety to include some security oversight.

Methodology, Scope of Analysis, and Organization of This Report

For this report, *safety* and *security* are defined as follows: *Safety* refers to conditions within the rail system, both natural and man-made, that lead to accidents and that cause accidents to result in casualties. For example, defective track is a condition that may lead to a derailment, causing an accident; the result may be injury to persons and the release of hazardous materials. *Security* refers to protection from criminal actions, assumed to be terrorist attacks, against the rail system and its infrastructure. This protection may take the form of reducing the threat of an attack, the vulnerability of the rail system to the attack, and the consequences resulting from a successful attack. Several analyses related to safety and security are documented in this report:

- Critical rail corridors were identified and a partial list of critical infrastructure was inventoried. Critical rail corridors in Pennsylvania were identified using information from the Pennsylvania State Rail Plan (R. L. Banks & Associates and Linare Consulting, 2003), the FRA National Rail Safety Action Plan (FRA, 2005a), and the Department of Defense Strategic Rail Corridor Network (STRACNET) (Military Traffic Management Command and FRA, 1998). The State Rail Plan identifies major corridors and provides data on freight volumes. FRA defines a national system of “principal rail lines,” using the following criteria: A principal rail line carries Amtrak service, is essential to national defense, or has annual freight volume exceeding 20 million gross tons (MGT). STRACNET identifies specific railroad lines that meet the minimum conditions for defense readiness. We also used earlier rail-security studies and other publicly available information from the transit agencies to identify passenger rail infrastructure and operational characteristics. This analysis is discussed in Chapter Two.
- We reviewed federal and state authority for oversight of rail freight and passenger rail transportation systems in Pennsylvania to determine possible actions that could be taken at the state level to improve rail safety and security. This review appears in Chapter Three.
- To support decisionmaking within state authority, we performed a qualitative analysis of risk factors with respect to rail safety and security in Pennsylvania. The reasons for performing a *qualitative* analysis are twofold: First, the focus of H.R. 824 is on the relationship between federal and state authority with respect to safety and security of rail systems; second, the breadth and time frame of inquiry, including a review of safety and security concerns for both freight and passenger rail, did not allow for a more detailed quantitative analysis. Our analysis is based on empirical data regarding the terrorist threat to rail (Wilson et al., 2007), safety data compiled by FRA (FRA, Office of Safety Analysis, 2008) and FTA (Federal Transit Administration, 2008), and a description of the physical and operating characteristics of the rail system in Pennsylvania. Within the context of this study, improving rail safety and security is equivalent to reducing risk factors in rail systems. We were unable to identify precisely the specific use of security measures in place at each rail facility in the state or to assess the immediate need to improve them, because of private security concerns. The analysis of risk factors appears in Chapter Four.
- To provide examples of possible actions Pennsylvania may wish to pursue to improve rail safety and security, we reviewed relevant federal actions and those of several other states. The intent of this task was to identify examples at the state level for addressing safety and security in rail systems, including possible collaborations with the federal government, adjoining states, municipalities, or rail carriers. This analysis included the training of railroad employees in safety, security, and terrorism response; the status of critical safety technology such as positive train control (PTC) systems; and the systems that protect cargo distributed by rail. Given the complexity of rail systems and the unique role they perform in the economies of each state and region, there does not appear to be a set menu of options, although examples from other states provide valuable insight for undertaking similar efforts in Pennsylvania. Federal and state actions are discussed in Chapter Five, based on a literature review and interviews with federal and state officials, local emergency responders, and railroad operators and employees.
- This report fits within the broader context of recent reports and actions taken to improve rail security since the September 11, 2001, terrorist attacks on the United States and the more recent terrorist attacks on passenger rail systems in England and Spain. These

reports and actions comprise a body of knowledge on security best practices and measures to improve security.³ Effective security “includes not just the deterrent and preventive measures that normally come under the heading of security practices, but all efforts to mitigate casualties, damage, and disruption and to rapidly restore operations after an attack” (Jenkins, 1997a, p. 5). A review of recent studies in the area was performed to provide an overview of security in rail and recommended actions to improve it. The review is summarized in Chapter Five.

- Chapter Six presents the findings of the study and identifies possible future state-level actions to improve rail safety and security within the Commonwealth of Pennsylvania.
- Appendix A presents maps of Pennsylvania’s railroad corridors. Appendix B is an annotated bibliography of recent studies in the area of rail safety and security. House Resolution 824 is reproduced in Appendix C.

³ Specifically, Wilson et al. (2007) analyzed data in the RAND–Memorial Institute for the Prevention of Terrorism database of terrorist attacks.

Rail Freight and Passenger Rail in Pennsylvania

More than 50 railway companies own and operate more than 5,000 miles of railroad in Pennsylvania. Railroads and public-transit systems are an integral component of Pennsylvania's transportation system and contribute greatly to the overall mobility of people and goods throughout the state. This chapter identifies Pennsylvania's most critical rail infrastructure, describes the flows of freight and passengers through Pennsylvania, and summarizes the economic role of this network in the state and the greater Northeast region.

Rail freight is vital to the economy of Pennsylvania. The state's coal mines, refineries, foundries, manufacturers, and retailers rely on railroads to deliver freight and to bring their products to customers and markets. Several very high-volume rail freight corridors run through the state, connecting the Northeast to major markets and ports elsewhere in the country. Class I carriers in Pennsylvania carried 209 million tons of freight in 2006 (AAR, 2008). This accounts for about 16 percent of the total tons of freight shipped in the state and nearly 30 percent of the ton-miles (Bureau of Transportation Statistics and U.S. Census Bureau, 2005).

Passenger rail in Pennsylvania improves mobility for state residents and visitors by providing an alternative to air travel and automobiles. All major cities and towns in the state are served by Amtrak's regional passenger rail service. Amtrak reported more than 5 million boardings and alightings in 2007 in Pennsylvania, with tens of millions more passengers passing through the state on its most heavily traveled route, the Northeast Corridor (Amtrak, 2008).¹ The two largest cities in Pennsylvania, Philadelphia and Pittsburgh, and their suburbs are served by heavy- and light-rail systems.² Philadelphia's transit rail system, SEPTA, is one of the busiest in the nation, with nearly 150 million passenger trips per year on its trains (National Transit Database, 2007).

Rail Freight Profile

Four Class I railroads operate in Pennsylvania: Norfolk Southern Combined Railroad Subsidiaries (NS), CSX Transportation (CSX), Grand Trunk Corporation (a subsidiary of Canadian National (CN)), and Canadian Pacific (CP).³ These four railroads carry the majority of rail freight transported within and through the state. As shown in Table 2.1, Norfolk Southern and

¹ A boarding is the act of getting on a train, and an alighting is the act of getting off at the passenger's destination.

² Rail transit also connects communities in New Jersey with Pennsylvania.

³ Federal regulation divides railroads into three categories based on annual operating revenues adjusted for inflation every year. Class I railroads are those with annual carrier operating revenues of \$346.8 million (\$250 million in 1991 dollars) or

Table 2.1
Miles of Freight Railroad Operated

Major Pennsylvania Freight Railroads	Miles Operated ^a	
	Excluding Trackage Rights ^b	Including Trackage Rights
Class I		
Norfolk Southern Corp.		2,388
CSX Transportation		1,055
Canadian Pacific Railway		452
Grand Trunk Corp. (Canadian National subsidiary)		155
Total Class I	2,552	4,050
Regional		
Buffalo & Pittsburgh		574
Wheeling & Lake Erie Railroad Co.		185
Total regional	683	759
Selected LST		
Reading Blue Mountain & Northern Railroad Co.		317
R. J. Corman Railroad/Pennsylvania Line		283
Consolidated Rail Corporation Shared Assets		245
Total LST	1,860	2,294
Total	5,095 ^c	7,103

SOURCE: Association of American Railroads, 2008.

^a Trackage rights are agreements between railroads that allow one railroad to operate trains on track owned by another, typically to access a customer or a rail yard.

^b AAR does not report track miles operated excluding trackage rights for individual railroads.

^c Amtrak also owns about 150 miles of track in Pennsylvania, some of which may be operated by freight railroads under trackage rights. AAR acknowledges this but does not include them in the figures cited in this table.

CSX owns and operates more than half of the railroad miles in the state. The Buffalo & Pittsburgh (BPRR) and the Wheeling & Lake Erie (WE) are regional railroads that own track and operate extensive but relatively low-volume railroads in Pennsylvania.⁴ In addition to these six railroads, approximately 45 short-line railroads (SLRR) are currently operating in Pennsylva-

more; Class II railroads have annual carrier operating revenues between \$27.8 million and \$346.8 million; and Class III railroads have annual carrier operating revenues below \$27.8 million (49 CFR, Part 1201).

⁴ AAR and many other organizations refer to Class II railroads as “regional railroads.” Regional railroads exclude switching and terminal railroads—railroads that move railcars around only in freight terminals and rail yards—regardless of operating revenue.

nia.⁵ Most of the SLRRs provide switching and terminal services between the Class I main lines and industrial areas and manufacturing plants. Several local railroads, such as the Nittany & Bald Eagle, the Pittsburgh & Shawmut, and the Union Railroad, provide vital line-haul railroad service to Pennsylvania communities outside of the major rail corridors. While these railroads may be critical for the economic vitality of some communities and some individual companies, they carry relatively little freight—most carry less than one MGT per year. Three of these railroads are notable for operating a more extensive railroad network in the state than the Grand Trunk Corporation (GTW): The Reading Blue Mountain & Northern (RBMN) operates 317 miles of track in central Pennsylvania around Reading and the Leigh Valley; R. J. Corman (RJCP) operates 283 miles of track between Cresson and the Norfolk Southern Buffalo Line through Clearfield; and Conrail Shared Assets (CSAO) operates 245 miles of track between Philadelphia and New Jersey (R. L. Banks & Associates and Linare Consulting, 2003). Conrail Shared Assets terminal and switching operations are used intensively by both Norfolk Southern and CSX.

According to the 2002 Commodity Flow Survey (Bureau of Transportation Statistics and U.S. Census Bureau, 2005), a total of 400 million tons worth \$428 billion of freight originated in Pennsylvania.⁶ As shown in Table 2.2, over the 10-year period ending in 2002, the total value of freight originating in Pennsylvania grew by 14 percent, while the total tonnage declined by 4 percent (Bureau of Transportation Statistics and U.S. Census Bureau, 2005;

Table 2.2
Freight Shipments Originating in Pennsylvania, by Mode

	Value (\$ millions)			Tons (thousands)		
	1993	2002	Percent Change	1993	2002	Percent Change
Total freight	372,925	426,760	14	416,916	399,764	-4
Truck	300,616	345,787	15	302,035	295,816	-2
Rail	10,662	5,285	-50	70,319	62,755	-11
Water	n/a	n/a	n/a	19,780	12,020	-39
Air	4,185	6,100	46	62	69	11
Rail and water	703	231	-67	14,072	8,326	-41
Truck and rail	493	535	8	313	254	-19
Other	56,757	69,355	22	10,648	20,778	95

SOURCES: Bureau of Transportation Statistics and U.S. Census Bureau, 2005; U.S. Department of Transportation and U.S. Census Bureau, 1997.

NOTE: Values are reported in 2008 dollars.

⁵ There are two categories of Class III railroads, or “short-line” railroads, as they are more commonly known. Local railroads are small line-haul railroads. Switching and terminal railroads are railroads that are used to transfer cars between larger rail systems or that provide services at a rail terminal.

⁶ All dollar values in this report, unless otherwise specified, have been adjusted for inflation using the consumer price index (CPI) as of June 26, 2008 (Bureau of Transportation Statistics and U.S. Census Bureau, 2005).

U.S. Department of Transportation and U.S. Census Bureau, 1997). More strikingly, the value of rail shipments declined by 50 percent over that period, while the volume declined by 11 percent. Rail activity in Pennsylvania increased from 28.9 percent of total U.S. freight ton-miles in 1997 to 29.7 percent of total U.S. ton-miles in 2002. These statistics reflect the fact that coal is the primary commodity shipped from Pennsylvania and that while the volume of coal has steadily grown, the increase in its value has not kept pace with that of other goods over this period. The 2002 Commodity Flow Survey data do not characterize intermodal (rail and truck) shipments well, and this type of freight traffic has been growing very rapidly.

Overall, the total tonnage of freight transportation in Pennsylvania appears to be decreasing, and goods shipped by rail have a lower value than that of other freight originating in the state. While rail carries just over 1 percent of the total value of goods originating in Pennsylvania, 30 percent of the total ton-miles are transported by rail. This is consistent with commodity flow statistics in many states, because rail is generally more cost-effective for long-distance hauls, and many heavy commodities can be carried economically only by railroad. The average shipment distance for all modes in the state is 446 miles; the average length of a rail shipment is 575 miles, while that of a truck shipment is 125 miles (Bureau of Transportation Statistics and U.S. Census Bureau, 2005).

By tonnage, the Port of Pittsburgh is the second largest inland port in the United States (Port of Pittsburgh Commission, n.d.). In 2006, the port handled about 42 million tons of freight, ranking it fifth in the nation for domestic trade and 18th overall (U.S. Army Corps of Engineers, 2008a). The port handles no international imports or exports but provides direct access to three inland waterways (the Allegheny, Monongahela, and Ohio rivers), and via the Ohio River, the port provides access to the U.S. inland waterway system, serving 24 states. Norfolk Southern provides access to 14 terminals, and CSX provides access to 10 terminals. The Port of Philadelphia, on the Delaware River, is a major port for foreign trade imports—24 million tons of freight in 2006 (exports totaled 315,000 tons)—making it the 20th largest port in the United States by tonnage and the fourth by value of foreign imports (U.S. Army Corps of Engineers, 2008a). The Port of Philadelphia handles large volumes of break-bulk freight, including high-value automobile and agricultural imports that require climate-controlled storage warehouses and other specialized facilities. There is also a cruise-ship terminal at the Port of Philadelphia. CSX, Norfolk Southern, and CP operate on-dock rail at the port, providing direct access to the Class I rail network. There are three other ports along the Delaware River in Pennsylvania: Marcus Hook, Penn Manor, and the Port of Chester. Ranked by tons of freight handled in 2006, Marcus Hook is the 38th largest port in the United States, Penn Manor is the 97th, and Chester is the 125th (U.S. Army Corps of Engineers, 2008a). The Port of Erie provides access to the St. Lawrence Seaway and is accessed by CSX and Norfolk Southern, but its freight volumes are very low. In 2005 and 2006, the port was ranked 143rd in the nation, handling about 1 million tons of freight (U.S. Army Corps of Engineers, 2008a).

As noted above, Pennsylvania ports do not handle a significant amount of containerized freight. A total of 150,000 foreign-loaded twenty-foot equivalent units (TEUs)—both inbound and outbound shipments—was handled in Philadelphia in 2006. The next busiest container port in Pennsylvania was Port Chester, which handled 105,000 TEUs that year (U.S. Army Corps of Engineers, 2008b). In comparison, the Port of New York and New Jersey loaded over 3 million TEUs in 2006. The other major container ports on the East Coast are New York, Norfolk, Virginia, Charleston, South Carolina, and Savannah, Georgia, which each handled approximately 1.5 million TEUs in 2006. Foreign intermodal freight entering through a Penn-

sylvania port is of far less security concern in Pennsylvania than in other states. Containerized freight and security implications are discussed further in Chapter Four.

Rail is the dominant mode of transportation for several key Pennsylvania commodities, the most important of which is coal. In 2002, 23 million ton-miles of coal were transported by rail; more than three-quarters of all coal moved in Pennsylvania was moved by rail, and coal movements accounted for 85 percent of all rail freight ton-miles. Table 2.3 shows other commodities for which rail moves 15 percent or more of all ton-miles originating in Pennsylvania; these include metal, sand, heavy equipment, and scrap material.⁷

Some rail freight is classified as hazardous materials, and railroads are widely accepted to be a relatively safe mode for transporting these materials, but, as shown in Table 2.4, only 5 percent of hazardous materials nationally are shipped by rail (National Transportation Safety Board, 2008a, p. 51). Twice as much is moved by water modes, and 10 times as much is moved by truck (Bureau of Transportation Statistics and U.S. Census Bureau, 2005). The fraction of hazardous materials moved by rail has *fallen* since 1997. Just over 4 percent of hazardous-materials tons shipped nationally start or end their journey in Pennsylvania (see Table 2.4). Unfortunately, there are no publicly available data about how many tons or ton-miles of hazardous-materials trips originating or terminating in Pennsylvania are carried by rail freight. Because several major rail corridors run through Pennsylvania, it is likely that the total amount of hazardous materials moving through the state is greater than the origin and destination figures would indicate. For example, as noted previously, AAR reports that in 2006, 209 million tons of rail freight traveled within and through Pennsylvania, of which 64 million tons originated and 68 million tons terminated in the state (Association of American Railroads, 2008).

Flammable liquids are the most common class of hazardous materials shipped; in 2002, flammable liquids accounted for more than 80 percent of the total volume (in tons) of hazardous-materials shipments in the United States.⁸ However, most of the flammable liquids travel by truck and by pipeline; railroads carry only 2 percent of these materials nationally. Table 2.4 summarizes the major classes of hazardous materials shipped in the United States and notes the percentage share that is transported by rail. Only 1.2 percent of all hazardous materials shipped are considered toxic inhalation hazard (TIH) (TIH materials can be liquids, gases, or corrosive materials). According to AAR, only 0.3 percent of all rail freight carloads carry TIH compounds, but because of the toxic nature of these chemicals, there is significant public concern regarding their release through accidents or a terrorist attack (Hamberger, 2006). There is also significant public concern about radioactive materials, which constitute 0.003 percent of all hazardous-materials tonnage; too small an amount was transported by rail in 2002 to be reported in the CFS.⁹

Using available data, we can estimate the volumes of hazardous materials transported through Pennsylvania by rail freight. The most recent data on hazardous-materials shipments

⁷ The commodity categories changed between 1992, when Standard Industrial Classification (SIC) codes were used, and 2002, when North American Industry Classification System (NAICS) codes were used. This explains why some categories do not appear in 1992. Also, only incomplete information was available for some specific commodities, indicated by NA (not available).

⁸ As with mode statistics, no state-level data are publicly available by class of hazardous material.

⁹ These statistics are cited in order to put the volumes of TIH and radioactive materials in perspective with overall rail freight movements, not to minimize or downplay the potential risk that a release poses to health and safety.

Table 2.3
Commodity Movements in Pennsylvania, 1992–2002

Commodity	1992		1997		2002	
	Ton-Miles	Percent	Ton-Miles	Percent	Ton-Miles	Percent
Coal						
Total	26,751		20,348		31,251	
Rail	17,266	65	14,042	69	23,073	74
Coal/petroleum						
Total	NA		1,888		1,120	
Rail	NA	NA	879	47	262	23
Base metal/primary metal						
Total	8,385		8,102		1,742	
Rail	2,208	26	2,029	25	1,159	67
Fabricated metal						
Total	1,702		3,365		2,369	
Rail	115	7	NA	NA	409	17
Natural sands						
Total	NA		361		276	
Rail	NA	NA	129	36	87	32
Transport. equipment						
Total	1,232		800		206	
Rail	355	29	332	42	60	29
Motorized vehicles and parts						
Total	NA		1,221		1,203	
Rail	NA	NA	215	18	NA	NA
Waste/scrap material						
Total	806		NA		NA	
Rail	140	17	NA	NA	NA	NA

SOURCE: Bureau of Transportation Statistics and U.S. Census Bureau, 2004.

Table 2.4
Hazardous-Materials Shipments in the United States and Pennsylvania in 2002

	All Modes		Railroad	
	Tons (millions)	Percent of Total	Tons (millions)	Percent Share ^a
U.S. total freight shipments	11,700		2,020	17.3
Hazardous materials freight shipments				
U.S. total	2,190	18.8	109	5.0
Total originating in Pennsylvania ^b	51	—	—	—
Total terminating in Pennsylvania ^b	52	—	—	—
Hazardous materials, by hazard class ^c				
Flammable liquids	1,790	81.6	36	2.0
Gases	213	9.7	29	13.7
Corrosive materials	91	4.1	24	26.4
TIH ^d	26	1.2	—	—
Radioactive materials	0.057	0.0026	0	0.0
All other classes ^e	98	4.5	20	20.4

SOURCE: Bureau of Transportation Statistics and U.S. Census Bureau, 2005.

^a Percent share is the share of the transportation of each commodity carried via rail.

^b The Commodity Flow Survey reports cumulative flows of commodities to and from origins and destinations, not flows through specific states or regions.

^c Hazard classes are mutually exclusive except for TIH.

^d The mode of transportation is not reported for TIH freight.

^e Other classes of hazards are explosives, flammable solids, oxidizers and organic peroxides, toxic (poison), and miscellaneous dangerous goods.

are from the 2002 Commodity Flow Survey. These data provide some insight about the volume of hazardous materials coming from and going to Pennsylvania; however, data regarding the classes of hazardous materials and the modes of transportation used are aggregated at the national level. If we assume that the characteristics of shipments of hazardous materials within and through Pennsylvania are similar to those in the rest of the country, it is possible to estimate the volumes of certain types of hazardous materials that move within and through the state on rail. As shown in Table 2.5, we estimate that approximately 11.3 million tons—240,000 railcars—of hazardous materials are transported annually by rail in Pennsylvania. We estimate that approximately 545,000 tons—12,000 to 13,000 tank cars—of this total are TIH.¹⁰

The large majority of rail freight moves through one or more of the three major rail corridors in Pennsylvania listed in Table 2.6. These rail lines cross approximately one thousand bridges and pass through dozens of tunnels. As will be discussed in detail in Chapter Four, the

¹⁰ These estimates assume that the average load of a rail car hauling hazardous materials is equal to the state average, i.e., 47 tons per railcar (AAR, 2008).

Table 2.5
Estimated Hazardous-Materials Shipments in Pennsylvania in 2006

	Tons (thousands)	Carloads ^a (thousands)
Total rail freight hauled in Pennsylvania	209,000	4,500
Hazardous materials hauled by rail in Pennsylvania, by hazard class ^b		
Flammable liquids	3,730	80
Gases	3,020	65
Corrosive materials	2,480	53
TIH	545	12
Radioactive materials ^c	0	0
All other classes ^d	2,080	44
Total hazardous-materials rail freight	11,300	240

SOURCE: Bureau of Transportation Statistics and U.S. Census Bureau, 2005, Association of American Railroads, 2008, and staff estimates.

^a Carload estimates were calculated by assuming an average load of 47 tons per carload.

^b TIH is not a mutually exclusive category of hazardous materials, so the sum of the tonnage values exceeds the total.

^c The Commodity Flow Survey did not report any radioactive commodity movements in 2002, but that does not mean that no radioactive material was transported by rail in 2002. We are, however, unable to estimate the volume, if any, of radioactive materials being transported through Pennsylvania.

number of bridges and tunnels has a direct bearing on the overall vulnerability of rail freight infrastructure in Pennsylvania. While most of the track lies in isolated regions of the state, the rail lines also pass through densely populated urban areas. Maps of the rail freight and passenger rail corridors are provided in Appendix A.

Passenger Rail Profile

Pennsylvania has an intercity passenger rail system provided by Amtrak that serves most of the state's major population centers. SEPTA operates an extensive regional passenger rail network, a heavy-rail urban-transit system, and nine light-rail lines in the greater Philadelphia region. New Jersey Transit (NJT) and the Port Authority Transit Corporation (PATCO) operate regional passenger rail service primarily in New Jersey, but they also provide service to Philadelphia. PAT operates a light-rail transit system in Pittsburgh. In addition, within Pennsylvania there are several inclined-plane railroads and other small tourist railroad operations that carry passengers; while these operations carry tens of thousands of passengers per year, we do not discuss them extensively in this report.

The southeastern corner of the state is the area of greatest concern with respect to safety and security of passenger rail. The four passenger rail systems operate within this densely

Table 2.6
Major Rail Corridors in Pennsylvania

Carrier	Length (miles)	Approximate 2003 Traffic Volume (annual MGT)	Critical Infrastructure			Nearby Urban Areas
			Number of Bridges	Number of Tunnels ^a	Other	
Keystone Corridor: Maryland state line to the Ohio state line through Pittsburgh ^b						
CSX	213	54–100	130	6	Neville Island Freight Cluster Intermodal Facility, Connellsville Amtrak station	Pittsburgh
Keystone Corridor: Philadelphia to the Ohio state line through Harrisburg and Pittsburgh						
NS	415	78–122	265	0	Conrail Double Stack Intermodal terminal (Pittsburgh), Harrisburg Lucknow Terminal, 9 Amtrak stations	North Philadelphia, Reading, Harrisburg, Pittsburgh
Amtrak ^c	104	10 ^d	~60	0	30th Street Station and 11 other Amtrak stations	West Philadelphia, Lancaster, Harrisburg
Northeast Corridor: Delaware state line to the New Jersey state line through Philadelphia						
CSX	50	24–32	~50	1	30th Street Station, Port of Philadelphia (on-dock rail), Twin Oaks Auto Terminal, Eastside Bulk Terminal	Philadelphia and Trenton, NJ
Amtrak	48	1 ^d	~70	1	30th Street Station, Harrisburg International Airport	Philadelphia and Trenton, NJ
Northeast Corridor: Maryland state line to the New Jersey state line through Harrisburg and Reading						
NS	270–320 ^e	18–78	~300	0	Conrail Double Stack Facility (Harrisburg), Beth Intermodal Transloading Terminal, Allentown/Bethlehem Piggyback Yard	Harrisburg, Reading, Allentown, Bethlehem
Lake Erie Corridor: New York state line to the Ohio state line through Erie						
CSX	44	109–113	29	0	Port of Erie, Erie International Airport	Erie
NS	44	27	35	0	Erie International Airport	Erie

^a The number of tunnels is calculated from geographic information systems (GIS) data provided by PennDOT, which appear to be incomplete.

^b The CSX main line connects to the Northeast Corridor through Maryland. In addition, several branch lines reach north from Maryland to interface with Norfolk Southern lines giving access to Harrisburg and points north.

^c Amtrak owns track only between Philadelphia and Harrisburg. Freight trains occasionally use this track, but volumes are unknown. Amtrak intercity passenger trains continue westward on Norfolk Southern railroad.

^d Traffic volumes for Amtrak are millions of passengers in fiscal year 2007.

^e There are two Norfolk Southern lines between the Maryland state line and Harrisburg: the 70-mile-long Lurgan branch and the 120-mile-long Port Road branch.

populated region and are tightly integrated with the Northeast Corridor, the busiest passenger rail corridor in the nation.

National Rail Passenger Corporation (Amtrak)

Amtrak operates 11 long-distance and intercity passenger routes on four railroad corridors serving 24 stations across Pennsylvania. Every day, approximately 120 Amtrak trains travel through Pennsylvania. In 2007, more than 5 million people got on or off an Amtrak train in Pennsylvania. Two of these Amtrak routes are particularly heavily traveled: the Acela Express[®], which connects Philadelphia to other major cities on the Eastern seaboard, and the Keystone ServiceSM, which provides service between Harrisburg and Philadelphia and to the communities between them.

Amtrak owns a significant amount of physical and operational railroad infrastructure in Pennsylvania, in contrast to much of its operations elsewhere. It owns much of the nearly 500-mile Northeast Corridor between Boston and Washington, D.C., 50 miles of which pass through Pennsylvania via Philadelphia. It also owns the 104-mile Keystone Corridor between Harrisburg and Philadelphia. Amtrak owns 30th Street Station in Philadelphia, which is also used by the SEPTA and NJT systems. In addition, Amtrak owns several maintenance facilities and operates one of its two reservation call centers in Philadelphia (Amtrak, 2008). The Northeast Corridor is the busiest Amtrak line in the nation, carrying more than 10 million passengers per year.

Of the 24 Amtrak stations in Pennsylvania, 30th Street Station in downtown Philadelphia is the busiest. In 2007, more than 3.6 million passengers boarded or alighted from an Amtrak train in that station. Table 2.7 shows the number of Amtrak passengers at each of the stations and the routes serving those stations. Amtrak operates 11 routes in Pennsylvania:

- Lake Shore Limited[®] runs between New York City and Chicago through Erie;
- Capitol LimitedSM runs between Chicago and Washington, D.C., through Pittsburgh and Connellsville;
- Keystone runs between Philadelphia and Harrisburg;
- PennsylvanianSM runs between New York City and Pittsburgh;
- Acela Express runs between Boston and Washington, D.C., through Philadelphia;
- Six other Amtrak routes stop in Philadelphia: RegionalSM, Cardinal[®], CarolinianSM, Crescent[®], Silver Service[®]/PalmettoSM, and VermonterSM.

Amtrak has implemented a number of enhancements to improve passenger security and prevent terrorism. According to information available online (Amtrak, n.d.-b), Amtrak claims to have implemented patrolling by uniformed police officers and other security teams, random baggage screening, and on-board security checks.

South Eastern Pennsylvania Transportation Authority

SEPTA is a large multimodal transit system that serves the greater Philadelphia area. The service area covers 825 square miles, potentially serving a population of more than 3 million people. It operates at least three different kinds of rail service, as shown in Table 2.8, along nearly 600 route miles. Annual rail ridership on this network exceeds 140 million trips.¹¹ SEPTA operates 52 elevated or underground heavy-rail stations, 175 commuter-rail stations, and 53 light-rail stations.

¹¹ Ridership is measured in “unlinked trips.” A single person may make several trips using transit every day, and each trip could include transfers between systems; each of these trip segments is considered one unlinked trip.

Table 2.7
Amtrak Stations in Pennsylvania

Station	Passengers (thousands)	Routes
Philadelphia 30th Street Station	3,674.3	Acela Express, Cardinal, Carolinian, Crescent, Keystone, Pennsylvanian, Regional, Silver Service/ Palmetto, and Vermonter
Harrisburg	464.9	Keystone and Pennsylvanian
Lancaster	420.5	Keystone
Pittsburgh	120.2	Capitol Limited and Pennsylvanian
Paoli	102.7	Keystone and Pennsylvanian
Elizabethtown	74.1	Keystone and Pennsylvanian
Exton	57.7	Keystone
Mount Joy	46.1	Keystone
Ardmore	40.6	Keystone
Middletown	39.3	Keystone
Downingtown	37.9	Keystone
Parkesburg	33.2	Keystone
Altoona	23.9	Pennsylvanian
Johnstown	17.4	Pennsylvanian
Lewistown	11.0	Pennsylvanian
Greensburg	10.3	Pennsylvanian
Erie	10.2	Lake Shore Limited
Coatesville	9.1	Keystone
Cornwells Heights	7.7	Keystone and Regional
Huntingdon	5.3	Pennsylvanian
Connellsville	3.9	Capitol Limited
Latrobe	3.2	Pennsylvanian
Tyrone	2.4	Pennsylvanian
North Philadelphia	0.3	Keystone and Regional

SOURCE: Amtrak, 2008.

NOTE: The number of passengers includes the total number of boardings and alightings at each station for Amtrak's 2007 fiscal year; it is a measure of how busy a station is but does not indicate the number of individual passengers using each station. Route information is current as of spring 2008 but should not be used for planning a trip on Amtrak.

Table 2.8
Annual Operating Statistics for SEPTA Rail Transit Lines

Type	Number of Lines	Annual Passenger Trips (thousands)	Vehicle Miles (thousands)	Route Miles
Heavy rail (grade separated)	2	84,600	15,600	75
Commuter rail (at grade)	13	34,200	16,000	447
Light rail	9	25,400	3,600	82

SOURCE: National Transit Database, 2007.

Port Authority Transportation Corporation

PATCO is a 14.2-mile regional rail-transit system that lies mostly within New Jersey but serves downtown Philadelphia. It has 13 stations, including four underground stations in Center City Philadelphia. Total ridership is 38,000 per day, and PATCO is an important service provider for commuters who live in New Jersey but work in Center City Philadelphia.

PATCO infrastructure passes under important landmarks and buildings in Center City. It shares one station (8th and Market) with SEPTA, connects to two other SEPTA stations via underground pedestrian walkways, and crosses the SEPTA Market-Frankford subway line. In addition, PATCO crosses the Delaware River over the Benjamin Franklin Bridge between Philadelphia and Camden. The Benjamin Franklin Bridge is critical transportation infrastructure, also carrying a major freeway (Interstate 676).

PATCO is currently investing in new security equipment “capable of detecting unauthorized intrusion or unusual activities” along its right of way and on the Benjamin Franklin Bridge (PATCO, 2008). It is also in the process of upgrading cameras in stations and at parking lots.

New Jersey Transit

NJT is an expansive system with 11 commuter rail lines and three light-rail lines. The system’s service area includes most of the state of New Jersey, with stops in New York and Pennsylvania. The only line that operates in Pennsylvania is the Atlantic City Line, which serves Philadelphia’s 30th Street Station. There are eight stations in total on this line, which terminates in Atlantic City. Annual ridership is 1.3 million, the lowest of all NJT’s lines.

At 30th Street Station, NJT passengers can transfer to Amtrak and SEPTA rail lines. The Atlantic City Line also interchanges with PATCO in New Jersey at Lindenwold Station (the terminus of PATCO). The line crosses the Delaware River on the Delair Bridge. In addition to bringing commuters from suburban New Jersey into Philadelphia, the line runs local and express service to Atlantic City.

Port Authority of Allegheny County

PAT operates the multimodal transit system in Pittsburgh. Rail operations consist of a single light-rail system called the T, which operates five routes over 25 miles. The transit authority operates 83 light-rail vehicles (LRVs) that traveled 1.5 million vehicle-miles in 2006 (National Transit Database, 2007). The average weekday ridership is 24,000 (Port Authority of Allegheny County, 2008). Along the five routes are four underground stations, 20 aboveground stations, and 49 street-level (i.e., without a raised platform) stops. There are 10 park-and-ride facilities.

According to a report by the Pittsburgh Downtown Partnership, half of all commuter trips into the central business district are made on rail.

PAT also operates two inclined railroads as tourist attractions. Both are popular and have relatively high ridership, but they travel very short distances. Pittsburgh's light rail passes under important landmarks and commercial buildings near its terminus beneath downtown's Golden Triangle. In addition, the Station Center station is adjacent to a large retail mall. The T crosses the Monongahela River over the rail-only Panhandle Bridge. PAT has begun construction on a 1.2-mile-long North Shore Connector project that will extend the light-rail system below the Allegheny River; tunneling is in progress.

Other Passenger Rail in Pennsylvania

Several tourist railroads operate in Pennsylvania, and several freight railroads provide rail excursions to supplement their operating revenue. According to the Department of Community and Economic Development (n.d.), more than 30 small tourist railroads operate in the state. There are two inclined railroads in Pittsburgh and a tourist inclined-plane railway in Johnstown.

Capital Area Transit of Harrisburg has proposed a commuter rail-transit system with two lines (Corridor One to Lancaster and Corridor Two to Lebanon) (Capital Area Transit, 2006). Preliminary engineering work on Corridor One is under way, but federal funding has not yet been authorized for either line (Latimer, 2007). The transit system would rely on the Cumberland Valley Railroad Bridge, which is currently unused, to cross the Susquehanna River.

The Economic Impact of Railroads

The Economic Impact of Railroads in Pennsylvania (Anater et al., 2005) quantifies the direct and indirect economic impact of railroad operations in the state. This study, commissioned by the Pennsylvania State Transportation Advisory Committee, determined that in 2001, more than \$18 billion worth of goods were shipped by rail in Pennsylvania, supporting approximately 52,000 jobs. In 2001, the rail industry directly and indirectly contributed \$4 billion to the Pennsylvania economy, and rail-related economic output totaled \$33 billion.¹²

It is unlikely that this economic activity would be lost entirely in the event of a terrorist attack or some other disruption to rail service, because many businesses that use rail are not "rail dependent"—meaning that they would be able to ship their goods via another mode of transportation if rail service was unavailable. They would, however, incur higher transportation costs. Rail-dependent businesses would suffer significant economic consequences if they lost for a long period their access to rail. The analytic methodology used in *The Economic Impact of Railroads in Pennsylvania* does not allow for an accurate quantification of the economic activity that is dependent on rail.¹³ It is important to note that the effects of a disruption would, however, fall disproportionately on large, heavy manufacturers, coal mines, chemical plants, and coal power generation. A successful terrorist attack on freight or passenger rail could have economic effects far exceeding the direct effects on people and infrastructure.

¹² All dollar amounts are in 2008 dollars. This is true throughout the report, unless otherwise noted.

¹³ Anater et al. (2005) did not account for inputs to production, only outputs.

Weatherford, Willis, and Ortiz (2008, pp. 39–40) note that railroad disruptions are inevitable and occur frequently. During a service disruption, rail traffic may be delayed for the duration of the disruption or rerouted with some delay. These delays impose costs on the railroads and the shippers. Often these costs are minor, as a delay may fall within the normal variability in shipment times. In other cases, e.g., trains carrying perishable or high-value goods, the cost of a delay can be much higher, especially if the disruption is severe (Martonosi, Ortiz, and Willis, 2005). In general, disruptions to the rail network are resolved within a matter of days or weeks.

The ability of railroads to reroute traffic depends on the amount of rail capacity on roughly parallel routes. The rail network in Pennsylvania contains a large number of roughly parallel routes running both east-to-west and north-to-south (see Figure A.1 in Appendix A). In the event of a significant disruption, traffic unable to flow along any of Pennsylvania's major corridors could be rerouted to other nearby routes, provided sufficient capacity exists on those routes to absorb the additional volumes. Such routes exist on track owned by Class I, regional, and short-line carriers. For example, if the CSX and Norfolk Southern lines along Lake Erie were to be destroyed by a natural or man-made disaster, the approximately 200,000 gross tons per day of eastbound rail freight could plausibly be diverted to the Keystone Corridor or other routes to the south and then to the Northeast Corridor to their original destinations. As shown in Table 2.6, these routes are already very heavily traveled, so the additional rail freight traffic could degrade the speed and reliability of service.

Alternatively, some traffic that is disrupted could be diverted to another mode—most likely truck—and in Pennsylvania, river barging is an available and practical alternative for transporting some commodities. Extensive shifting of freight from railroads to trucks increases transportation costs for shippers and will likely increase travel times for all other users of the highway transportation system.

The Legal Framework for Rail Oversight: The United States and Pennsylvania

Government legal oversight for U.S. railroads is a very complicated subject, for a number of reasons. The railroads embody a capital-intensive industry which historically evolved from a dispersed set of local monopolies. Economic regulation of the railroads goes back to the late 19th century and originally reflected concerns about both the railroads' exercise of local monopoly power and their vital importance to interstate commerce throughout the country. On a very different note, the actual infrastructure of the railroads constitutes an enormous and widely distributed physical asset, one with substantial safety and development implications for localities and states, as well as for rail operators themselves. Government oversight concerning these aspects of the railroads has been important over the past century and implicates a diverse set of statutes and administrative agencies. In 2008, legal authority to regulate the railroads is strikingly fractured, both between federal and state levels and among a multiplicity of statutes and agencies tasked with addressing different elements of railroad operations, development, infrastructure, and safety.

Legal authority over the security of railroads has grown even more complicated in the wake of the attacks of September 11, 2001. Concerns about terrorist threats and critical-infrastructure protection have resulted in the legal mandates dealing generally with the railroads being partly overshadowed by new mandates connected with homeland security.¹ The consequence is an even more complex regulatory environment, in which substantial legal ambiguity and overlapping areas of authority have yet to be fully resolved and optimized. From Pennsylvania's point of view, this uncertainty leads to a basic challenge in formulating options for new state-level rail-security policies, since the scope of the state's power to legislate in this area is not clear.

The following discussion briefly reviews existing federal and state legal mandates as they relate to oversight of the rail transportation system in Pennsylvania. It begins with a review of major federal railroad laws, after which we describe Pennsylvania's state railroad laws. We conclude with a discussion of newer mandates and regulatory authority concerning homeland security and how these fit into—and supersede—Pennsylvania's traditional oversight framework for railroads.

¹ Most notably, the Implementing Recommendations of the 911 Commission Act of 2007 (P.L. 110-53), discussed below.

Federal Railroad Laws: A Primer

Federal government regulation of the railroads, and particularly of the business activities of railroad firms, dates back at least to 1887, when the Interstate Commerce Act (24 Stat. 379) first established regulatory authority through the Interstate Commerce Commission (ICC) (Bump, 2007; CBO, 2006). Railroad operators were required to seek approval from ICC for a wide range of activities, including construction of new rail lines, corporate mergers and acquisitions, and abandonment of lines of service. ICC also had significant power to review and control changes to rail rates (Bump, 2007; CBO, 2006). These oversight powers were considerable, and they imposed corresponding burdens on the railroad industry. Over time, as less-regulated transportation modalities emerged to compete with railroads (e.g., interstate trucking), the railroads became less economically competitive. Therefore, several legislative reforms were undertaken during the 1980s and 1990s, including the Staggers Rail Act of 1980 (P.L. 96-448) and the ICC Termination Act of 1995 (P.L. 104-88), to loosen some of the federal oversight concerning the business of the railroads, particularly in regard to abandonment of rail infrastructure, regulation of rail shipping rates, and vertical and horizontal integrations (e.g., mergers).

In the wake of the ICC Termination Act, ICC was replaced by STB, which continues to operate as the primary federal regulator for the business of railroads.² Although STB's power to regulate the economic activities of railroads is considerably reduced from the days of ICC (see, e.g., FRA, n.d.), STB nevertheless retains significant power over railroad operations. Notably, STB's enabling statute grants it exclusive jurisdiction in connection with its exercise of power and remedies over many aspects of rail transportation (e.g., carriers and the establishment of rates, routes, services, and facilities).³ In some ways, this mandate has been interpreted expansively by STB, and it has sometimes been used to preempt state and local zoning and permitting requirements for some aspects of railroad operations and ancillary activities (Eldredge, 2004). Conceivably, STB preemption of local authority could be used to limit states or localities in undertaking some kinds of unilateral security measures, particularly with regard to permitting restrictions and the construction of facilities ancillary to rail infrastructure (Eldredge, 2004).

Quite apart from STB and its enabling legislation, a number of other federal statutes deal with other, specific aspects of federal law and intervention concerning railroads and their workers. These laws include the Railway Labor Act (44 Stat. 577) (RLA),⁴ the Federal Employers' Liability Act (35 Stat. 65) (FELA),⁵ the Railroad Retirement Act (50 Stat. 307),⁶ and the Railroad Unemployment Insurance Act (P.L. 75-722) (RUIA).⁷ These acts all emerged in the early

² The codified statute that empowers STB and limits its authority now appears at 49 U.S.C. 10101 et seq. (2008).

³ See 49 U.S.C. 10501(b) (2008).

⁴ The RLA is similar to the National Labor Relations Act (49 Stat. 449); it deals with collective-bargaining issues specifically in the context of railroads.

⁵ FELA is basically a federal workers' compensation statute that applies to railroad workers.

⁶ The Railroad Retirement Act shortly preceded the Social Security Act (49 Stat. 620); it provides a unique system for railroad retirement benefits outside the framework of Social Security.

⁷ The Railroad Unemployment Insurance Act provides a special framework for unemployment benefits for railroad workers.

20th century, and they all touch on the rights and benefits of rail workers. A more detailed review of these labor statutes is available elsewhere (e.g., CBO, 2006). For our purposes, it suffices to say that these laws are not concerned primarily with safety or security issues, although FELA, at least, could be peripherally relevant in compensating workers following a catastrophic rail incident.

More important, a separate body of federal legislation has been enacted to create safety standards and oversight for rail facilities and operations. One of the first of these safety laws was the Department of Transportation Act of 1966 (P.L. 89-670), which created FRA as an agency within DOT, dedicated to promulgating and enforcing rail-safety regulations.⁸ A number of subsequent legislative enactments then expanded on federal powers concerning rail safety, notably the Hazardous Materials Transportation Act of 1974 (P.L. 93-633), the Hours of Service Act (34 Stat. 1415), the Signal Inspection Act (P.L. 103-272), the Accident Reports Act (36 Stat. 350), and the Locomotive Inspection Act (P.L. 103-272).⁹ Most of the federal statutes concerning rail safety have been consolidated in Title 49 of the U.S. Code (Transportation), at Subtitle V (Rail Programs), Part A (Safety). According to FRA, regulatory authority concerning hazardous-materials transportation by rail has been delegated, at least in part, by the Secretary of DOT to FRA (see FRA, 2008). However, the federal regulations concerning rail transportation of hazardous materials are codified at 49 C.F.R. 174, and those rules appear to have been promulgated by the Pipeline and Hazardous Materials Safety Administration (PHMSA).¹⁰ Pursuant to these statutes, FRA has become the lead regulatory agency within DOT in connection with most aspects of rail safety.¹¹ In this vein, the Federal Railroad Safety Act of 1970 (P.L. 91-458) reportedly authorized FRA to work directly with the states in enforcing federal safety regulations, and related federal-state partnerships are currently administered under the auspices of FRA's State Rail Safety Participation Program.¹² Pennsylvania is one of 30 states that have entered into a partnership with FRA to enforce federal rail-safety regulations, and PPUC is the lead state agency for this purpose.¹³

On September 24, 2008, Congress passed a final version of the Rail Safety Improvement Act of 2008 (P.L. 110-432). This law amends title 49 of the U.S. Code with a number of provisions intended to improve rail safety. Additionally, the legislation incorporates the Passenger Rail Investment and Improvement Act of 2008, which reauthorizes federal support for Amtrak. The amendments in the Rail Safety Improvement Act of 2008 cover a range of topics, including changing the hours of service requirements for railroad employees and contractors, requiring the deployment of positive train control (PTC) systems along certain corridors, and mandating new owner/operator requirements in connection with safety at grade crossings,

⁸ See 49 U.S.C. 103. According to the Federal Railroad Act (1970), the agency has also been given a broader mandate within DOT, which includes the administration of rail-safety programs and support for research and development in connection with rail safety and rail policy.

⁹ The Signal Inspection Act and the Locomotive Inspection Act were recodified under the same set of laws (P.L. 103-272).

¹⁰ Federal laws concerning hazardous-materials transportation are not limited in application to the railroads; they appear at 49 USC, Subtitle III (General and Intermodal Programs), Chapter 51 (Transportation of Hazardous Materials).

¹¹ Again, the exception concerns hazardous-materials regulation, which involves intermodal transport rules and for which DOT appears to have promulgated regulations through PHMSA.

¹² See the description in FRA (2007). The core federal rail-safety regulations can be found at 49 C.F.R. 213–228.

¹³ See the discussion of federal-state partnership in FRA (2007).

among others. In general, the Rail Safety Improvement Act of 2008 appears to extend and build upon existing federal statutory authorities concerning rail safety, with affirmative mandates for DOT safety regulation in diverse areas pertaining to the operation of railroads (e.g., training, maintenance, facilities, reporting, etc.). At the same time, the Act also appears to recognize state authority in some areas pertaining to rail safety, as where it directs the Secretary of Transportation to develop and make available “to State and local governments model State legislation providing for civil or criminal penalties, or both, for violations of highway-rail grade crossing signs, signals, markings, or other warning devices (Sec. 208).” From a state-law perspective, the full ramifications of the Rail Safety Improvement Act of 2008 are unlikely become clear until the U.S. DOT promulgates new regulations based on it.

To summarize, many federal laws deal with different aspects of the railroads. Setting aside the various rail labor laws, there appear to be two main strands of relevant federal legal authority. One focuses on the business and operational side of railroads and empowers STB to regulate many of those aspects of the industry, with fairly strong preemption of competing state authority. The other focuses on the safety of railroad operations and empowers FRA with primary regulatory jurisdiction over many aspects of it, including operations, equipment, and infrastructure.

State Railroad Laws in Pennsylvania

The role of Pennsylvania state law in dealing with railroads is more limited than that of federal law. Notably, several Pennsylvania statutes are currently dedicated to promoting rail economic development within the state, including the Rail Freight Preservation and Improvement Act of 1984 (Pa. P.L. 587-119)¹⁴ (which authorizes the conduct of a state rail freight study, as well as other grant-making and regulatory activities by PennDOT to support and sustain state rail lines) and the State Railroad Infrastructure Act of 2004¹⁵ (which empowers PennDOT to form the State Railroad Infrastructure Development Bank and thereby to provide low-interest loans to rail entities in support of infrastructure development). Together, these statutes assign responsibility for some aspects of railroad development and oversight, including some regulatory authority, to PennDOT.¹⁶ Although not specifically mentioned in the statutes, the Pennsylvania Bureau of Rail Freight, Ports and Waterways is the PennDOT entity that carries out many of the department’s rail-development responsibilities and coordinates the technical-support functions of the department in assisting PPUC on railroad matters.¹⁷

For our purposes, a more important set of state laws are those that establish PPUC as an independent agency and that empower PPUC to regulate some aspects of railroad operations

¹⁴ Codified at 55 P.S. (Navigation) Ch. 17 G. (2008), “Rail Freight Preservation and Improvement Act.”

¹⁵ Codified at 73 P.S. (Trade and Commerce) Ch. 12D-2 (2008), “State Railroad Infrastructure Act.”

¹⁶ We were not able to find any evidence in an online search of the Pennsylvania Code that PennDOT has ever made use of its regulatory power concerning railroads pursuant to the Rail Freight Preservation and Improvement Act. The enabling statute for PennDOT, which appears at 71 P.S. (State Government) 511 et seq. (2008), assigns the department general responsibility for transportation planning and development but only very limited specific powers in connection with railroads.

¹⁷ See the discussion in Pennsylvania Department of Transportation (n.d.).

within the state, including rail safety.¹⁸ Several related Pennsylvania statutes have imposed specific safety mandates on rail operations in connection with grade crossings, signaling practices, and locomotive speedometers.¹⁹ Beyond those statutory requirements, PPUC has also enacted some general safety regulations that apply to the railroads.²⁰ The PPUC Rail Safety Division notes that PPUC has exclusive state jurisdiction over the construction and safety of public highway-railroad crossings.²¹ PPUC also emphasizes that, pursuant to the Federal Railroad Safety Act of 1970 (P.L. 91-458), it has entered into an agreement with FRA to enforce a long list of federal rail-safety regulations within the borders of Pennsylvania.²²

Federal Homeland Security Laws: A New Dimension in Rail Oversight

As mentioned above, the federal government passed a raft of new legislation in the wake of the September 11, 2001, attacks, designed to address threats to the U.S. homeland and to create a new set of administrative agencies and powers to carry out that mission. Whereas DOT (and its subordinate agencies) has general jurisdiction with regard to railroad operations and safety in the United States, primary responsibility for *security* matters shifted to the new DHS in 2002, as did control over TSA (formerly a DOT agency).²³ Particularly striking in this regard, the federal statute that authorizes DOT to promulgate rail-*safety* regulations now also says that DHS will consult with DOT in regard to issuing any *security* regulation or order that “affects the safety of railroad operations.”²⁴ In effect, this legal provision vests security authority primarily with DHS, while acknowledging that there is overlap between DOT’s safety functions and DHS’s security functions. Meanwhile, TSA, the lead agency within DHS for dealing with rail-security issues, has been working collaboratively with DOT in some regulatory areas, perhaps most notably in developing a list of freight-rail-security action items (TSA, n.d.).

Several of the post-9/11 statutes the federal government has enacted affect (or soon will affect) security requirements for railroad operations in the United States. The most important of these is almost certainly the Implementing Recommendations of the 911 Commission Act of 2007 (IRC Act) (P.L. 110-53), which includes extensive provisions relating to railroad security and requires DHS to (1) develop a national rail-security strategy and risk assessment; (2) compel rail carriers to undertake their own institutional risk assessments; (3) implement new programs

¹⁸ See 66 Pa. S. (Public Utilities) s. 301, 501, 1501 (2008) concerning the establishment and general regulatory powers of PPUC, and 66 Pa. S. (Public Utilities) Part I, Subpart D, Chapter 27 (Railroads) (2008) concerning specific statutory mandates on railroad safety.

¹⁹ Again, see 66 Pa. S. (Public Utilities) Part I, Subpart D, Chapter 27 (Railroads) (2008) for specific mandates on railroad safety.

²⁰ See 52 Pa. Code Chapter 33 (Railroad Transportation) (2008).

²¹ Per 66 Pa. S. (Public Utilities) s. 2702-04 (2008); see also PPUC (n.d.).

²² See the discussion in PPUC (n.d.). The federal rail-safety regulations enforced by PPUC are codified at 49 CFR 213–228.

²³ See generally the Homeland Security Act of 2002 (P.L. 107-296, §§402–403; 7 U.S.C. 202, 203).

²⁴ 49 U.S.C. 20103. Although DHS has the power to promulgate rail-security regulations, a brief review of the provisions Title 6 of the CFR (“Homeland Security”) suggests that DHS has yet to actually do so. In the wake of the August 2007 passage of the Implementing Recommendations of the 911 Commission Act (P.L. 110-53), however, it appears likely that DHS will be issuing new rail-security regulations in the not-too-distant future.

for rail-security training, rail-security exercises, and tank-car-security testing; and (4) support rail-security research and development, both directly and through grant-making activities.²⁵ The IRC Act also includes provisions requiring DHS and DOT to work together to tighten and update existing security and safety regulations connected with hazardous-materials transportation by rail.²⁶ Finally, the IRC Act includes a clarification provision regarding preemption of conflicting state laws, which basically says that federal rail-security and safety standards will establish a uniform, national legal floor, but that states may enact stricter security and safety laws under at least some limited conditions.²⁷

There does not appear to be any legal activity analogous to the new federal legislation and authority on homeland security at the state level in Pennsylvania, at least in connection with railroads. The state does maintain an Office of Homeland Security within PEMA, which coordinates critical-infrastructure-protection planning within the state and liaises between the federal DHS and various Pennsylvania state agencies. Presumably, both PennDOT and PPUC are involved in rail-security planning and assessment activities at the state level, but at present there are no unique statutory or regulatory provisions specifically regarding these agencies or their roles in railroad security.

Legal Considerations for State Oversight of Rail Safety and Security

The foregoing review of federal and state railroad laws makes several points clear. First is the long and complicated history of railroad law and regulation in the United States, particularly at the federal level. However, many aspects of federal railroad law, such as the various federal railway-labor acts, have little or no relevance to safety and security issues. Regulation of the business and operational aspects of the railroads by STB remains very important in the United States but is again somewhat peripheral to safety and security issues. The primary regulator for rail safety in the United States is FRA (under its parent, DOT), and FRA partners with many states (including Pennsylvania) on enforcement of federal rail-safety regulations.

Second, state railroad law and regulatory authority (in Pennsylvania and elsewhere) are considerably more limited. PPUC is the primary state regulator involved with railroad safety (and other aspects of rail operations) in Pennsylvania, and it has promulgated some safety regulations. Much of PPUC's railroad-safety activity, however, has derived from its partnership with FRA in enforcing federal rail-safety standards. PennDOT, through its Bureau of Rail Freight, Ports and Waterways, appears to provide technical support to PPUC in its regulatory mission. And although the state has not been entirely preempted from passing laws related to rail safety, federal mandates have probably significantly limited the scope for related state activities.

Third, post-September 11 federal legislation on homeland security has considerably complicated the legal landscape regarding railroad security and safety. Although DOT retains its traditional responsibility for rail safety, DHS has now assumed primary responsibility for rail

²⁵ Implementing Recommendations of the 911 Commission Act of 2007 (110 P.L. 53) at §§1511–1528.

²⁶ Implementing Recommendations of the 911 Commission Act of 2007 (110 P.L. 53) at §§1551–1552.

²⁷ Implementing Recommendations of the 911 Commission Act of 2007 (110 P.L. 53) at §1528. Specifically, state laws will not be preempted (1) when not in conflict with U.S. law; (2) when necessary to address an essentially local hazard; and (3) when not unreasonably burdensome to interstate commerce (110 P.L. 53). What this language actually means in practice, of course, is far from clear.

security, and the newest set of federal statutory mandates will substantially expand the role of DHS (and presumably TSA) as a primary regulator of rail security. As a practical matter, there is a lot of overlap between rail safety and security issues, which presumably means that DOT and DHS will need to coordinate closely in promulgating and implementing new rail policies. Meanwhile, in the wake of the IRC Act (and its new preemption clause), the role of the states (including Pennsylvania) as *independent lawmakers* regarding rail safety and security appears likely to be even more limited in the future.

One topic we have not dealt with in this review is the potential for civil liability among Pennsylvania rail operators, shippers, and other commercial participants in rail freight transit, in connection with accidents or terrorist incidents involving the rail system. Although this is also a legal concern that clearly touches on rail safety and security standards, it is an area mostly outside of current Pennsylvania statutory and regulatory authority. Any future catastrophic terrorist incidents involving Pennsylvania railroads would likely reveal significant ambiguity in civil-liability standards, and that ambiguity would likely be resolved, in large part, under common law.²⁸ The details of this kind of civil liability are beyond the scope of this report to address. What we can nevertheless say with some confidence is that (1) basic civil-liability standards connected with rail incidents are likely to be evaluated under state common law, and (2) rail operators potentially can be held liable by bystander victims in connection with some catastrophic rail incidents.²⁹

²⁸ We have analyzed some related civil-liability issues elsewhere, in connection with terrorist attacks targeting maritime shipping and assets. See the discussion in Greenberg et al. (2006).

²⁹ See the discussion of a high-profile toxic railcar fire and subsequent civil litigation in Louisiana, in *Adams v CSX*, 615 So. 2d 476 (1993).

Risk Factors Affecting Rail Safety and Security in Pennsylvania

This chapter provides an overview of key factors contributing to safety and security risks to railroads in Pennsylvania. Here, risk refers to the risk of injury and death of passengers, employees, and bystanders or community members due to accidents and terrorist attacks, as well as the direct and indirect economic damages that result. Detailed safety-related risk assessments that focus on particular aspects of the rail system exist in the peer-reviewed literature (e.g., Anderson and Barkan, 2004; Barkan, Dick, and Anderson, 2003; Glickman and Rosenfield, 1984). The description of risk factors in this chapter is qualitative in nature, and no attempt is made to determine the cost-effectiveness of any particular measure or to provide a detailed ranking of risk reduction as a result of specific measures.

Risk, whether due to safety issues or to terrorism, is a combination of “the existence of *threat*, the presence of *vulnerability*, and the potential for *consequences*” [emphasis in original] (Greenberg et al., 2006, p. 143). Threat refers to the conditions underlying an accident and the potential for an attack. The policies of a single state may be able to alter the conditions that could lead to accidents and may be able to deter terrorist attacks on targets within the state, but they are unlikely to have much effect on the nationwide terrorist threat. Vulnerability is a measure of susceptibility to damage or disruption in the event of an accident or attack. Consequences are the potential results, from minor to catastrophic, of an accident or attack. Many options and measures may reduce these risk factors. For example, effective track maintenance can reduce the probability, and hence the threat, of railroad accidents; proper design of stations, e.g., using hardened construction materials and providing clear means of egress, can reduce their vulnerability; and effective emergency response can reduce the consequences of hazardous-materials spills.

Our analysis parses risk factors for both safety and security and for both freight and passenger rail systems. Table 4.1 highlights the approach taken to break the analysis into specific pieces. For the analysis of safety, data on the frequency of accidents are used to characterize the threat and vulnerability of passenger rail and rail freight systems. Data reported to FRA are used to estimate direct consequences of accidents in Pennsylvania. Estimating potential indirect consequences from rail accidents is very difficult. To address security-related risk factors, we use or adapt a number of sources: The threat of attacks on the rail system is drawn from the RAND–Memorial Institute for the Prevention of Terrorism (MIPT) database of terrorist attacks, as in Wilson et al. (2007). In that study, a qualitative vulnerability assessment of passenger rail infrastructure components is made based on the accessibility of the components by a particular mode of attack. We use this assessment for passenger rail vulnerability and extend it to rail freight. Wilson et al. (2007) also apply the data from the RAND–MIPT database to assess the potential consequences of terrorist attacks on passenger rail systems. Because of the

Table 4.1
Data Sources for Analysis of Risk Factors for Rail Safety and Security

Risk Factor	Security		Safety	
	Passenger Rail	Rail Freight	Passenger Rail	Rail Freight
Threat	RAND-MIPT database of terrorist attacks as in Wilson et al. (2007)	RAND-MIPT database of terrorist attacks, adapted from Wilson et al. (2007)	Frequency of accidents from FRA and FTA data	Frequency of accidents from FRA data
Vulnerability	Proportional to accessibility of infrastructure component as in Wilson et al. (2007)	Proportional to accessibility of infrastructure component, adapted from Wilson et al. (2007)	Frequency of accidents from FRA and FTA data	Frequency of accidents from FRA data
Consequence	RAND-MIPT database of terrorist attacks, as in Wilson et al. (2007).	Extrapolated from accidents releasing hazardous materials investigated by the NTSB.	FRA and FTA data on direct damages from accidents.	FRA data on direct damages from accidents.

fundamental differences between passenger rail and rail freight, we cannot extend this analysis directly. Instead, we consider the consequences of several recent catastrophic rail freight accidents involving hazardous materials, as analyzed by the National Transportation Safety Board (NTSB). These are used to determine order-of-magnitude estimates of potential consequences resulting from a purposeful attack on rail freight. The remainder of this chapter is organized along the three components of risk, as shown in Table 4.1. The results derived here inform the discussion in Chapters Five and Six, in which state-level actions to improve safety and security are identified and recommendations are made for possible state-level action.

Threats to Rail Systems

The Terrorist Threat to Passenger Rail and Rail Freight

Wilson et al. (2007) use the RAND-MIPT database of terrorist incidents to determine the prevalence of types of attacks (e.g., bombings and attacks with small-arms fire) on passengers and components of railroad infrastructure (e.g., trains, stations, bridges). This database catalogs terrorist attacks worldwide, including events dating back to the 1920s. The incidents include attacks on both rail freight and passenger rail systems. Tables 4.2 and 4.3, from Wilson et al. (2007), describe the tactics used by terrorists to attack rail systems and the types of weapons employed in such attacks. While the majority of terrorist attacks on rail systems in the RAND-MIPT database are against passenger rail systems, a small subset are against rail freight.¹ We regard the threat assessment presented in Wilson et al. (2007) to be valid for both rail freight and passenger rail systems.

The majority of terrorist incidents on rail systems are bombings with conventional bombs, but other tactics have also been successfully employed. On March 20, 1995, the Aum Shin-rikyo cult attacked the Tokyo subway by releasing sarin, a nerve gas, killing 12 and injuring

¹ Wilson et al. (2007) noted that of all attacks on rail, 55 percent were on passenger rail, 10 percent were on freight, and the remaining 35 percent were undetermined (p. 7, footnote 2). They included all the rail attacks in their analysis.

Table 4.2
Terrorist Tactics in Rail Incidents Since the 1920s, Worldwide

Tactic	Number	Percent
Bombing	708	80
Armed attack	55	6
Sabotage	49	6
Arson	29	3
Unconventional attack	24	3
Unknown	9	1
Logistics activity (nonattack)	5	1
Kidnapping	3	0
Barricade or hostage	2	0
Hijacking	2	0
Total	886	100

SOURCE: Wilson et al., 2007, p. 9.

NOTE: Sabotage is willful damaging of railroad infrastructure, such as removing tie bars to create a track hazard. Logistics activity consists of incidents in which terrorists used or targeted a train, but an attack did not occur.

Table 4.3
Weapons Used in Attacks on Rail Systems

Weapon	Number	Percent
Explosives	643	77
Fire or firebomb	39	5
Firearms	51	6
Chemical agent	17	2
Radiological agent	3	0
Threat	65	8
Unknown	18	2
None	1	0
Total	837	100

SOURCE: Wilson et al., 2007, p. 10.

NOTE: There are 49 fewer total incidents here than in Table 4.2, because sabotage incidents (shown in Table 4.2) do not involve a weapon and are therefore not included here.

thousands (Jenkins and Gersten, 2001). On October 9, 1995, the Amtrak Sunset Limited was purposely derailed on a trestle, instigating a derailment that killed at least one person and injured 65 others, 20 of them critically (Graebner, 1997). These incidents—one against a heavily used urban transit system and the other in a remote area—illustrate the range of threats

and situations that must be considered in efforts to improve rail safety and security in Pennsylvania, a large state that has both densely populated urban areas and sparsely populated and remote rural areas.

Intermodal container shipments are also an area of security concern for Pennsylvania, but not an area in which rail-specific security measures are likely to be effective. To date, security in containerized freight has been of concern primarily in the maritime domain at the national level. It is addressed in detail in a number of pieces of federal legislation, most recently the SAFE Port Act of 2006 (P.L. 109-347). The only rail-specific provision in the SAFE Port Act establishes a center for testing radiation-screening equipment for on-dock rail. The center is to be established at a public facility where the majority of laden-container movements are directly to on-dock rail. Norfolk Southern, CSX, and Canadian Pacific (through Grand Trunk) have on-dock rail access at Philadelphia. Philadelphia, however, is not a major container port and would not be a likely candidate for such a test center. Any additional legal requirements would need to be federally mandated.

All of the containers that enter the United States are subject to a risk analysis based on factors such as the status of the shipper and the manifest and, when indicated, are subject to nonintrusive and possibly hand inspection (Willis and Ortiz, 2004). Therefore, any container of foreign origin traveling through Pennsylvania, whether by rail, truck, or inland waterway, has been cleared by U.S. Customs and Border Protection, though some risk always remains.

As discussed in Chapter Two, there are several intermodal rail-truck facilities in Pennsylvania which facilitate the transshipment of goods from truck to rail freight and vice versa; additional organized inspection of containers could take place at these facilities. However, the facilities transship only a fraction of the containerized freight that travels through Pennsylvania, providing little additional opportunity for reducing risk. For example, the Rutherford Intermodal Terminal outside of Harrisburg is capable of transshipping 250,000 containers per year, or approximately 700 containers per day, and is part of Norfolk Southern's network that moves containers from the port of Norfolk to the Midwest. In the event of an emergency requiring the isolation of a container for further inspection, it would be possible to isolate a truck or divert a train to a siding, provided the container can be located.

Rail Accidents in Pennsylvania, 1998–2007

Both FRA and FTA require rail operators to submit reports of rail incidents. This provides a body of evidence to draw on to assess the threat to safety.² FRA receives, compiles, and analyzes incident data from the Class I freight carriers, commuter railroads, and Amtrak (Federal Railroad Administration, Office of Safety Analysis, 2008). The reported incidents are those that meet a minimum level of injury or physical damage. They are compiled and analyzed to develop and assess compliance and the success of rail-safety laws, programs, and initiatives.

FRA classifies railroad incidents into several categories, as shown in Table 4.4. Table 4.5 summarizes data collected by FRA on the types of incidents experienced on freight and passenger rail systems in Pennsylvania (Amtrak and commuter rail) from 1998 through 2007. The majority of accidents and incidents are classified as “other,” with the rest classified as train

² FTA incident data for Pennsylvania rail carriers were provided to RAND by FTA. In risk analysis, the product of threat and vulnerability is commonly referred to as the likelihood of an event. An accident rate as derived here for Pennsylvania inherently takes into account both of these factors. For this reason, we do not consider safety concerns in the following subsection on rail-systems vulnerability.

Table 4.4
FRA Accident/Incident Reporting Requirements

Type of Accident/Incident	Definition	Reporting Requirements
Train accident	Collision, derailment, fire, etc., involving on-track equipment.	Threshold damage value of \$8,500 (in 2008) or hazardous materials are involved.
Train incident	Event involving on-track equipment that results in a reportable casualty.	No monetary threshold level.
Non-train incident	Event not involving on-track equipment that results in a reportable casualty.	No monetary threshold level.
Highway-rail grade-crossing accident/incident	Impact between on-track rail equipment and a highway user (any mode of surface transportation) at a designated crossing site.	
Other accidents/incidents	Includes obstruction accidents, explosions, fires, other impacts, and "other."	Results in death, injury, or occupational illness.

SOURCE: Federal Railroad Administration, Office of Safety Analysis, 2008.

Table 4.5
Rail Accidents and Incidents in Pennsylvania, 1998–2007

Type of Accident/Incident	Freight Railroads		Amtrak, SEPTA, and NJT	
	Number	Percent	Number	Percent
Train accidents/incidents	870	26	217	5
Highway-rail grade crossing accidents/incidents	685	21	33	1
Other accidents/incidents	1,759	53	3,904	94

SOURCE: FRA accident/incident data from Federal Railroad Administration, Office of Safety Analysis, 2008.

NOTE: Train accidents must meet a threshold value of damages to be reported. SEPTA incidents are for heavy rail only.

accidents or highway-rail grade-crossing accidents/incidents, for both rail freight and passenger rail.³

The principal area of concern with respect to safety and security in rail freight is the shipment of hazardous materials, which is governed by DOT's PHMSA. All accidents involving hazardous materials are reported to the National Response Center regardless of the amount of damages (which are also tabulated differently from those reported by FRA). Because of the different reporting requirements of FRA and PHMSA, the numbers of reported incidents involving hazardous materials differ. For example, in 2007 in Pennsylvania, one train accident in which two railcars released hazardous materials was reported by FRA (U.S. Department of Transportation, 2008), but 36 hazardous-materials incidents involving rail were reported by

³ Highway-rail grade-crossing accidents that result in a fatality are also reported to the National Response Center. An investigation by *The New York Times* revealed discrepancies among FRA accident records and National Response Center accident records, indicating that many accidents are not promptly reported (Bogdanich, 2004).

PHMSA (Federal Railroad Administration, Office of Safety Analysis, 2008). Table 4.6 lists train accidents involving hazardous materials, as reported by FRA, from 1998 through 2007.

For passenger rail, FTA also classifies incidents into the general categories of collision, derailment, evacuation, fire, not otherwise classified, security, and suicide. Security incidents reported to FTA are largely fare-jumping and other crimes. To date, no rail-security incidents in the United States have been related to terrorism. Those incidents “not otherwise classified” are typically slips and falls within the transit system that result in minor injuries.⁴ Table 4.7 presents data collected by FTA on rail incidents in Pennsylvania that occurred on SEPTA, PATCO, and PAT rail lines. Incidents occurring on NJT are excluded from the data because FTA does not report incidents by location, and most of the accidents on NJT occur in New Jersey.

Table 4.6
Train Accidents Involving Hazardous Materials in Pennsylvania,
1998–2007, as Reported by FRA

Type of Accident	Number
Hazardous-materials releases	13
Hazardous-materials releases per train accident	0.015
Cars carrying hazardous materials in accidents/incidents	1,363
Cars carrying hazardous materials damaged/derailed	261
Cars releasing hazardous materials	38

SOURCE: FRA accident/incident data from Federal Railroad Administration, Office of Safety Analysis, 2008.

NOTE: Train accidents must meet a threshold value of damages to be reported.

Table 4.7
Average Annual Passenger Rail Incidents in Pennsylvania,
2002–2007, as Reported by FTA

Type of Incident	Average Incidents per Year
Collision	319
Derailment	7
Evacuation	11
Fire	14
Not otherwise classified	724
Security	800
Suicide	3

SOURCE: FTA, data provided to RAND.

NOTE: Excludes incidents that occurred on NJT.

⁴ Timothy Braxton, “Explanation of FTA Safety and Security Data for New Jersey and Pennsylvania,” sent to Liisa Ecola, February 8, 2008.

Vulnerability of Rail Systems in Pennsylvania to Terrorist Attacks

The existence of a terrorist threat to rail or a pattern of safety incidents becomes of concern when the threat or accident exploits a vulnerability of rail equipment and infrastructure, employees, passengers, or bystanders. Vulnerabilities of rail systems to a specific attack are indications of the practicality of such an attack, assuming standard security measures are in place (Wilson et al., 2007).⁵ The concept of vulnerability can be applied to specific pieces of infrastructure, such as 30th Street Station in Philadelphia, or combinations of infrastructure, such as the Norfolk Southern corridor connecting Pittsburgh and Harrisburg. The combination of threat and vulnerability is sometimes referred to as the likelihood of an attack (Greenberg et al., 2006).

Wilson et al. (2007) performed an analysis of a “notional” urban passenger rail system that includes underground, grade, and elevated infrastructure. They developed a matrix of vulnerabilities of infrastructure components to specific attack modes (Wilson et al., 2007, Figure A.2). Their approach was to assess the “practicality of a given attack mode” for each infrastructure component. For example, a truck-sized bomb would be difficult to transport to an underground station, so underground infrastructure would have relatively lower vulnerability to this mode of attack than would an aboveground station with roadside access. Wilson et al. (2007) concluded that stations and pathways are more vulnerable than other infrastructure components and that aboveground and elevated infrastructure is generally more vulnerable than underground infrastructure. Certain terrorist tactics, such as the use of unconventional weapons, armed attacks, and the use of small bombs carried by persons, are well suited to in-train attacks. System operation and power infrastructure was judged to be highly vulnerable to many attack modes, because it is generally accessible, although it may be in a different location from the principal components of a passenger rail system.

The vulnerability of components of rail freight infrastructure can be assessed by taking a point of view similar to that of Wilson et al. (2007). Table 4.8 lists the components of passenger rail infrastructure considered in Wilson et al. (2007) and the analogous components of rail freight infrastructure. Though there are significant differences in the structure and operation of these systems when considered on a component-by-component basis, this approach may yield insights into key vulnerabilities. However, several components of passenger rail systems do not have analogous components in the rail freight system—for example, there are no public stations or access pathways for rail freight.

Taking an approach similar to that of Wilson et al. (2007), we consider the practicality of using specific attack modes on the rail freight infrastructure components listed in Table 4.8. In contrast to urban passenger rail systems, rail freight systems consist predominantly of ground-level infrastructure, much of it on partially controlled right of way. The partially controlled right of way provides frequent vehicle and pedestrian access points, making attacks quite practical, with the tracks having greater vulnerability to large bombs and incendiaries than if they were secured along their length. Vehicle access to bridge and tunnel infrastructure is limited in most cases, but bridges and tunnels are easily accessed by persons, making them relatively more vulnerable to small bombs and incendiaries; moreover, much of this infrastructure is remote and therefore difficult to secure and guard. We did not investigate the security of yard

⁵ The standard security measures assumed by Wilson et al. (2007) are perimeter surveillance systems; rail-station surveillance systems; uniformed patrols; rapid-deployment forces; and an automated vehicle-locator system to detect out-of-the-ordinary delays in trains that might indicate that an attack has occurred.

Table 4.8
Passenger Rail Infrastructure Components and Analogous Rail Freight Infrastructure Components

Passenger Rail Infrastructure Component or Attack Scenario	Analogous Rail Freight Infrastructure Component or Attack Scenario	Assessment of Vulnerability
Weapon placed inside train car	Weapon placed on dwelling locomotive or car	Vulnerability to rail freight is lower because of limited public access to yards.
Underground station	None	—
Underground access	None	—
Underground infrastructure	Tunnels	Underground components of rail freight systems are typically not as extensive as those of urban passenger rail systems and may be more easily accessed.
External underground attack on train	None	—
Ground-level station	None	—
Ground-level track and infrastructure	Yard and loading infrastructure	—
	Track, partially controlled right of way	Physically separated from other traffic but with frequent highway-rail grade crossings permitting access.
	Track, fully controlled right of way ^a	Physically separated without grade crossings or legal means of access; may include widely separated grade crossings.
External ground-level attack on train	External attack on dwelling locomotive or car	—
	External attack on moving locomotive or car	Assumed to have a lower vulnerability than a dwelling train for certain attack modes.
Elevated track and infrastructure	Bridges	—
Elevated station	None	—
System operation and power infrastructure	System operation and control infrastructure	Refers to dispatch and system operations; vulnerability is lower than that for passenger rail systems because freight tracks are typically unpowered, and control centers may be remotely located and redundant.

^a Formal designations of rights of way for urban transit systems appear in Vuchic (2007, p. 47). Here we extend Vuchic's definitions slightly to accommodate both urban and rural rail systems.

and loading infrastructure. In general, yards are fenced and may be further secured by controlled access points for people and vehicles and remote video surveillance; security forces may also be employed. For this reason, we conclude that the practicality of carrying out an attack on yard and loading infrastructure is similar to that of ground-level track on infrastructure for passenger rail systems, to which unlimited public access is not generally available.

Attacks on freight trains would also be quite practical.⁶ Standoff attacks could be carried out at points throughout the system. A weapon could be placed on a locomotive or rail car whenever it is at rest (or “dwelling”). Cars and locomotives are stopped for long periods of time only at rail yards, although they often come to rest for shorter periods at signals and on sidings. There is vulnerability whenever they are accessible. The vulnerability of unsecured dwelling trains has been identified by PHMSA, FRA, and TSA and is an explicit part of the security actions being taken at the federal level (Gorton, 2008; Pipeline and Hazardous Materials Safety Administration and Federal Railroad Administration, 2008). Unlike passenger rail information, rail freight operational schedules and procedures are not readily available, making the targeting of specific shipments relatively more difficult.

These observations may be applied to assess qualitatively the vulnerability of rail in Pennsylvania. The preponderance of the passenger rail system consists of ground-level stations and track. Much of the Amtrak system shares railroad tracks with rail freight, and most stations serve very few people. The notable exceptions are 30th Street Station in Philadelphia, the Amtrak station in Harrisburg, and the Amtrak station in Lancaster. The concentrations of people at other Amtrak stations would seem to be too low to attract an attack. SEPTA, PATCO, and Pittsburgh light rail have sections of track underground, with underground stations that serve many passengers; an attack on any of these infrastructures could result in many casualties and severe disruption to those transit systems.

Rail freight infrastructure in Pennsylvania is extensive, and public access is not generally controlled. In some urban and suburban areas, rail freight travels along private rights of way, which limits access and vulnerability. Rail freight yard and loading infrastructure is not publicly accessible in the same way that passenger stations are.

Consequences

The consequences of rail safety and security incidents may be classified as direct or indirect. Direct consequences are fatalities, injuries, and damage to facilities and rail infrastructure. Indirect consequences result from the disruption of passengers or freight flows by the incident and the response to it.

Direct Consequences of Passenger Rail and Rail Freight Accidents in Pennsylvania

Tables 4.9 and 4.10 present the human and economic consequences of rail accidents and incidents in Pennsylvania over the 10-year period ending in December 2007. The tables contain national rate data for comparison purposes.⁷

Summary statistics of accidents and incidents provide some insight into the actual consequences of rail accidents.⁸ Over the past decade, Pennsylvania experienced approximately

⁶ We do not consider cases in which an attack uses the rail system as a conveyance—for example, terrorist contamination of a shipment of food being transported via rail.

⁷ We have not attempted to account for factors that may explain the difference between U.S. and Pennsylvania accident rates.

⁸ The summary statistics should not be used for predictive purposes. A number of other factors regarding railroad accidents are omitted from this analysis, including, but not limited to, the class of track, the hours of service of the crew, and the maintenance conditions of the track or grade crossing.

Table 4.9
Deaths and Injuries from Rail Accidents and Incidents in Pennsylvania, 1998–2007

Type of Accident/Incident	Freight Railroads ^a				AMTRAK, SEPTA, NJT			
	Deaths	Injuries	PA Rate ^b	U.S. Rate ^c	Deaths	Injuries	PA Rate ^b	U.S. Rate ^c
Train accidents	0	19	0.022	0.11	1	79	0.37	0.81
Highway-rail grade-crossing accidents/incidents	39	147	0.27	0.45	6	25	0.94	0.87
Other accidents/incidents	115	1,690	1.03	1.03	80	3,996	1.04	1.02
Employee on duty ^d	3	1,481	148		2	2,469	247	
Trespasser ^e	108	120	23		70	42	11	
Annual average	27	346			16	661		

SOURCE: Federal Railroad Administration, Office of Safety Analysis, 2008.

NOTES: For reporting to be required, damages in train accidents must meet a threshold value (\$8,500 in 2008) or the accident must involve a non-employee injury requiring medical attention beyond first aid, an injury to an employee that results in lost work time, or restrictions on duties.

^a Freight railroads including switching railroads.

^b The rate in Pennsylvania is deaths or injuries per event for accidents/incidents and per year for employees on duty and trespassers.

^c The U.S. rate is national average per event.

^d Employee on-duty injuries include reported illnesses.

^e Trespasser does not include highway-rail accidents and incidents.

Table 4.10
Direct Economic Damages of Train Accidents and Incidents in Pennsylvania, 1998–2007

Economic Damage	Freight Railroads ^a			Amtrak, SEPTA, NJT		
	Number	Percent	U.S. Percent	Number	Percent	U.S. Percent
Less than \$100,000	754	87	82	206	95	91
\$100,001–\$500,000	90	10	13	9	4	7
\$500,001–\$1,000,000	19	2	3	0	0	1
More than \$1,000,000	7	1	2	2	1	1

SOURCE: Federal Railroad Administration, Office of Safety Analysis, 2008.

^a Freight railroads include switching railroads. Damages are to rail equipment and track, including labor but excluding clearance of wrecks. Reportable damages in train accidents must meet an inflation-adjusted threshold value, which in 2008 is \$8,500.

330 reportable rail freight accidents and incidents annually, or slightly less than one per day (see Table 4.5). The majority of these accidents and incidents are categorized as “other,” and slightly more than one death or injury occurred per incident. The casualty rate for highway-rail-grade-crossing accidents is 0.27 per event. Between 1998 and 2007, no deaths and 19 injuries were reported to have resulted from train accidents in Pennsylvania. The casualty rate was 0.022 per event, which is approximately one-fifth the national average rate.

Casualty rates for passenger rail are higher, due in part to the fact that passengers, in addition to employees, are typically at direct risk. Over the 10 years ending in December 2007, there were approximately 4,200 FRA-reported accidents and incidents in passenger rail in Pennsylvania, or approximately 11 incidents every 10 days. Train accidents resulted in 80 casualties, and highway-rail-crossing accidents resulted in 31. The majority of injuries, however, were due to accidents in the “other” category.

Table 4.10 presents distributions of direct damages to equipment and infrastructure incurred as a result of train accidents and incidents. The majority of train accidents and incidents (87 percent of freight and 95 percent of passenger) incur less than \$100,000 each in damages. The majority of the remainder (10 percent for freight and 4 percent for passenger) incur damages of between \$100,000 and \$500,000. Very few rail accidents in Pennsylvania have resulted in significant economic consequences. Between 1998 and 2007, seven rail freight accidents incurred damages greater than \$1 million. Only two passenger rail accidents resulted in direct damages greater than \$1 million.

Potential Direct Consequences of Terrorist Attacks on Passenger Rail and Rail Freight

Direct consequences of terrorist attacks against rail systems and accidents have been limited. Wilson et al. (2007) calculated an average of four fatalities and 13 injuries per successful terrorist attack on passenger rail systems.⁹ Of course, the tactic employed by the terrorists has a significant effect on the number of people killed and injured in an attack, and average values do not take into account worst-case scenarios. The median casualties of attacks resulting in at least one casualty are one fatality and 10 injuries; if all attacks are included in the calculation, the median value is zero casualties (Wilson et al., 2007). The most common tactic employed against rail systems by terrorist groups is the use of small bombs, which when detonated at the appropriate time and place can cause significant casualties. The March 2004 attacks on the Madrid regional rail system comprised 10 coordinated successful bombings and resulted in 191 deaths and more than 1,800 injuries; the July 2005 bombings on the Tube in London comprised three suicide bombings, in which 39 people were killed and more than 660 were injured (Wilson et al., 2007).

The majority of terrorist attacks on rail have been against passenger rail systems, so it is not possible to make an empirical estimate of the direct consequences from an attack on rail freight. However, it is possible to infer a range of potential consequences by considering past accidents and incidents involving rail freight (see Tables 4.9 and 4.10). As discussed above, accidents and incidents do not, on average, result in significant casualties or damages. However, damages resulting from accidents may not necessarily indicate the potential human and economic consequences of a successful attack on the rail freight system. Several examples of recent accidents help to illustrate these potential consequences:

- On October 20, 2006, a Norfolk Southern unit train transporting 83 tank cars filled with denatured fuel ethanol derailed while crossing the Beaver River in New Brighton, Pennsylvania. Approximately 20 of the tank cars ruptured, releasing ethanol that caught fire and burned for two days. Several blocks surrounding the accident were evacuated. There were no fatalities or injuries. The cause of the accident was a track defect. NTSB

⁹ Multiple simultaneous bombings were each counted as a single attack. The March 1995 sarin gas attacks on the Tokyo subway, which killed 11 and injured more than 5,000 (Jenkins and Gersten, 2001), are excluded from this calculation.

determined that the defect should have been detected during routine rail inspections but that Norfolk Southern's procedures allowed for anomalies during testing (National Transportation Safety Board, 2008c). NTSB has not released a complete report of the accident, which would include an estimation of damages.

- On January 6, 2005, a Norfolk Southern train was traveling through Graniteville, South Carolina, when it encountered an improperly aligned switch and was diverted from the main line to an industrial track, where it struck a parked train. The locomotive and 16 of the 42 freight cars derailed. Three freight cars contained chlorine; one of them was breached, releasing chlorine gas. The train engineer and eight other people died as a result of the gas release, and more than 500 people were documented as injured. More than 5,000 people were evacuated. Damages resulting from the accident totaled more than \$7.8 million. The cause of the accident was human error—the switch was improperly aligned (National Transportation Safety Board, 2005).
- On January 18, 2002, 31 of 112 cars of a Canadian Pacific Railway train derailed near Minot, North Dakota. Five of the derailed cars contained anhydrous ammonia. These cars were breached, releasing their contents as a vapor cloud. The incident resulted in one death, 11 serious injuries, and more than 300 other injuries. Among the injured were two crew members. Direct damages amounted to more than \$3.0 million, but environmental remediation costs were reported to exceed \$10 million. Track defects were determined to be the primary cause of the accident (National Transportation Safety Board, 2004).

To generalize using the above severe accidents as a guide, direct human consequences from a successful terrorist attack on the rail freight system could be tens of deaths, hundreds of injuries, and tens of thousands of persons evacuated. Direct economic consequences could be in the tens of millions of dollars.¹⁰

We can draw several conclusions from this high-level look at rail accidents and incidents in Pennsylvania. First, a significant number of rail accidents and incidents occur, about one per day for both freight and passenger rail. Second, the majority of these incidents do not cause injury or significant damages. Third, using prior experience to estimate the consequences of accidents and terrorist attacks may result in understating the potential for damages.

Indirect Consequences of Safety and Security Incidents in Pennsylvania

None of the available data sources assess the indirect economic consequences of prior rail accidents. Indirect consequences are those that result from the disruption in service that accompanies a rail accident or attack. Given that so many accidents and incidents have occurred without significant economic harm, we conclude that both freight and passenger carriers have developed methods to adjust operations to accommodate minor accidents and incidents, limiting the magnitude of indirect economic consequences as well. Experience in accommodating regular accidents and incidents and disasters has shown that indirect consequences of either accidents and incidents or terrorist attacks are not catastrophic. Derailments and collisions are common occurrences that are part of day-to-day operations of railroads. Occasionally, such as in the New Brighton, Pennsylvania, derailment, the accident causes significant damage to a bridge or other piece of infrastructure, but railroads are used to accommodating these acci-

¹⁰ A more accurate estimate would quantitatively take into account a number of factors, including, but not limited to, the population density in the area, the atmospheric conditions, the time of day, and the quality of the emergency response.

dents without significant losses. An example of a catastrophic incident that was accommodated quickly is the damage to the CSX Gulf Coast Line, which was heavily damaged during Hurricane Katrina in August 2005. The storm surge destroyed a two-mile-long bridge across St. Louis Bay, along with significant additional rail and transportation infrastructure within the region. Most services were reconstituted within weeks; the bridge repair was completed in five months (CSX Transportation, 2006b).

Key Causes and Factors Influencing Vulnerability and Consequences

The frequencies of the types and principal causes of train accidents and incidents in Pennsylvania for freight and passenger rail are shown in Table 4.11. For rail freight, the dominant type of accident is a derailment, and the dominant cause is a track defect. For passenger rail, the dominant type of accident is “other,” and the dominant cause is “miscellaneous,” yielding little insight into the key factors involved. Human errors are cited as the primary cause in 34 percent of rail freight accidents and 19 percent of passenger rail accidents.

The large-scale damages that could result from a spill of hazardous materials have been widely acknowledged, and the causes have been the subject of significant study. Most prior analyses have focused on derailments, since in general, derailments at high speed have the greatest potential consequences. Collisions generally occur at lower speeds and in yards (Anderson and Barkan, 2004), resulting in few releases of hazardous materials. In general, previous studies have validated the usefulness of emergency response and have linked damages to particular track and equipment failures.

Glickman and Rosenfield (1984) studied risks arising from the release of hazardous materials from rail tank cars during derailments. They analyzed accident data from 1975 to 1978, a period when railroads were in financial difficulty and railroad maintenance was frequently deferred;

Table 4.11
Types of Train Accidents and Incidents in Pennsylvania and Major Causes, 1998–2007

Type of Accident/Incident	Freight Railroads ^a			AMTRAK, SEPTA, NJT		
	Number	Percent	U.S. Percent	Number	Percent	U.S. Percent
Collision	57	7	7	25	12	6
Derailment	691	79	74	64	29	35
Other	122	14	18	128	59	59
Principal cause						
Human error	292	34	39	42	19	27
Track	353	41	35	52	24	31
Motive power/equipment	93	11	12	50	23	23
Signal	23	3	2	15	7	1
Miscellaneous	109	13	13	58	27	18

SOURCE: Federal Railroad Administration, Office of Safety Analysis, 2008.

^a Freight railroads include switching railroads.

derailments were more frequent then than they are today (Weatherford, Willis, and Ortiz, 2008, p. 25). The key findings in the study stem from the sensitivity analysis that was performed to test the robustness of the results. Certain obvious conjectures hold: Whenever the railroad traffic or population in the vicinity of railroad lines increases, the risk increases proportionately.

But appropriate emergency response can significantly limit the scale of consequences resulting from incidents.

Anderson and Barkan (2004) analyzed FRA accident data for 1992 through 2001, along with data on track class,¹¹ to determine accident rates for Class I and non-Class I freight trains. The maximum permissible speed on a given section of track is a function of the track's class, with higher speeds permissible on higher classes of track. Track class is an indirect indicator of the level of maintenance and should be an indicator of the rate of derailment.¹² Overall, rail accident rates (defined as the number of accidents per million train-miles) increased from 1997 to 2001, largely due to the increase in accidents in yards. However, with few exceptions, trains travel more slowly in yards than on main-line track, so with respect to the potential release of hazardous materials, the increase in yard accidents is not a major concern.

Over the study period, derailments were the primary cause of hazardous-materials releases. For Class I and non-Class I railroads, derailments accounted for 346 of 377 cars releasing hazardous materials, or 92 percent. The rate for cars traveling on higher-class track is not substantially higher than that for cars traveling on lower-class track. The rates of release for non-Class I and Class I railroads are similar, but the main-line derailment rate for non-Class I freight trains is significantly higher than that for Class I freight trains. Anderson and Barkan (2004) hypothesize that the difference in derailment rate can be attributed to the lower classes of track on which these railroads typically operate. This is an important observation to consider for Pennsylvania, because non-Class I railroads operate a significant fraction of track-miles.

In another analysis, Barkan, Dick, and Anderson (2003) applied several statistical techniques to determine factors related to hazardous-materials risk, including the speed at which the train is traveling when derailment occurs, the length of the train, the number of cars derailed, and the financial extent of damages. The authors found positive correlations between speed, the number of cars derailed, and the proportion of hazardous-materials cars that released their contents.

Additional analyses were performed using the FRA accident causes: track, equipment, human errors, signal, and miscellaneous.¹³ Broken rails or welds are among the highest-frequency causes of accidents, but high-speed accidents are significantly more severe. Bearing failure causes many high-speed accidents, since bearing loads are heavier at higher speeds, but does not often result in severe accidents. The authors conclude that track defects tend to cause the most-severe accidents, including those releasing hazardous materials.

¹¹ Nine classes of track are designated by FRA. Class 9 is the highest quality, with allowable passenger train speeds up to 200 mph. Freight-train speeds are designated only up to Class 5, on which they are allowed to travel up to 80 mph. Track classes are designated with Arabic numbers, while railroad carrier classes are designated with Roman numerals (Class I, II, and III).

¹² The authors note several caveats. First, track class was never intended to be used as an indicator of maintenance level. Second, trains do not often operate at slower speeds than permitted (as discussed in Chapter Five).

¹³ Highway-rail-grade-crossing accidents were not included in the analysis.

Review of Recent Activity to Improve Rail Safety and Security

This chapter describes major federal and state initiatives to improve rail safety and security. While it provides examples of best practices that may be considered models as Pennsylvania considers possible actions, it is not intended to be comprehensive. As discussed in Chapter Three, the authority for regulating rail safety and security resides largely with the federal government. Here, we discuss how several states have been able to implement programs to improve rail safety and security within that structure. Examples include recent actions by California and New Jersey to improve rail safety and security for rail freight. In California, CPUC—the FRA partner in implementing safety regulations—is the state body taking the lead. In New Jersey, the state OHS is working with the rail carriers and DHS to improve security of rail systems. This chapter also discusses Pennsylvania’s current situation with regard to rail-safety inspections and railroad-safety training for local communities.

Major Federal Initiatives

Programs Addressing TIH Risk

At the federal level, DOT and DHS have been collaborating on initiatives to improve security in rail transportation of TIH materials. The first major initiative, known as the Toxic by Inhalation Hazard Risk Reduction Program, assumes that risk in the transportation of TIH materials is directly proportional to the dwell time and volume of those materials being transported through high-threat urban areas.¹ The program seeks to reduce risk through four specific actions:

- “The establishment of secure storage areas for railcars carrying Toxic Inhalation Hazard (TIH) materials;
- The expedited movement of trains transporting railcars carrying TIH materials;
- The positive and secure handoff of TIH railcars at points of carrier interchange and at points of origination and delivery; and
- The minimization of unattended loaded tank cars carrying TIH materials” (Transportation Security Administration, 2006).

To provide support for these recommended actions, TSA analyzed in-transit data on shipments of TIH, radioactive, and explosive materials from June 2005 through June 2006. These

¹ The term *high-threat urban area* (HTUA) has been adopted by DHS to describe cities with both high populations and high population densities. Under this measure, New York receives the highest ranking.

data were compared with geographic data on the population living near rail facilities. Additionally, TSA has been performing site surveys of rail facilities in and around U.S. cities to assist in the implementation of the program. According to TSA, as of January 2008, almost 1,500 surveys had been performed at almost 250 locations, representing 33 rail carriers (Gorton, 2008). The areas receiving surveys were chosen on the basis of a measure of population-density-weighted population, with the first set of surveys taking place in New York and New Jersey. TSA reports that although shipments of TIH materials have increased 10 percent since the initiation of the program, risks have been reduced because dwell times have been reduced, storage areas are secured, and customers are receiving shipments more quickly (Gorton, 2008).

The second major federal initiative is an update to the hazardous-materials transportation rules that will encourage carriers to further reduce risks by transporting TIH materials over the “safest and most secure commercially practicable routes” (Pipeline and Hazardous Materials Safety Administration and Federal Railroad Administration, 2008). To determine the safest and most secure route, carriers are to collect and analyze data regarding the quantity and routing of shipments of hazardous materials, taking into account the proximity of the routes to population centers. The revised transportation rules formalize policies regarding reducing the quantity of hazardous materials and the length of time they are left unattended and ensuring an appropriate handoff between shippers, carriers, and consignees. No specific guidance is given regarding methods for determining the safety and security of a route, but a list of 27 factors related to safety, security, and rail operations to be considered is provided. DOT is in the process of developing analytical tools to assist carriers in estimating risk and improving recovery, and it expects to release a final rule later in 2008 (Schoonover, 2008).

Advanced Signaling Technology

FRA has made implementing a new generation of signaling technology, positive train control (PTC), a priority since 1997. This technology has been on the National Transportation Safety Board’s “Most Wanted List” since 1990 (NTSB, 2008b). PTC systems consist of sensors, location and communications equipment, and advanced computing systems that together provide detailed and accurate information regarding the status of operations on a rail network. In addition to improving safety, PTC systems are anticipated to increase the capacity of the existing track and improve the efficiency of rail operations by allowing closer spacing of trains; they will also reduce operating and maintenance costs by taking these factors into account when routing and scheduling trains. According to FRA, “Pilot versions of PTC were successfully tested a decade ago, but the systems were never deployed on a wide scale” (FRA, 2007). The reasons given for the slow development and implementation of PTC systems include cost, technological challenges, and a lack of standards (FRA, 2005b). This new technology would have likely prevented railroad accidents such as the 2005 Norfolk Southern collision near Graniteville, South Carolina, and the 1987 Conrail collision near Chase, Maryland. While the cause of the September 2008 Metrolink–Burlington Northern Santa Fe (BNSF) collision in Chatsworth, California, is still under investigation, some authorities claim that PTC would have prevented that tragedy as well.

Amtrak has begun to implement PTC systems along the Northeast Corridor and the Keystone Corridor. Class I railroads operating on these corridors have partially equipped their locomotives with the technology necessary to use Amtrak’s signaling systems. There does not appear to be an effort to implement PTC systems elsewhere in the state. The Railroad Safety Enhancement Act of 2008 (P.L. 110-432) requires the Class I railroads to implement PTC on

lines carrying hazardous materials and lines carrying both freight and passengers by 2015. This would include nearly all of the major railroad corridors in Pennsylvania.

While they increase safety, PTC systems may also create new safety and security vulnerabilities if the systems malfunction or are compromised. And the integration of technologies and communications systems may create additional unforeseen vulnerabilities. Hartong, Goel, and Wijesekera (2008, p. 57) have noted that “due to their reliance on wireless communications, PTC systems are vulnerable to attacks that can compromise safety and potentially cause serious accidents.” AAR has also noted that the ability of these systems to calculate proper braking distances and forces given “train length, weight, grade of track and track curvature” remains unresolved and could lead to accidents (Association of American Railroads, n.d.).

Pennsylvania’s Actions to Improve Rail Safety and Security

State Rail Safety Participation Program

Pennsylvania is one of 30 states given authority by FRA to implement federal rail-safety regulations, which cover topics ranging from track safety, to alcohol and drug policies, to hours of service. In Pennsylvania, the Rail Safety Division of PPUC is responsible for overseeing such enforcement through the FRA’s State Rail Safety Participation Program (Federal Railroad Administration, 2008). The working relationship between FRA and PPUC is governed by an annually updated Safety, Communication, and Work Plan (Pennsylvania Public Utilities Commission, 2007b). The State Rail Safety Participation Program includes five safety “disciplines” in which FRA trains and certifies inspectors: track, motive power and equipment, operating practices, hazardous materials, and signals. PPUC has certified inspectors in four of the five disciplines—Pennsylvania does not have a certified signals inspector.

PPUC inspectors conduct two types of inspections, regular and focused. The latter, generally conducted jointly with FRA, focus on locations and disciplines where FRA data indicate an increase in accidents. For example, a focused inspection might look at dispatch or switching operations, where many accidents are caused by human error. Results are shared with the railroad to help reduce the risk of future accidents. In 2006 and 2007, PPUC inspected 24,550 railroad cars, 469 locomotives, and 4,160 miles of track² and conducted 347 inspections of operating practices (Pennsylvania Public Utilities Commission, 2007c). Track and operating-practices inspections are conducted jointly with railroad employees, while inspections of motive power and equipment and hazardous materials are conducted unannounced.³ In a 2007 FRA review covering the number and completeness of inspections, Pennsylvania ranked highly in the track, equipment, and operating practices inspection disciplines (Pennsylvania Public Utilities Commission, 2007a).

According to an annual work plan, PPUC inspectors generally work in the middle of the state (east of Pittsburgh to Allentown), while FRA conducts most of the inspections in and

² Most track inspections are conducted in a vehicle called a hi-rail, which rides along the track. Whether PPUC inspectors ride a hi-rail or walk the track, they are accompanied by railroad employees to ensure that the employees understand the location and nature of any deficiencies noted. Note that PPUC reports 9,000 miles of track, whereas State Rail Plan figures show 5,000 miles of track right of way; this difference is likely due to the fact that PPUC inspects all sections of track where it is double- and triple-tracked.

³ David Hart, Manager, Rail Safety Division, PPUC, interview with Liisa Ecola, June 20, 2008.

around Pittsburgh and Philadelphia. (FRA has a regional office in Philadelphia.) Both PPUC and FRA conduct inspections of all types of railroads, Class I, regional, and short-line.⁴

PPUC also implements state railroad regulations (Pennsylvania Code, Title 52, Chapter 33). These regulations are concerned with safety reporting, grade crossings, bridge and tunnel safety, train operation, sanitation, passenger-train service, and stations. The regulations do not refer to security provisions, and Pennsylvania has not passed the type of legislation that exists in California, which would require railroads to share safety and security plans with the state.

While their formal duties have not changed, PPUC employees are required to be trained in the National Incident Management System, a DHS program for integrating federal, state, and local response to attacks. Employees take courses online; managerial training takes three days. This requirement is new in 2008, and at the time this report was written, PPUC managers had not yet taken the training.⁵ They do meet regularly with PEMA, although not specifically with the Pennsylvania OHS.⁶

Commonwealth Critical Infrastructure Protection Program

The Commonwealth Critical Infrastructure Protection Program (CCIPP) seeks to protect Pennsylvania's critical infrastructure from terrorist attack or natural disasters. This program is a state-level version of the national Critical Infrastructure Protection Program, which was established in response to Homeland Security Presidential Directive (HSPD) 7 (Bush, 2003). The program is administered by the Pennsylvania OHS and includes the collaboration of the State Police and PEMA. Security for both rail freight and passenger rail is addressed by the transportation working group of CCIPP.

CCIPP allocates specific tasks in infrastructure protection to specific agencies. The State Police focus on preventing attacks through coordinating their actions with those of external law enforcement and intelligence agencies. OHS focuses on protection of infrastructure through identification of critical infrastructure and its overall risk of terrorist attack. PEMA is responsible for response and recovery operations, including coordination with first responders at all levels of government, and training. Agencies are expected to coordinate planning and response with the private sector (Office of Homeland Security, 2007).

The protection plan under CCIPP is the state-level complement of the Federal National Infrastructure Protection Plan (U.S. Department of Homeland Security, 2008). With respect to rail, the transportation sector plan covers mass transit, passenger rail, and rail freight.

Class I Security Plans, Circular OT-55, and Community Training and Assistance

In response to the attacks of September 11, 2001, AAR formed the Railroad Security Task Force. Using national intelligence community "best practices," the Railroad Security Task Force developed a comprehensive risk analysis and voluntary security plan that includes:

1. A nationwide database of critical railroad assets
2. Assessments of vulnerabilities of those assets and rail operations

⁴ Ibid.

⁵ Ibid.

⁶ Ibid.

3. Analysis of the terrorism threat
4. Calculations of risk
5. Identification of countermeasures to reduce risk
6. Definition of alert levels
7. Delineation of actions to be taken at each alert level
8. Functions of the AAR operations center and railroad alert network.

The AAR security plan was first issued in December 2001 and has recently been revised.⁷

The security plan established four alert levels to guide security preparation and described a progressive series of actions to respond to terrorist threats to railroad personnel and assets. It also specifies additional countermeasures that will be applied in the areas of operations, information technology and communications, and police. The four alert levels are

- Level 1: new normal day-to-day operations
- Level 2: heightened security awareness
- Level 3: a credible threat of an attack on the United States or the railroad industry
- Level 4: a confirmed threat of an attack against the railroad industry or an actual attack in the United States.

The AAR security plan is the basis for the security plans developed by the Class I railroads in fulfillment of TSA requirements. The actual plan is considered to be extremely sensitive, proprietary, and confidential, and each railroad maintains a specific customized version, also proprietary and confidential. Security officials with whom we have spoken who have been allowed to review the plans find them comprehensive, encompassing scenarios and breadth beyond the physical rail and structural infrastructure to include information systems, financial networks, and other systems that are less tangible but critical for business continuity (Blum, 2002; California Public Utilities Commission, 2008). In its implementation of its security plan, CSX operates remote video surveillance equipment at certain yards and facilities. Both CSX and Norfolk Southern have enhanced their background checks on employees and contractors and have identified assets that are to receive greater security resources as a function of the security alert level.⁸ CSX and Norfolk Southern have also modified operations on infrastructure that has been identified as requiring higher levels of security.

Railroad employees claim that actions by the Class I carriers have been insufficient. Most notably, the Teamsters Rail Conference published a document entitled *High Alert* that reports the results of a nationwide survey of several thousand railroad employees regarding security. The survey indicates that railroad employees do not feel that effective security actions have been taken by the railroads since 2001. The document also warns of inadequate staffing of federal agencies responsible for oversight of rail and criticizes the use of remote-control locomotives (Teamsters Rail Conference, 2005). Representatives of the Brotherhood of Locomotive

⁷ Tom Murta, interview with David Ortiz, July 28, 2008.

⁸ Tom Murta, interview with David Ortiz, July 28, 2008; Hugh Kiley, interview with David Ortiz, September 30, 2008.

Engineers and Trainmen have expressed a clear feeling of disenfranchisement on the part of labor with respect to security and security planning.⁹

AAR has also issued guidelines to its members regarding best practices in transporting and handling hazardous materials, including TIH. These guidelines are voluntary but are considered to be obligatory for AAR members. Updated frequently, *Circular OT-55* describes protocols for the designation of “key trains” and “key routes,” based on the volume of hazardous materials transported (VanderClute, 2005). In particular, best operating practices for key trains—trains carrying one carload of spent nuclear fuel or high-level radioactive waste, five carloads of TIH materials, or 20 carloads or intermodal portable tankloads of other hazardous materials—specify a maximum operating speed of 50 miles per hour and require the use of cars equipped with roller bearings.¹⁰ Key routes are those that transport 4,000 carloads of spent nuclear fuel, high-level radioactive waste, or TIH materials, or 10,000 carloads or intermodal portable tankloads of other hazardous materials annually. Key routes are to have wayside defective-bearing detectors installed at intervals of not more than 40 miles and are to be inspected at least twice annually. In addition, the circular outlines yard coupling speeds and handling and storage minimum distances from main-line track.

Circular OT-55 describes a protocol through which local emergency responders may request information regarding the types of hazardous materials transported through the community: “Upon written request, AAR members will provide bona fide emergency response agencies or planning groups with specific commodity flow information covering at a minimum the top 25 hazardous commodities transported through the community in rank order” (VanderClute, 2005). The community is expected to safeguard the information and use it only for emergency-response planning. According to *Circular OT-55*, the purpose of providing such information is to “assist [local emergency-planning committees] in developing emergency plans to cope with hazardous materials transportation incidents; and assist community response organizations in preparations for responding to hazardous materials incidents” (VanderClute, 2005).

The Class I carriers often provide formal training in preparing for and responding to rail incidents. CSX Transportation’s *Community Awareness Emergency Planning Guide* (CAEPG) (CSX Transportation, 2006a), most recently updated in October 2006, is designed for public safety officials engaged in planning for railroad emergencies.¹¹ Its *Emergency Response to Railroad Incidents* (ERRI) (CSX Transportation, 2005) is a self-study guide for first responders.

The CAEPG contains an overview of the CSX network and operations, background information on the most commonly transported hazardous materials, detailed information on how train cars containing hazardous materials are labeled, the structure of a train consist,¹² instructions on how to identify the exact location of the incident with a CSX crossing marker,

⁹ Ken Kertesz, David Caniff, Gene Imler, and Linda Rhinehart, interview with David Ortiz and Michael D. Greenberg, April 18, 2008.

¹⁰ These policies are consistent with results from the analysis of rail accidents that identify as key risk factors the speed at which the train is traveling during a derailment and bearing failure.

¹¹ Norfolk Southern also produces a Railroad Emergency Response Planning Guide, which it distributes to participants in its training sessions (D. L. Schoendorfer, response to RAND Corporation questions, sent to Michael Fesen, September 25, 2008). According to Norfolk Southern, the training materials it uses are industry standard and similar to those used by other carriers (Hugh Kiley, interview with David Ortiz, September 30, 2008).

¹² A consist is the combination of locomotives and cars, but the term also sometimes refers to the documentation carried on the train regarding quantities of hazardous materials and specific instructions in case of release.

information on the lines of responsibility in case of an incident, and a list of factors that make responding to incidents in tunnels and on bridges more difficult. The appendices contain sample pages from a train consist, annotated to show where to find specific information (a useful guide, as much of the key information is not self-explanatory).

The CAEPG emphasizes the importance of coordination between CSX and local emergency personnel. It is not always clear how such coordination would occur and be maintained during an emergency. For example, an organization chart (Figure 4-A in the CAEPG) shows a unified command of federal, state, local, and CSX officials, but the accompanying text does not explain when state or federal officials would be called to assist local responders (CSX Transportation, 2006a). The text makes it clear that CSX works under the authority of local officials, but they are shown as an equal partner in the command structure.

An area of potential confusion is the role of specialized contractors in righting a derailed train and cleaning up a hazardous-materials spill. The guide states clearly that “local responders typically do not have the equipment or manpower to handle large spill clean up or railroad rerailling operations.” It further discusses CSX “contracts and agreements with pre-qualified and regularly audited suppliers of these services” (CSX Transportation, 2006a). It is not clear whether such contractors maintain 24/7 availability, especially in remote areas, or what would happen if such assistance could not be found in a timely fashion. It is also unclear whether a responding support contractor would accept direct orders from local emergency personnel rather than a CSX official.

Finally, the CAEPG lists and describes additional resources to assist in planning and emergency response. They include the following:

- CHEMTREC (CHEMical TRAnspOrtation Emergency Center), a voluntary service of the American Chemistry Council for tracking chemical shipments, offers an 800-number hotline for reporting spills 24/7 and information on handling different types of hazardous materials (for example, CHEMTREC can fax or e-mail material data-safety sheets, which are not routinely carried on trains, immediately upon request).
- Center for Toxicology and Environmental Health is a private firm that conducts air-quality modeling; its alliance with CSX is called TestNET.
- TRANSCAER (TRANSPortation Community Awareness and Emergency Response) is an organization of shippers and carriers dealing with hazardous materials that, among other duties, conducts exercises for local officials around the country. The last Pennsylvania events organized by CSX under the auspices of TRANSCAER were emergency-response drills in Barnesville in May 2006 and Westmoreland County in December 2006.
- Operation Respond Institute is a public-private partnership that provides information to emergency responders. Operation Respond Institute developed a software program called OREIS (Operation Respond Emergency Information System) that provides users with properties of hazardous materials, railroad schematics, and other information. The software is free to emergency-response agencies.

The CAEPG also includes a list of passenger train operators in the regions served by CSX. Included are “non-emergency” general office numbers, but it is not clear whether these would be the best way to contact emergency personnel from those operators in the event of an incident requiring that notice be given to other carriers (CSX Transportation, 2006a).

The ERRI (CSX Transportation, 2005) is designed to be a self-study guide for first responders. Some of the information is identical to that in the CAEPG (e.g., the discussions of bridge and tunnel safety and of freight/passenger rail collisions and the annotation of train-consist documentation). However, given the responder audience, the ERRI emphasizes more “on-the-scene” issues such as identification of railcar types, the difference between low- and high-pressure tank cars, and safety equipment. The ERRI contains a number of annotated photos showing, for example, what an emergency fuel-cutoff switch or vapor line looks like, as well as diagrams showing where to locate them on a tank car (CSX Transportation, 2005).

The ERRI also discusses in more detail the types of CSX officials who might assist at the scene of an incident and the specific responsibilities of each, whereas the CAEPG discusses only a CSX “incident commander” and does not provide details of emergency response. The ERRI explains that officials representing the three main operations departments—transportation, mechanical, and engineering—would each play a role: transportation would manage the overall response and provide the incident commander; mechanical would upright and remove derailed cars; and engineering would handle damaged track and signal equipment (CSX Transportation, 2005, 2006a). It also contains a map showing where the eight CSX hazardous-materials field service managers are located (there are none in Pennsylvania, but there is one in Baltimore and one in western New York near Buffalo). The ERRI does not discuss emergency-response contractors in any more detail than the CAEPG does.

Finally, the ERRI contains safety instructions specific to working on railroad incidents, such as ensuring that trains have ceased moving along the affected stretch of track and never putting one’s body in front of valves or gauges. It uses some terms that may or may not be familiar to first responders, such as “blue flag” and “chocked” (e.g. “make sure the hand brake is set and the car is chocked”) (CSX Transportation, 2005).¹³

The ERRI also contains an “open-book” exam that can be sent back to CSX for grading. CSX will issue a certificate of completion to those who pass the exam.

At least one state, California, provides additional railroad-safety training to state and local first responders. Included in the general curriculum for hazardous-materials emergency response is specific information regarding hazardous-materials transport by rail (CPUC, 2008, p. 20).

Class I Rail Incident-Response Training in Pennsylvania

The RAND project team conducted interviews with representatives of three communities that have had in-person training from CSX during the past five years: a large city (Philadelphia¹⁴), a small city (Butler County¹⁵), and a rural area (Bedford County¹⁶). The purpose of the inter-

¹³ A blue flag is a marker on a railcar indicating to other personnel that it should not be moved; a chock is an implement that prevents train wheels from turning.

¹⁴ Joseph McGraw, Philadelphia Fire Department, interview with Liisa Ecola, April 14, 2008.

¹⁵ Frank Matis, Butler County Emergency Services, interview with Liisa Ecola, April 14, 2008.

¹⁶ David Cubberson, Bedford County Emergency Services, interview with Liisa Ecola, April 14, 2008.

views was to determine whether the recipients felt that the training provided useful knowledge and skills and to gain a diversity of perspectives on the usefulness of the training.¹⁷

All three representatives characterized the CSX training as very helpful. While the characteristics of the communities are quite different, all received similar training on recognizing types of railcars and their constituent parts and on understanding their operation (e.g., how pressure valves would behave in the event of a spill or rupture). Bedford County's training took place in a classroom setting, while Butler County's training took place in a railcar outfitted as a classroom. Philadelphia has had both types of training in the past. Much of the training was applicable in general to rail incidents involving hazardous materials and was not particular to CSX.

The interviewees varied in their assessment of the training. Those in Philadelphia felt that the material complemented and expanded the knowledge of their hazardous-materials team. Bedford County contracts its hazardous-materials work to a neighboring county, and the participants found the material to be less useful from the perspective of emergency response. All indicated that one positive outcome was an ongoing relationship with CSX, which provided updated lists of emergency contacts and assurance that the railroad would take responsibility in the event of a hazardous-materials incident (which none of the jurisdictions had experienced in recent years).

The less-urbanized counties indicated that CSX training was helpful in raising their awareness about the potential consequences of a hazardous-materials incident. The representative from Bedford County said that one of the county's jurisdictions developed and adopted an evacuation plan after attending the training, something it had not previously done.¹⁸

We were unable to obtain accurate figures on the number of personnel who have received training in some cases, because the training occurred either several years ago (in Butler and Bedford counties) or multiple times (in Philadelphia). In Philadelphia, it is estimated that 150 firefighters and Emergency Medical Services (EMS) staff (out of 2,300) have been trained. The last Bedford County training was given to 34 people, including representatives of county and local jurisdictions, first responders, 911 dispatchers, and local officials.

The CSX training is not mandatory. In Philadelphia, the training has a good reputation, so chiefs often request that their personnel attend, but it also competes with training on other issues and for staff time (union rules dictate how often firefighters can cover for colleagues not present due to training). CSX has paid for several of Philadelphia's hazardous-materials specialists to attend more in-depth hazardous-materials training at the Transportation Technology Center in Colorado.¹⁹ Bedford County tries to rotate rail-safety training with training on other topics (such as high-pressure-gas and over-the-road hazardous-materials transportation) every few years.²⁰

CSX approached both Bedford and Butler counties, offering to conduct training in their areas. While neither contains major rail infrastructure or large cities, Bedford County sits on CSX's busy Keystone Corridor, which moves a volume of 54 MGT of freight annually. (In

¹⁷ We would like to have discussed perceptions of the effectiveness of this training with a community that has subsequently responded to a rail incident, but we were unable to determine a suitable candidate.

¹⁸ David Cubbersson, Bedford County Emergency Services, interview with Liisa Ecola, April 14, 2008.

¹⁹ Joseph McGraw, Philadelphia Fire Department, interview with Liisa Ecola, April 14, 2008.

²⁰ David Cubbersson, Bedford County Emergency Services, interview with Liisa Ecola, April 14, 2008.

contrast, the CSX corridor through Philadelphia moves about 24 MGT, and Butler County's line carries approximately 5 MGT.²¹) It was not clear whether the approaches to these counties were part of a broader CSX outreach effort or whether the counties had been targeted for some other reason. The CSX relationship with the Philadelphia Fire Department is long-standing and includes regular training sessions.

The jurisdictions differed most greatly in their potential sources of information for use in the event of a hazardous-materials incident. The Hazardous Materials Administrative Unit of the Philadelphia Fire Department maintains its own library of materials, subscribes to the OREIS software, and uses a protocol of referencing three information sources on the safe handling of chemicals, following the guidelines of the most conservative source (e.g., if two recommend an evacuation distance of one-half mile and the third recommends one mile, they would use one mile as the evacuation distance). Butler County uses CHEMTREC, while Bedford County would rely on the train-consist document to guide its response. Larger urban areas have more internal resources to prepare for emergency response, while smaller jurisdictions are more reliant on outside expertise and resources, although without information on how well these communities react to an actual event, it is difficult to assess whether their levels of preparation are adequate.

Norfolk Southern places its community outreach and training under the auspices of its activities in TRANSCAER. Training activities include a "Whistle-Stop Tour," in which a specialized Norfolk Southern train visits communities to enhance community awareness and provide first-responder training. The 2008 "Whistle-Stop Tour" occurred from September 15 through 19 in Georgia, North Carolina, and Virginia and provided training to 1,000 emergency responders. Other activities include full-scale simulations of hazardous-materials spills. Locations for Norfolk Southern's TRANSCAER activities are chosen based on proximity to key routes and requests from shippers and emergency responders. In 2007, some Norfolk Southern activities under TRANSCAER took place in Pennsylvania.²²

State Examples

The New Jersey Office of Homeland Security

By collaborating and partnering with DHS and TSA, New Jersey OHS has built capacity in rail security. In 2004, as part of the TIH Hazard Risk Reduction Program (see above), New Jersey OHS participated in site inspections in northern New Jersey, which is designated an HTUA. New Jersey OHS officials literally "walked the tracks" throughout the region, with TSA and railroad employees.²³ The physical inspections enabled the state to assist the railroads in consolidating the number of yards accepting TIH shipments and focus security efforts on those yards. In 2006, partly on the basis of knowledge gained during the prior inspections, New Jersey OHS recommended five freight rail yards and three passenger rail yards for funding under the Federal Emergency Management Agency Buffer Zone Protection Program (Federal Emergency Management Agency, 2008). State officials also collaborated with TSA

²¹ All figures are from the 2003 Pennsylvania State Rail Plan (R. L. Banks & Associates and Linare Consulting, 2003), the most recent available.

²² D. L. Schoendorfer, response to RAND Corporation questions, sent to Michael Fesen, September 25, 2008.

²³ Sherry Black, interview with David Ortiz, April 2, 2008.

in executing “corridor security assessments,” identifying rail segments that are easily accessible and where trains may idle due to congestion elsewhere in the system. New Jersey OHS was then able to seek joint solutions with railroads or to facilitate the application process for federal grant funding. CSX, a major Class I carrier in New Jersey and Pennsylvania, has an agreement with New Jersey to share information regarding train movements and contents with state security officials through access to the railroad’s online tracking system, the Network Operations Workstation (NOW) (New Jersey Office of Homeland Security and Preparedness, 2007).²⁴ It is hoped that access to the system will facilitate response in the event of a safety or security incident involving hazardous materials. New Jersey attempts to take full advantage of opportunities for joint training of police, responders, and railroads.²⁵

The California Public Utilities Commission

In September 2006, the California Assembly passed Assembly Bill (AB) 3023 (Local Community Rail Security Act, 2006), which focused on rail safety and security. The bill contained three major sections. The first two were devoted to safety issues such as signage warning of changes in maximum speed and the presence of highway-rail grade crossings. The third was intended to protect the “security and safety of local communities and local community facilities, to protect local communities from transportation practices that fail to secure rail facilities and equipment from the threat of terrorism, and to ensure proper communication between the owners and operators of rail facilities and equipment with local and state first responders” (Local Community Rail Security Act, 2006). This section of AB 3023 focused on the transport of hazardous materials and required that all railroads in the state do the following:

- Provide a risk assessment of their facilities and operations to local officials and emergency responders.
- Develop and implement an infrastructure protection program, including annual employee counterterrorism training (supporting documentation for the infrastructure protection program would have to be filed with CPUC and implementation of the program would have been subject to inspection and verification by CPUC officials).²⁶
- Employ a security force for all facilities that handle hazardous materials located within 15 miles of a community.
- Improve communications with local responders in case of an emergency.

The bill also limited the use of remote-control locomotives to handle hazardous materials under certain conditions.

²⁴ States use the NOW system within facilities for collecting and analyzing intelligence run by state law enforcement. For CSX to provide access to the NOW system, such facilities must employ extensive physical and information security measures, limiting access to those cleared by the state authority. CSX enters into an agreement with the state and system operators regarding the proprietary and confidential nature of the information available on the NOW system and provides training so that the operator may extract information most appropriate to emergency response and recovery (Tom Murta, interview with David Ortiz, July 28, 2008). Norfolk Southern is also able to provide up-to-the-minute information on car location and contents to customers, communities, and emergency responders (Hugh Kiley, interview with David Ortiz, September 30, 2008).

²⁵ Sherry Black, interview with David Ortiz, April 2, 2008.

²⁶ CPUC is the state-level partner that assists FRA in implementation of the Federal Railroad Safety Act.

In December 2006, two railroads, the Burlington Northern Santa Fe (BNSF) and the Union Pacific (UP), filed suit against the state of California, claiming that most of the provisions of AB 3023 were preempted by existing federal law, including the Federal Railroad Safety Act, the Hazardous Materials Transportation Act (HMTA), and the Locomotive Boiler Inspection Act. In May 2007, the railroads and the state reached an agreement with the District Court regarding the implementation of AB 3023 and addressing the legal issues raised by the railroad (Wanger, 2007). Provisions of the agreement with respect to the movement and security of hazardous materials included the following:²⁷

- Agreement that the HMTA and the Homeland Security Act of 2002 provide the national basis for the safe and secure transport of hazardous materials, as codified by DOT regulations known as HM-232.²⁸ The National Infrastructure Protection Program (NIPP) supplements these regulations. The parties also agreed that the Federal Railroad Safety Act establishes appropriate means for state review of railroad-security programs.
- The security programs developed by the railroads in compliance with federal law also comply with the requirements of AB 3023.
- Officials of CPUC with appropriate federal security clearances and background checks may review the security programs at the corporate offices of the railroads and also conduct field inspections.

CPUC is in the process of implementing AB 3023 and the settlement agreement. The settlement agreement affects only the BNSF and UP railroads, the two Class I carriers that operate in the state. Prior to the development of infrastructure-protection programs, CPUC reviewed with the railroads their plans to ensure the safe transport of hazardous materials. With the emphasis now on security and counterterrorism in the form of infrastructure-protection programs, CPUC inspectors found that they did not have the appropriate levels of security clearance. To resolve this issue temporarily, surrogates from the California OHS who had appropriate security clearances were designated. CPUC is in the process of clearing its inspectors so that they will be able to perform the required field inspections in support of the settlement agreement (CPUC, 2008). The CPUC inspectors are to be federally certified in both safety and security and may recommend enforcement actions in the execution of their duties. It is important to note that any enforcement action would be under federal law and authority.

Developing an infrastructure protection capacity at CPUC is important. Sixteen short-line carriers operate in California and are subject to the provisions of AB 3023.²⁹ Based on its experience with the Class I carriers, CPUC is assisting California's short lines in the preparation and review of infrastructure-security plans. CPUC officials feel that by developing and maintaining a capacity in rail security in addition to expertise in safety, CPUC can more effec-

²⁷ Discussions with CPUC officials indicated that the signage requirements of AB 3023 were secondary to the security requirements; we do not include descriptions of the signage aspects of the agreement.

²⁸ HM-232 refers to the DOT docket number of the rulemaking.

²⁹ CPUC discussion with Liisa Ecola, David S. Ortiz, and Brian Weatherford regarding AB 3023 settlement and subsequent implementation, April 1, 2008.

tively provide oversight of rail in California. The goal is a uniform system for compliance and enforcement of rail safety and security provisions.³⁰

CPUC views the passage of AB 3023 and the resulting settlement as a positive step toward improving security in California's rail system. CPUC is in the process of building a centralized state-level capacity for providing rail-safety and security oversight on behalf of the federal government. This capacity augments considerable rail-safety investigative capabilities—CPUC performs its own investigations of highway-rail grade-crossing and trespassing incidents.

CPUC recently released a report containing recommendations to the state legislature to improve rail safety. The Special Rail Safety Task Force reviewed safety and security deficiencies in current state and federal law, regulations, land-use planning, and emergency-response practices and concluded that safety and security threats are adequately addressed under existing laws and programs, despite a dynamic regulatory environment and overlapping jurisdictions. The task force recommended that communication and coordination between first responders and railroads continue to be improved. It encouraged local first responders to take advantage of training offered by the railroads and to organize joint training exercises with railroad personnel. Additionally, significant safety improvements can be made in land-use planning, codes, and development practices. The task force recommended charging developers impact fees to fund highway-rail grade-crossing separations, amending land-use planning codes throughout the state to prevent unsafe development near railroad facilities, and offering rail-safety awareness training to city officials and developers (CPUC, 2008).

Best Practices in Passenger Rail Security

Implementing best practices reduces the contribution of threat, vulnerability, and consequences to the overall risk of a passenger rail disaster. Best practices for security in passenger systems are well established. In a detailed set of case studies of major surface-transit systems, both rail and bus, Jenkins (1997b) and McCarthy (1997) identify best practices to improve security. A follow-up study by Jenkins and Gersten (2001) added new case studies, including the response to the attack on Tokyo's subway system in 1995 and the various challenges that large and small transit operators face in improving security. Many of these practices are codified (see, for example, Boyd Maier & Associates, 1998). Larger operators have greater resources to devote to security, and many employ their own security forces and deploy extensive security systems. Many smaller operators must rely on local police to provide assistance in ensuring security within their systems. It is possible to categorize the best practices identified in Jenkins (1997b) and in Jenkins and Gersten (2001) as relating to design, technology, organization, or planning and response:

- **Design.** Intelligent design of transit systems can significantly improve security. Stations and public areas may be designed to resist collapse in the event of an explosion and to ensure safe egress for the public and ingress for emergency responders. Effective design can also ensure appropriate line-of-sight for security cameras. Finally, blast-resistant waste bins and public furniture can reduce the fragmentation that may result from an explosion.

³⁰ Ibid.

- **Technology.** Large urban transit systems, such as the New York City Transit Authority and the London Underground, employ closed-circuit television (CCTV) cameras to monitor stations and platforms. Communications systems connect operators, passengers, trains, and stations with controllers and first responders. While such systems do have a deterrent effect, much of their value is realized when they are used to monitor and facilitate response during an evolving security event.
- **Organization.** An effective organization of security resources and first responders facilitates response and reduces casualties. Significant security events can overwhelm the resources of even the largest transit operators. Coordinating the various authorities—transit, local, state, and federal—that will be involved in the event of an incident is an essential first step in mounting an effective response.
- **Planning and response.** Many of the best practices in rail security involve planning and response. Having alert levels that ratchet up the presence of security forces and prepare potential first responders is an important best practice that requires advance planning. The New York City Transit Authority, the New York Police and Fire Departments, and the Mayor’s Office of Emergency Management, along with appropriate state officials, hold tabletop and field simulations to exercise plans and ensure coordination among system operators, responders, hospitals, and non-governmental and volunteer organizations. Staging areas throughout the city are identified, and lessons from past incidents and exercises are incorporated into response plans. These include such basic directives as not blocking the ingress to and egress from the site of an incident.

Synthesizing this prior work, Wilson et al. (2007, p. 26) describe five effective security measures installed at the large transit systems they surveyed: perimeter surveillance systems (CCTV), rail-station surveillance systems (CCTV), uniformed patrols, rapid-deployment forces, and automatic vehicle-locator systems. In addition to installing these security measures and providing adequate resources to operate them properly, transit operators are advised to conduct detailed vulnerability assessments and develop plans to improve security at the most vulnerable locations.

The application of technology and physical-security best practices in Pennsylvania is most important in the dense passenger rail-transportation network in the southeastern corner of the state. Here, long-distance and intercity passenger rail share infrastructure and other rail facilities with regional passenger rail. An attack on a key infrastructure component, such as 30th Street Station in Philadelphia, could result in significant casualties and immediate disruption of both passenger rail and rail freight in the region. The organizational structure of the security forces and first responders in greater Philadelphia closely resembles that of the urban-transit providers discussed in Jenkins (1997a) and Jenkins and Gersten (2001).

Much of the remainder of Pennsylvania’s passenger rail network runs through rural areas for which the application of standard security technology and planning and response may be more difficult. It is widely acknowledged that it is impractical to secure all track, switches, and other rail infrastructure. Additionally, initial emergency response in these areas will almost certainly be left to local officials, who may need the assistance of state, railroad, and federal personnel. Planning for both safety and security in such areas can be particularly challenging given the wide range of possible incidents and locations where they may occur and the limited availability of emergency responders. The state may be able to play an active role in ensuring preparedness and effective response in these rural areas.

These examples of reducing risk and improving security in passenger rail have analogs to the rail freight system. Clearly, there are notable differences between the rolling stock and the track infrastructure used, but effectively deploying intelligent design practices and technology and planning coordination and response operations apply to securing the rail freight network as well. Opportunities may exist for the state to engage with the railroads to improve security and to plan for emergency response.

Findings and Possible State-Level Actions to Improve Rail Safety and Security

In this chapter, we present our findings and suggestions for possible next steps to improve the safety and security of rail in Pennsylvania. The findings fall broadly into the categories of rail infrastructure and operations, risk factors, legal authority, and best practices. The possible state-level actions to improve safety and security require additional study and consideration, perhaps by appropriate state agencies. We have not analyzed the potential costs of such measures or the improvements in safety and security that they may provide.

Findings

1. Pennsylvania has a dense network of routes, though Class I railroads carry the vast majority of freight.

Four Class I railroads and nearly four dozen regional and short-line railroads provide rail freight services in Pennsylvania on a network covering more than 5,000 track-miles. Alternate parallel routes exist, both north-south and east-west, within Pennsylvania or neighboring states. Because of this density of active rail freight service providers, disruptions within the system can be rerouted relatively easily on the Class I carrier's network, or if appropriate and available, along other railroads—Class I, regional, or short-line.

All Class I corridors through Pennsylvania are part of the U.S. Department of Defense Strategic Rail Corridor Network, which means that they provide rail freight services to and from key military installations. While information on the quantity of hazardous materials transported along Pennsylvania railroads is not available to the general public, three Class I corridors carried at least 100 million gross tons of freight in 2003 and can safely be assumed to be designated “key routes” according to AAR *Circular OT-55*, which governs the transport of hazardous materials. Additional safety equipment to detect and prevent bearing failure is installed along these key routes, and periodic inspections to detect track defects are performed (VanderClute, 2005). While such measures do not prevent all accidents, they constitute an additional level of oversight along these heavily traveled corridors.

2. Pennsylvania's passenger rail services are concentrated in the southeastern corner of the state.

Passenger rail infrastructure and services in Pennsylvania are concentrated in the greater Philadelphia region. SEPTA operates a large urban-transit system consisting of light rail, rail rapid transit, and commuter rail components. Amtrak's Northeast Corridor, which runs through Philadelphia along the Delaware River, connecting Boston to Washington, D.C., is

the busiest intercity rail corridor in the United States. Its Keystone Corridor provides rail service between Philadelphia and Harrisburg. These and other systems interchange at 30th Street Station in Philadelphia. Other passenger rail systems in Pennsylvania carry an order of magnitude fewer passengers annually than the major systems in the southeastern corner of the state.

3. There is a documented terrorist threat against rail systems, and infrastructure will always be vulnerable.

Documented attacks have occurred against all types of passenger rail systems (Jenkins, 1997c; Jenkins and Gersten, 2001; Wilson et al., 2007). The most common mode of attack is bombing stations or loaded passenger cars; there is a lesser threat of armed attacks. Sabotage and unconventional attacks have also occurred, including a purposeful derailment of the Amtrak Sunset Limited in 1995 and the release of sarin gas, a potent nerve agent, in the Tokyo subway in the same year. With the exception of the Tokyo attack, terrorist attacks on rail systems have resulted in relatively few casualties, averaging four fatalities and 13 injuries per incident.

There is no similar history of past attacks on rail freight to guide analysis. A prior RAND study assessed the vulnerability of passenger rail by considering the practicality of attacks against specific infrastructure components (Wilson et al., 2007). Generalizing this approach to rail freight, we conclude that much of the infrastructure is accessible to would-be attackers and is vulnerable. The practicality of attacks against freight trains depends on their accessibility when dwelling in yards or on sidings and the attacker's knowledge of routes and schedules. The consequences of accidents in rail freight, if taken as a guide to possible consequences, are relatively minor. Safety incidents in rail freight generally do not result in casualties and do not incur significant direct damage to track and equipment. Incidents involving the release of hazardous materials can have far more severe consequences. Were such an incident to be perpetrated with the intent of maximizing casualties, the results could be catastrophic.

4. The extent and diversity of railroad infrastructure and operations in Pennsylvania require an equally diverse approach to security.

The rail freight and passenger rail network throughout Pennsylvania serves both densely populated urban areas and sparsely populated and difficult-to-access rural areas. Ensuring safety and security within the urban areas requires coordination among a number of different agencies, jurisdictions, and carriers. In rural areas, identifying appropriately equipped and trained emergency-response capabilities may be difficult. Moreover, the differences in the resources a carrier may bring to assist in the response to an incident could vary widely among the Class I, regional, and short-line carriers.

5. Effective response is essential to minimizing casualties and economic damages resulting from rail safety and security incidents.

Research on the safety of hazardous-materials transport by rail has concluded that effective emergency response contributes importantly to reducing the casualties resulting from a hazardous-materials spill (Glickman and Rosenfield, 1984). However, providing effective emergency-response services can be difficult and requires appropriate resources, training, planning, interagency coordination, and practice (Jenkins, 1997a; Jenkins and Gersten, 2001). Both CSX and Norfolk Southern provide training free of charge to emergency responders. The Philadelphia Fire Department consistently participates in CSX's training and exercises.

Other communities throughout the state have participated, but on an irregular basis. Exercises, both tabletop and in the field, are an important component of emergency-response training to ensure that lines of communication are clear and logistics practiced (Jenkins, 1997a).

6. There is significant flexibility within existing legal authority for Pennsylvania to play an active role in shaping its rail safety and security.

Legal authority over rail infrastructure and operations is largely a federal activity. However, since states partner with FRA in enforcing key railroad-safety legislation, there are many opportunities for states to take an active role in overseeing rail safety and security. Within the current regulatory system, states perform many safety- and security-related functions, both in collaboration with federal agencies and on their own. In Pennsylvania, PPUC is the state agency that assists FRA in implementing federal rail-safety regulations. In New Jersey, collaborative work on rail security occurs through the New Jersey OHS, which collaborates with federal officials and railroads in the evaluation of rail and hazardous-materials transport security and the mitigation of major risks. New Jersey has developed expertise and has been able to identify promising areas for federal grant funding for security infrastructure. In California, CPUC is expanding its expertise in rail safety to include some security oversight.

Additionally, the major transit agencies in Pennsylvania employ their own police forces to enforce law, investigate threats, and maintain public safety and security.

Possible State-Level Actions to Improve Rail Safety and Security

1. Use state rail development funding to improve rail transportation and safety and security.

PennDOT's Rail Freight Assistance Program and Rail Transportation Assistance Program provide grants to bolster rail infrastructure as an economic-development tool, preserving rail services throughout the state. PennDOT could create a complementary program to fund safety and security improvements to regional and short-line railroads in Pennsylvania that provide essential feeder and connection services. The authority for such measures appears to exist under the Rail Freight Preservation and Improvement Act. Straightforward improvements to track and supporting infrastructure of these railroads could have a significant effect on safety and security, for two principal reasons.¹ First, smaller carriers tend to be undercapitalized and to operate lower classes of track than the Class I carriers; thus they experience higher accident rates than Class I carriers (Anderson and Barkan, 2004). Second, in the event of a significant disruption, such as that which would result from disabling a major bridge or tunnel, reconstituted regional or short-line routes may be able to improve the resilience of the rail freight system. Federal homeland-security grant programs already exist and may serve as a source of funding for such activities. Two examples of such programs are the Buffer Zone Protection Program² administered by the Federal Emergency Management Agency (FEMA) and the Transit Security Grant Program³ administered by DHS. Incorporating additional net-

¹ Specifically, track and structures parallel to important routes should be upgraded to accommodate modern 286,000-pound railcars.

² For more information, see <http://www.fema.gov/government/grant/bzpp/index.shtm> (as of September 21, 2008).

³ For more information, see http://www.dhs.gov/xgovt/grants/gc_1178820367100.shtm (as of September 21, 2008).

workwide safety and security benefits into these programs would require quantifying these networkwide effects.

2. Be prepared to provide a wide range of support services, depending on local needs.

Each of the Pennsylvania communities in which rail operations occur has unique abilities to plan for and mount a response to a rail safety or security incident. State officials, possibly from the Pennsylvania OHS, could assist communities in identifying key components of infrastructure and in applying for grant programs to bolster and improve them. In the event of an incident, state resources may augment local capabilities or may coordinate the complete response. Ensuring that such planning and response is effective requires close coordination of the relevant state agencies—the State Police, PPUC, OHS, and PEMA, among others—with local communities and carriers and system operators.

3. Coordinate simulations and exercises including personnel from local and state agencies, neighboring states, federal agencies, volunteer organizations, and the railroads.

The Commonwealth of Pennsylvania, possibly led by PEMA, could coordinate training exercises that simulate or rehearse for a serious hazardous-materials release or terrorist railroad incident. Such training would test lines of communication and allow participants to practice logistics, deployment, evacuation, and other response and recovery operations. This would provide state agencies with critical hands-on understanding of their roles in disaster response and would improve interagency communication. Ideally, these exercises would include both freight and passenger rail and would be conducted throughout the state. Participation among state agencies, local first responders, and railroad personnel and employees should improve communication and ultimately reduce the impacts of intentional or accidental railroad incidents.

4. Build state-level capacity in rail safety and security.

PPUC could seek to emulate the example of CPUC in carrying out its responsibilities under the State Rail Safety Participation Program and the New Jersey OHS in its collaboration with TSA on security matters. FRA and TSA have welcomed the increased involvement of states. Moreover, state resources and expertise could be focused on areas not necessarily covered by FRA or TSA. For example, CPUC investigates all incidents that occur at grade crossings in the state, something that FRA does not do. The expertise gained at the state level could be transferred to regional and short-line railroads, which may not have the resources or the in-house expertise to implement certain safety and security practices.

Pennsylvania may choose to pursue a formal intelligence collection and analysis center, similar to the center established by New Jersey, which would maintain direct contact among Pennsylvania law enforcement, the federal government, local communities, and system operators, perhaps employing the CSX NOW terminal and the car-location data offered by Norfolk Southern.

Concluding Thoughts

Federal law restricts the positive actions states can take with regard to imposing new regulations on the railroads. However, there are many opportunities for policymakers to improve coordination and information-sharing on railroad-security issues. Overall, the appropriate role

for the Commonwealth of Pennsylvania, if it wishes to be more actively involved in improving railroad-security training and preparedness, appears to be not regulatory, but rather as a clearinghouse for data and information and as a partner with communities, local agencies, and the railroads.

Maps of Pennsylvania Rail Corridors

This appendix presents maps of rail corridors in Pennsylvania, aggregated by type. Pennsylvania, like much of the U.S. East Coast, has a dense rail-freight network connecting it to adjoining states. Intercity passenger rail service, provided by Amtrak, serves eastern Pennsylvania via the Northeast Corridor, connects Harrisburg to Philadelphia, and provides service to several other cities throughout the state (see Chapter Two for a detailed discussion). The color coding of the rail corridors in the maps below corresponds to ownership of the track.

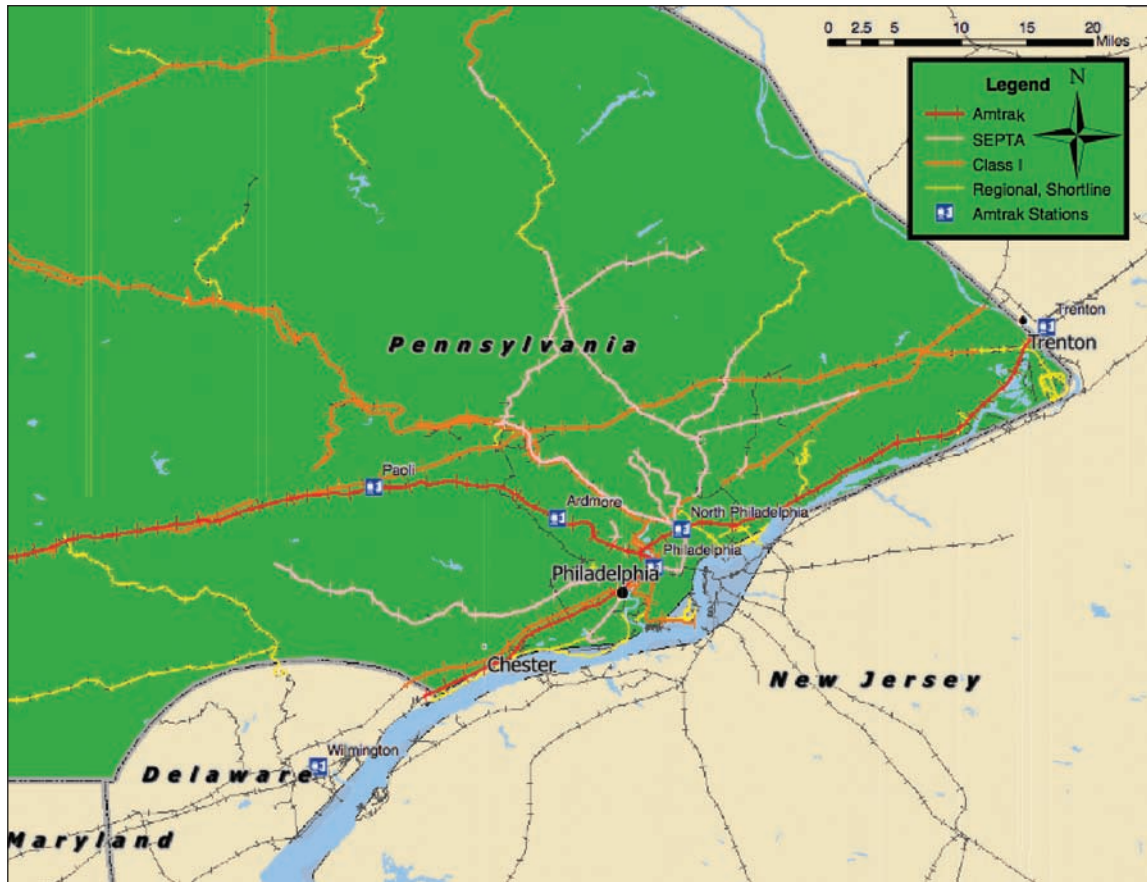
Figure A.1
Pennsylvania Rail Corridors



SOURCE: Pennsylvania Department of Transportation, 2008.

RAND TR615-A.1

Figure A.2
Southeastern Pennsylvania Rail Corridors



SOURCE: Pennsylvania Department of Transportation, 2008.
RAND TR615-A.2

Annotated Bibliography

Reports

AASHTO and Cambridge Systematics, Inc., *Freight-Rail Bottom Line Report*, Washington, D.C.: American Association of State Highway and Transportation Officials, 2003.

The *Freight-Rail Bottom Line Report* describes the rail freight industry and the reasons that rail is critical to the intermodal freight-transportation system. The benefits described and quantified include increases in the capacity of the freight-transportation system, highway cost savings, economic development, facilitation of international trade, more fuel efficiency and less pollution than achieved with trucks, and importance for national defense. The American Association of State Highway and Transportation Officials (AASHTO) calculates that \$195 billion to \$220 billion will have to be invested in the rail system over the next 20 years to meet safety and maintenance needs and to increase capacity to meet expected demand. This cost estimate is preliminary and highly speculative. While most of the money will come from the railroads themselves, AASHTO recommends that the public sector form partnerships with the railroads and invest public funds in rail infrastructure improvements. AASHTO observes that under current transportation financing, the federal government has a much smaller role in public railroad investments than do the states. The report also provides information about 28 regional and state rail freight projects.

Anater, Patrick, Keith Chase, Kathy Malarich, Brian Funkhouser, and Erica Kagle, *The Economic Impact of Railroads in Pennsylvania*, Harrisburg, Penn.: The Pennsylvania State Transportation Advisory Committee, 2005.

This report, commissioned by the Pennsylvania State Transportation Advisory Committee, calculates the direct and indirect economic effects of rail in the Pennsylvania economy and develops a tool for local agencies to assess the economic impacts of rail infrastructure investments. The researchers conducted four case studies and a macroeconomic analysis using the IMPLAN input/output model. In addition to typical quantitative transportation statistics, the researchers used the TRANSEARCH rail shipment database and interviewed various industry experts. The report calculates the economic impact of rail in Pennsylvania in terms of wages, tax revenue, and direct and indirect spending by the rail industry. In 2001, the rail industry directly and indirectly contributed \$4 billion to the Pennsylvania economy, and rail-related economic output totaled \$33 billion. Among the economic benefits estimated in the report are benefits to the transportation system from fewer truck movements. The report also discusses, but does not quantify, increased tourism derived from railroad attractions and tourist rail excursions.

Argonne National Laboratory, *Preparedness of Hazardous Materials Emergencies in Railyards: Guidance for Railroads and Adjacent Communities*, Washington, D.C.: Federal Emergency Management Agency, 1991.

This report provides guidance to railroads and communities on preparing for and responding to hazardous-materials release emergencies in rail yards. According to the report, hazardous-materials accidents are more likely to occur in rail yards than while in transit or at fixed sites because railcars are frequently moved around within the yard, making it more difficult to locate them and take special precautions. The report explains emergency-preparedness actions and responsibilities and contains 150 specific guidance recommendations that are tailored specifically for the special needs and resources of rail yards and the adjacent communities. FEMA issued this report to update existing guidance, in part as a response to changes in the rail industry following the Staggers Act of 1980, which altered the ability of the railroad industry to prepare for and respond to hazardous-materials emergencies in both positive and negative ways. The four basic “messages” that this report addresses are (1) increase interorganizational cooperation and coordination; (2) improve the availability of life-saving and injury-reducing resources and provide the training needed to access them; (3) increase the frequency and scope and improve the quality of emergency-preparedness exercises; and (4) develop (or update and improve) emergency preparedness plans and procedures specifically for rail yards.

Association of American Railroads, “Freight Railroad Security Plan.” As of October 21, 2008: <http://www.aar.org/IndustryInformation/RailSecurity/SecurityPlan.aspx>

This document summarizes the development and implementation of the AAR Terrorism Risk Analysis and Security Management Plan, which has not been made publicly available. Using national intelligence community best practices, the Railroad Security Task Force developed a comprehensive risk analysis and security plan that includes the following components:

- a nationwide database of critical railroad assets
- assessments of vulnerabilities to those assets and rail operations
- an analysis of the terrorism threat
- calculations of risk
- an identification of countermeasures to reduce risk
- definitions of four alert levels that correspond to security actions:
 - Level 1: normal day-to-day operations
 - Level 2: heightened security awareness
 - Level 3: a credible threat of an attack on the United States or the railroad industry
 - Level 4: a confirmed threat of an attack against the railroad industry or an actual attack within the United States
- the security actions to be taken at each alert level, and
- a description of the functions of the AAR operations center and railroad alert network.

Blue Ribbon Panel on Bridge and Tunnel Security, *Recommendations for Bridge and Tunnel Security*, American Association of State Highway and Transportation Officials, 2003. As of October 21, 2008: <http://www.fhwa.dot.gov/bridge/security/brptoc.cfm>

This document reports the recommendations of an expert panel assembled to address the vulnerabilities of bridges and tunnels to terrorist attacks. The report focuses on design and

engineering solutions to address security vulnerabilities. The framework used by the panel to develop its recommendations included the following steps: use a general risk assessment to identify and prioritize “critical” bridges and tunnels, assess potential threats, determine the possible scope of possible damage, evaluate possible countermeasures, and evaluate the current state of relevant knowledge available to engineering professionals. The panel made the following seven recommendations:

- Improve coordination and collaboration among the Federal Highway Administration (FHWA), AASHTO, TSA, and other highway transportation stakeholders to ensure that assessment methodologies and security solutions meet stakeholder needs.
- Federal agencies should disseminate information about bridge and tunnel security and cost-effective countermeasures to decisionmakers, facility owners and operators, designers, and elected officials.
- FHWA should seek to clarify the legal position of state Departments of Transportation and public-transportation authorities with respect to their responsibility to act on the indications of risk studies for their facilities.
- Provide for new funding sources for bridge and tunnel security beyond and outside of current federal-aid highway funding sources.
- Expand funding eligibility and increase funding flexibility.
- FHWA should lend its technical engineering expertise to TSA in its effort to prioritize critical bridges and tunnels for funding security improvements.
- Develop and evaluate engineering standards and technology to respond to bridge and tunnel security concerns, using appropriate R&D initiatives.

The panel also developed short-, mid-, and long-term strategies to improve security by improving planning and policy, mitigating threats and consequences through better engineering, and defining various other institutional roles for FHWA and AASHTO.

Boyd, Annabelle, and John P. Sullivan, “Emergency Preparedness for Transit Terrorism,” *Synthesis of Transit Practice*, Vol. 27, Transportation Research Board, 1997.

This document is a synthesis of practices by U.S. transit agencies in 1993–1997 to prevent and respond to terrorism. The first section reports the results of a survey of 60 transit agencies (response rate was 70 percent) regarding their counterterrorism perceptions and practices. Transit officials regard terrorism as a serious threat, with particular concern focused on traditional threats—bombings, shootings, and hijackings—rather than unconventional threats—chemical, nuclear, and biological. The majority of transit officials considered urban rail, commuter rail, and rail terminals to be at greater risk of being targeted than other transit facilities. Fewer than half of the surveyed transit agencies had specifically developed a plan to respond to terrorism, but 79 percent had developed at least a general emergency plan. Bomb threats were the most commonly reported security threat, and 90 percent of surveyed transit agencies had developed a specific plan to deal with them. The majority of transit agencies reported that they regularly communicated with local police and with federal agencies, but fewer than half coordinated their plans with local hospitals and state police. The remaining sections of the report synthesize best practices in preparing for and responding to transit terrorism. The study identifies the following obstacles to improving preparedness:

- Limited financial resources to support personnel, training, and equipment costs
- The difficulty of developing or obtaining accurate and timely intelligence concerning threat levels and potential terrorist activity
- The need for improved support from the FBI and other federal agencies for training and response guidelines
- Enhanced coordination to support improvements in tactical response to emergencies involving terrorism and acts of extreme violence, including use of the incident command system (ICS).

Boyd Maier & Associates, *Transit Security Handbook*, Cambridge, Mass.: Volpe National Transportation Systems Center, 1998.

This report explains the security provisions specified in FTA's State Safety Oversight Rule (Part 659). This rule addresses safety and security risks to rail-transit passengers and employees. The report provides general rail-security information to state oversight agencies and rail-transit-agency personnel. The handbook also provides rail-transit agencies with information to help comply with the rule. Possibly in need of updating for the post-9/11 security environment, the *Transit Security Handbook* nonetheless contains a wealth of information. It describes a systems approach to transit security that focuses on preventing and deterring threats throughout the life cycle of the transit system; in other words, security should be addressed during the planning and design of the transit system as well as during operations. The handbook is comprehensive and addresses security and crime prevention through system design, planning, technology, security officers, training and exercises, interagency coordination, and data collection.

Bureau of Transportation Statistics, *Pennsylvania: Summary Travel Characteristics*, Washington, D.C.: Department of Transportation, 1997.

This profile of long-distance (100 miles or more) travel behavior in Pennsylvania is a summary of results from the 1995 American Travel Survey. Rail is the mode of travel for 598,000 of the nearly 50 million annual household trips of 100 miles or more in Pennsylvania. Most trips from and to Pennsylvania are by personal vehicle or airplane. Rail is the primary mode of transportation used in 1.3 percent of trips originating in Pennsylvania with a destination outside the state, 1.6 percent of trips originating outside the state with a destination in Pennsylvania, and 0.7 percent of long-distance trips within Pennsylvania. Trip characteristics are not cross-tabulated by mode.

Cantrell, B., M. Lazo, and R. Ruttenberg, *Training in Hazmat and Rail Security: Current Status and Future Needs of Rail Workers and Community Members*, Citizens for Rail Safety, 2006.

This report concludes that current hazardous-materials training for rail workers in the United States is inadequate. The researchers review industry statements, government studies, training materials, and other studies about current training practices in the rail industry on handling hazardous materials and rail security. Provided as background are calculations of the economic and health impacts of historical and potential hazardous-materials accidents. The authors calculate that in a worst-case scenario in which a single 90-ton chlorine tanker were to release its contents, the toxic plume could be as large as 100 miles by 40 miles and could kill up to

100,000 people and injure many more. Their key findings include ways to improve training for rail employees and community members. In addition, they recommend that rail workers, emergency responders, and community members conduct joint training exercises. The authors make more than 100 specific recommendations. An appendix assembles an extensive chart listing common hazardous materials, health risks, and the possible range of contamination in the event of a release.

Democratic Staff of the House Committee on Homeland Security, *Detour Ahead: Critical Vulnerabilities in America's Rail and Mass Transit Security Programs*, 2006.

This report was prepared for the members of the Committee on Homeland Security in the U.S. House of Representatives by the Democratic staff of that committee. It highlights the large discrepancy between spending to secure aviation and spending on other modes of travel and calls for TSA to begin addressing surface-transportation security. The report recommends that TSA's authority over surface-transportation security be clarified and strengthened to eliminate redundancy and simplify cooperation with the private sector and local agencies. Seven additional specific recommendations are made that cover reporting, information sharing, and security training.

Duwadi, Sheila Rimal, and Steven B. Chase, *Multiyear Plan for Bridge and Tunnel Security Research, Development, and Deployment*, Washington, D.C.: Federal Highway Administration, 2006.

This report proposes a multiyear R&D program addressing highway bridge and tunnel security. The report identifies the priority goals of such a research program and proposes specific topic areas. The focus of the program is on highways, but the technology and engineering knowledge would transfer to rail bridges and tunnels. The report notes that most terrorist attacks use bombs, but that transportation engineers need to design for all reasonable threats. Possible terrorist threats to bridges include fire, impact, mechanical cutting devices, corrosive chemicals, and explosions. In addition to these, the report adds chemical and biological attacks as a terrorist threat to tunnels. The focus areas of the research program are

- Risk and vulnerability assessment
- System analysis and design
- Improved materials
- Prevention, detection, and surveillance
- Post-event assessment
- Repair and restoration
- Evaluation and training.

Federal Railroad Administration, *Action Plan for Addressing Critical Railroad Safety Issues*, Washington, D.C.: U.S. Department of Transportation, 2005.

FRA's plan to improve railroad safety proposes to collect data on "close calls," deploy technology that can better measure track condition, and accelerate research on problems such as employee fatigue and tank-car structural integrity. FRA hopes to identify the most frequent causes of rail accidents so that they might be targeted and prevented or mitigated. FRA also hopes to learn where its limited oversight and inspection resources would be most

effectively deployed. The primary areas of safety concern are human factors, track condition, hazardous materials, and grade crossings. The plan does not address efforts to improve rail security.

Federal Railroad Administration, *Collision Hazard Analysis Guide: Commuter and Passenger Rail*, Washington, D.C.: U.S. Department of Transportation, 2007.

This document provides guidance on identifying hazards on the passenger rail system and how to address them to improve safety. It is intended for passenger rail carriers. It is based on a hazard-analysis framework developed by the U.S. Department of Defense (MIL-STD-882), which provides a formal analytic process for identifying, analyzing, and addressing different types of hazards. Though focused on avoiding collisions, the *Collision Hazard Analysis Guide* provides a framework suitable for assessing other hazards. The focus on passenger rail makes it of limited utility for freight carriers. The document applies a hazard-analysis technique that involves the following steps: system definition, hazard identification, hazard assessment, hazard resolution, and follow-up. Examples of several different types of hazards and steps to mitigate them are presented.

Field, Mary A., “Highway Security and Terrorism,” *Review of Policy Research*, Vol. 21, No. 3, 2004, pp. 317–328.

This article focuses on highway transportation security, with an emphasis on the transportation of hazardous materials. It looks at state and federal regulation of hazardous-materials transportation, highway operations, and other related security measures—such as access control and physical infrastructure protection—before and after the September 11, 2001, terrorist attacks. Specifically, Field notes that hazardous-materials transportation is regulated by the U.S. Department of Transportation but that states are responsible for enforcing the regulations. In 2003, the U.S. DOT published a new rule, *Security Requirements for Offerors and Transporters of Hazardous Materials*, requiring shippers to develop security plans and provide security training for their employees. Additional state regulation of hazardous-materials transportation is possible but must be compliant with federal law; seven states—not including Pennsylvania—currently participate in a state permitting program that provides the states with some information and control regarding hazardous-materials movements within their boundaries. Field comments that highways are difficult to secure against terrorism and that before 9/11, terrorism was not a major concern, but the 2001 attacks demonstrated that there is a real risk that should receive attention. The author concludes that funding will be a problem in implementing infrastructure protection efforts but that successful public-private partnerships are improving hazardous-materials security.

Fink, Camille N. Y., Brian D. Taylor, and Anastasia Loukaitou-Sideris, “From Policy and Response to System Design and Operations: Inter-Governmental Transit Security Planning in the U.S.,” *Journal of Public Transportation*, Vol. 8, No. 4, 2002, pp. 1–16.

This paper examines how security considerations are being incorporated into the planning, design, and operation of U.S. transit systems following the September 11, 2001, attacks. Data were collected from two sources: nine unstructured interviews with officials from federal

agencies, Amtrak, and the American Public Transportation Association, and a nationally representative 2004 survey of 113 regional transit agencies. The key findings of the study are the following:

- Transit operators believe that an attack on transit is very likely; however, most systems remain very vulnerable to a terrorist attack.
- Increased intra-agency coordination and information sharing is important for transit-security planning.
- Transit operators perceive balancing security with operational considerations to be a major challenge.

Flynn, Stephen E., "Transportation Security Agenda for the 21st Century," *TR News*, Vol. 211, November-December 2000, pp. 3–7.

This short article highlights the vulnerability of America's freight-transportation infrastructure to terrorist attack. It is a precursor to Flynn's book *America the Vulnerable*. The article does not address passenger-transportation vulnerabilities. It notes that criminals routinely exploit America's weak transportation security for smuggling and that terrorists could do the same to bring weapons of mass destruction into the country. The article ominously posits a hypothetical scenario involving Osama bin Laden importing a shipping container concealing a biological agent to Newark. Flynn suggests five policy actions to improve transportation security: (1) raise awareness of the threat; (2) improve global cooperation to enact security measures; (3) increase the transparency of the goods movement system; (4) form public-private partnerships to improve security with a minimum of additional cost and disruption; (5) provide the necessary resources to enact the previous four actions. These policy improvements would have benefits beyond transportation security; they would increase supply-chain efficiency, streamline government regulation, reform labor agreements, improve transportation infrastructure, and reduce corruption.

Hamberger, Edward R., *Current Issues in the Rail Transportation of Hazardous Materials*, Testimony before the U.S. House of Representatives Committee on Transportation and Infrastructure, June 13, 2006.

The president of AAR presents the policy position of the Class I railroads toward liability for hazardous-materials accidents. Hamberger states that railroads have an excellent safety record but face exposure to unlimited liability in case of an accident. Railroads are taking action to improve safety by optimizing operations, assisting communities in developing emergency-response plans, providing communities with lists of hazardous materials that pass through them, training employees, and improving the design of tank cars. AAR would like policy action to limit the railroads' liability in the event of an accident and supports efforts by manufacturers to substitute safer materials for hazardous materials in manufacturing processes.

Hamberger, Edward R., *Hearing on Transit and Rail Security*, Testimony before the U.S. House of Representatives Committee on Transportation and Infrastructure, March 7, 2007.

The president of AAR describes the railroad Terrorism Risk Analysis and Security Management Plan to members of the House Committee on Transportation and Infrastructure (as described above) and claims that the railroads' plan is a model that other industries could use to improve

their security. In addition, Hamberger describes the railroad industry's emergency-response training and preparation programs. These include the Transportation Community Awareness and Emergency Response Program (TRANSCAER), which provides training for communities and reviews community emergency response plans, and the Emergency Response Training Center (ERTC), which allows hands-on hazardous-materials training on actual railcars. Hamberger also describes how hazardous-materials and security training that teaches employees how to identify and respond to security threats has been implemented and standardized across the industry.

Recent Legislation

Public Law 110-432, Rail Safety Improvement Act of 2008.

Passed on September 24, 2008, the Rail Safety Improvement Act of 2008 reauthorized FRA and created a new position, "Chief Safety Officer," within that organization. The secretary of transportation and the administrator are required to develop a long-term plan for improving rail safety and to report semiannually regarding the state of rail safety in the United States. The law specifies that hours of service regulations now apply to railroad employees and their contractors, sets a maximum on-duty time of 12 hours, and includes other provisions intended to reduce employee fatigue. Grade-crossing safety enhancements include the development of emergency reporting and communication plans for malfunctioning controls at grade crossings, a national inventory of grade crossings, the funding of Operation Lifesaver, the drafting and dissemination of model state legislation preventing the violation of grade-crossing signals, and targeted grants for improving safety at highway-rail grade crossings. The Act further authorizes up to \$1.5 million per year in federal grants to states (up to \$250,000 per state per year) to improve highway-rail grade-crossing safety. The Act requires Class I railroads to implement PTC on main lines carrying TIH materials and lines carrying both freight and passengers by December 31, 2015. Further, the Act directs NTSB to establish a program to assist rail accident victims and their families; authorizes a study of locomotive cab safety; establishes minimum training standards for railroad employees and contractors; prohibits railroads from denying medical treatment to employees; requires railroads to provide emergency breathing apparatus for crew on trains carrying TIH; requires FRA to study track inspection procedures and to regulate concrete rail ties; increases civil penalties for violations; increases the number of federal rail safety inspectors and their support staff to 200 over the next five years; requires railroads to maintain an inventory of bridges and tunnels and make certain information available to public inspectors; and reiterates the right of state governments to regulate rail-owned solid-waste transfer and processing facilities. Additionally, the Act authorizes the design and construction of a facility at the Transportation Technology Center in Pueblo, CO, to help test and evaluate underground station and tunnel safety and assist in emergency-responder training. Also included in the Act is the Passenger Rail Investment and Improvement Act of 2008, which reauthorizes Amtrak.

U.S. Congress, House of Representatives, Rail and Public Transportation Security Act of 2007, H.R. 1401, 110th Congress, 2007.

The Rail and Public Transportation Security Act of 2007 directs the Secretary of Homeland Security to develop and implement a plan entitled the National Strategy for Rail and Public Transportation Security. This legislation would require transportation providers to assess their vulnerability to terrorism and to implement a security plan that addresses security performance requirements and standards. DHS would be required to develop these requirements and standards. H.R. 1401 further requires the Secretary of Homeland Security to report to Congress on the feasibility of implementing name-based checks against terrorist watch lists for all Amtrak passengers. The bill also directs DHS and transportation providers to develop security and terrorism-response training programs for transportation workers. H.R. 1401 passed the House in March 2008 (299–124) and was referred to the Senate Committee on Commerce, Science, and Transportation.

U.S. Congress, Senate, Railroad Crossing and Hazardous Materials Transport Safety Act of 2007, S. 1438, 110th Congress, 2007.

The Railroad Crossing and Hazardous Materials Transport Safety Act of 2007 directs the Secretary of Transportation to maintain a national database of information on the safety of highway-rail grade crossings, investigate the cause of each fatal crossing accident, and prescribe regulations for improving crossing safety, maintenance, and surveillance. The bill further requires annual safety reviews by crossing inspectors and increases the civil penalties for crossing-safety-requirement violations. S. 1438 also increases civil penalties for violations of hazardous-materials transportation requirements and establishes strong penalties for a carrier whose negligence results in a hazardous-materials accident. The bill sets inspection requirements for tank cars carrying hazardous materials, directs FRA to double the number of hazardous-materials inspectors from 25 to 50, and requires the rail carriers to provide state homeland-security coordinators lists of all hazardous materials scheduled to be transported through a state, upon request. S. 1438 has been referred to the Senate Commerce, Science, and Transportation Committee.

California Legislature, Assembly, Local Community Rail Security Act of 2006, AB 3023, 2006.

The Local Community Rail Security Act of 2006 required railroads operating in California to meet new signage-system requirements, notify CPUC when new remote-control locomotives are used in the state, and to immediately notify the California Office of Emergency Services in the event of a rail accident. AB 3023 also required the railroads to develop, implement, and share with appropriate state officials an infrastructure-protection program to protect California rail infrastructure from acts of sabotage, terrorism, or other crimes. These risk assessments were to describe all rail facilities in the state and the types of cargo transported, with an emphasis on hazardous-materials transportation and storage. The railroads were further required to provide a description of security practices implemented to protect rail facilities and to specify employee training programs used. This “infrastructure protection program information” was to be kept confidential. The bill was passed (45–31) in August 2006 but the Class I railroads sued CPUC, arguing that most of the new requirements conflicted with and were preempted by federal law (see Settlement Agreement, below).

Union Pacific Railway Company and BNSF Railway Company v. California Public Utilities Commission, U.S District Court, Eastern District of California, Fresno Division, Stipulated Final Judgment, 2007.

This is a settlement agreement among UP, BNSF, and CPUC regarding the requirements of AB 3023, which passed and was signed into law in 2006. That legislation, described above, required the railroads to assess rail security risks and describe how they were mitigating them. The railroads argued that AB 3023 was preempted by existing U.S. law and settled their case with CPUC out of court (leaving the pertinent issue of establishing the legal authority for states to pass independent rail-security laws unsettled). CPUC agreed that the railroads' signage practices should be consistent throughout the United States, and the railroads agreed to notify CPUC whenever new remote-control locomotives came into use. The railroads and CPUC agreed that the railroads' continued compliance with federal security programs—the Hazardous Materials Transportation Act and the National Infrastructure Protection Program—constituted compliance with the risk-assessment and reporting requirements of AB 3023. The railroads agreed with CPUC to allow state officials to review railroad-security plans (although there is questionable language requiring those officials to meet certain federal security clearance and “need-to-know” requirements, which could pose problems in the future). The railroads also agreed to consider CPUC comments when updating their security plans, and the parties agreed that CPUC “will not order” the railroads to make specific changes to the security plans. The railroads and CPUC further agreed that CPUC could not require training programs unless the programs are approved by federal agencies.

Pennsylvania House Resolution 824

PRIOR PRINTER'S NOS. 4446, 4663

PRINTER'S NO. **4901**

THE GENERAL ASSEMBLY OF PENNSYLVANIA

HOUSE RESOLUTION

No. 824 Session of
2006

INTRODUCED BY GANNON, B. SMITH, PHILLIPS, CRAHALLA, DERMODY,
GEORGE, FREEMAN, WANSACZ, MUSTIO, PISTELLA, SATHER, JAMES,
SAYLOR, BEBKO-JONES, PETRONE, RAPP, SIPTROTH, FAIRCHILD,
SAINATO, CRUZ, BEYER, CAPPELLI, CLYMER, HESS, MAJOR,
READSHAW, VEON, TIGUE, SOLOBAY, COHEN, CALTAGIRONE, LEDERER,
LEACH, GOODMAN, ADOLPH, YUDICHAK, SONNEY, HERSHEY, BOYD,
PALLONE, MUNDY, FRANKEL, E. Z. TAYLOR, HARHAI AND GINGRICH,
JUNE 30, 2006

AS AMENDED, HOUSE OF REPRESENTATIVES, OCTOBER 24, 2006

A RESOLUTION

1 Directing the Legislative Budget and Finance Committee to
2 undertake a review of the existing Federal and State
3 statutory and regulatory authority as it relates to the
4 oversight of freight and passenger rail transportation
5 systems in this Commonwealth.

6 WHEREAS, The House of Representatives recognizes the need for
7 a safe and secure network of passenger and freight rail in this
8 Commonwealth and the need to prepare for, prevent and respond to
9 natural disasters, terrorist attacks or hazardous materials
10 incidents associated with our passenger and freight
11 transportation systems; and

12 WHEREAS, This Commonwealth's extensive rail transportation
13 infrastructure is essential to the flow of goods and people
14 across this Commonwealth and the nation, and interference with
15 that flow of commerce and people could have serious national
16 repercussions; and

1 WHEREAS, Pennsylvania's government is a leader among the
2 states in investing in railroad development; and

3 WHEREAS, The Commonwealth contributes to the economic
4 vitality of passenger and freight railroads through the Rail
5 Freight Assistance Program, and by providing funding through the
6 General Fund appropriation to the Department of Transportation,
7 grant assistance in the State capital budget and low-interest
8 loans through State infrastructure banks; and

9 WHEREAS, The residents of this Commonwealth depend on
10 railroads to deliver goods, provide employment, stimulate the
11 economy and provide a means of passenger transportation; and

12 WHEREAS, In the case of any disaster, attack or incident, the
13 prepared responsiveness of the transportation industry and its
14 employees will be of the utmost importance; and

15 WHEREAS, It is acknowledged that the freight and passenger
16 rail transportation systems and those industries utilizing
17 freight rail have worked and continue to work with the Federal
18 and State governments to enhance existing safety and security
19 measures and systems and continue to implement new procedures
20 and systems; and

<—

21 ~~WHEREAS, It is understood that the Commonwealth is federally~~
22 ~~preempted from taking actions that would interfere with certain~~
23 ~~activities of the rail transportation system and is preempted~~
24 ~~from interfering with the free flow of commerce; therefore be it~~
25 AND SYSTEMS; THEREFORE BE IT

<—

26 RESOLVED, That the House of Representatives direct the
27 Legislative Budget and Finance Committee to undertake a review
28 of the existing Federal and State statutory and regulatory
29 authority as it relates to the oversight of freight and
30 passenger rail transportation systems in this Commonwealth; and

1 be it further

2 RESOLVED, That, during the course of the review of relevant
3 Federal and State statutes and regulations, the Legislative
4 Budget and Finance Committee contact the appropriate Federal and
5 State agencies which have oversight for the safety and security
6 of passenger and freight rail; and be it further

7 RESOLVED, That the review include the following:

8 (1) The need, if any, to improve the security of rail
9 infrastructure and facilities, terminals, tunnels, rail
10 bridges, rail switching areas and other rail-related areas.

11 (2) The status of implementation of technology to reduce
12 the incidents of human error in rail accidents and
13 ~~derailments which have proven to be the largest cause of rail~~ <—
14 ~~accidents and derailments.~~ DERAILMENTS. <—

15 (3) Training of railroad employees in safety and
16 security measures;. <—

17 (4) THE CONTINUING SAFETY AND SECURITY OF CARGO IMPORTED <—
18 INTO AND THROUGH THIS COMMONWEALTH ON RAILROADS, INCLUDING
19 THE DISTRIBUTION CHAIN OF FREIGHT FROM PORTS TO TRUCKING TO
20 RAILROADS AND BACKUP SYSTEMS REQUIRED TO ENSURE THE SAFE
21 OPERATION OF CRITICAL ELEMENTS IN THE EVENT OF AN INCIDENT.

22 (5) THE TRAINING OF RAILROAD EMPLOYEES IN TERRORISM
23 RESPONSE ACTIVITIES.

24 (6) PASSENGER AND CARGO SECURITY PROTECTION SYSTEMS;
25 and be it further

26 RESOLVED, That the Legislative Budget and Finance Committee
27 make a report of its review to the Speaker of the House of
28 Representatives and to the Transportation Committee and the
29 Veterans Affairs and Emergency Preparedness Committee within two
30 years of the adoption of this resolution.

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