BASIC CHARACTERISTICS OF FREIGHT RAIL TRANSPORTATION IN THE UNITED STATES

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PREFACE

This report provides a preliminary assessment of the freight railroad system as a critical infrastructure of the United States, and describes the system's ability to continue to operate after accidents, natural disasters, actions caused by trespassers, and possible terrorist attacks.

This report was prepared with inputs from the Federal Railroad Administration, the knowledge and experience of the members of the Transportation Team of the President's Commission on Critical Infrastructure Protection (PCCIP), the American Association of Railroads, and several railroads that received the PCCIP team for visitations and discussions.

This report will be incorporated into the broader findings of the PCCIP, which will address critical infrastructure vulnerabilities, determination of critical infrastructures, and ultimately the nature of government-industry cooperation necessary to protect the nation's critical infrastructures.

This report is offered as a basis for further discussion and input from both government and the industry and should not be considered to be the final conclusions of the PCCIP, nor a basis for action.

EXECUTIVE SUMMARY

Executive Order (EO) 13010 signed on July 15, 1996, and titled "Critical Infrastructure Protection," states that "…certain national infrastructures are so vital that their incapacity or destruction would have a debilitating impact on the defense or economic security of the United States." The EO lists transportation as one of those critical infrastructures.

This report on the freight railroad segment of the transportation infrastructure provides a preliminary assessment of the nation's railroad system, describing its importance to the national security and economic well-being of the United States, and potential areas of vulnerability to disruption. The report concludes that any significant disruption of the railroad freight service would have serious, national-level impact, and thus suggests that the freight railroad system is a critical infrastructure of the United States.

Passenger transportation and the other modes of transportation will be addressed in later reports.

The freight railroad industry consists of nine very large railroads (perhaps eight if the CSX-Conrail merger is approved), thirty-two smaller ones, and four hundred and eight-seven short line railroads. The industry carries about 40 percent of the ton-miles of freight moved in the United States over about 123,000 miles of track owned, built, and maintained by the railroad companies. Many industries could not continue to operate if they were deprived of rail service. Thus, freight rail transportation is one of the essential infrastructures. The importance of the railroad industry is recognized by the National Railway Labor Act that provides for immediate intervention by government to prevent a walk-out or a lock-out that would interrupt rail transportation if labor and management fail to reach agreement on a new contract. The Act sets up procedures to arrive at a basis for settlement of disagreements while the railroads continue to operate.

Operators of freight railroads have had 170 years of experience in dealing with accidents. trespassers, and natural disasters. After partial deregulation in 1980, railroads have decreased rates, increased investment in track and equipment, and become profitable. The industry is in the best physical shape in its history.

- Since the industry has an ever-improving safety record, accidents represent a smaller problem than they did three or four decades ago.
- The response to recent natural disasters , particularly flooding, has been very effective.

- The railroads have long been confronted by the need to control trespass on their property. Railroad police have the power to arrest in any jurisdiction in which the employing railroad owns property. These forces have played an important role in providing for the physical security of the industry and the control of trespassing by their own actions and by cooperation with local police forces.

The railroad industry has a proven track record of ensuring continuity of service under the worst of conditions. Further consideration or action by the PCCIP to address shortfalls or vulnerabilities in the areas of accidents, trespassers, or natural disasters appears unnecessary.

However, the EO tasked the PCCIP to also address concerns that critical infrastructures could be disrupted by terrorist or cyber attacks. These concerns raise new issues for the railroad industry beyond those addressed by historical precedents.

In the past, when industrial strife affecting the railroads' customers threatened violence, the industry took special measures to keep critical structures under surveillance. Since the Oklahoma City bombing, most of the industry took decisive steps to increase physical security by restricting access to, and hardening critical facilities, and where thought necessary, providing back-up systems. These redundant and back-up facilities and systems are intended to ensure that central data resources and computer and communication facilities can be restored to operation quickly if the primary facility is damaged or destroyed.

The industry is generally aware of the potential for cyber threats, with the greatest threat considered to be the insider. Extremely limited data is available on the number or extent of intrusions into railroad database or communication systems. Of the railroads visited, none reported damage by viruses or malicious tampering by unauthorized individuals penetrating the system. Several of the railroads are increasing their protective measures by increasing system security staffs and using consultants to evaluate and test their systems. However, the industry, having no documented experience with cyber attacks, nor with a clearly defined threat, at times has difficulty justifying the expenditures necessary to protect vital systems.

Since the threats of concern to the PCCIP are different from those faced until now by the railroads, government-industry partnerships will be more effective than efforts to control and prevent disruption of critical services either by industry or government acting alone. These partnerships could have access to the experience of the railroads in responding to accidents, trespassers, and natural disasters, and draw on threat information gathered by the law enforcement and intelligence communities. Agencies concerned with the security of major networks and databases systems could share information not only on protective measures, but also on threats and vulnerabilities. The form of such public-private partnerships will be explored as the PCCIP and the industry continue their studies on critical infrastructure protection.

The centralization of dispatching and database functions, and the open and apparently unprotected nature of the railroads' physical plant, suggests the railroads may be vulnerable to attack. Industry understands these vulnerabilities and has taken steps to harden these sites against physical threats. However, the effectiveness of information and communications system security varies with the level of expertise of information technology managers and the willingness of management to invest funds based on the level of perceived threat. These partnerships would facilitate information sharing and potentially address, from an industry-wide perspective, possible vulnerabilities of critical parts of the essential freight railroad infrastructure to terrorist or cyber attacks.

One of the special issues these government-industry partnerships would have to consider is the responsibility of paying for a higher level of protection than is required for normal business reasons. This higher level of protection would be considered in order to protect the essential freight railroad infrastructure against terrorist attacks that are intended to affect the defense and the economy of the United States. These attacks could have an intensity and a sophistication that would not be expected from casual hackers or from commercial competitors.

The railroad industry is dependent on many other infrastructures. Railroads require reliable and stable electric power for signal systems, grade crossing protective systems, tools in machine shops, and computers and communication systems. The railroads depend on a steady flow of fuel for their locomotives. The public network carries a critical part of the railroads' communication and database systems. Accurate and timely weather forecasts are required for system-wide planning for effective equipment dispatch and utilization. The railroads depend on the commercial banking systems for their financial transactions. The railroads are becoming increasingly dependent on the internet and electronic data interchange for their business transactions. The railroad infrastructure is not self-sufficient; it is interdependent on many parts of the national infrastructure.

MISSION

Presidential Decision Directive (PDD) 39 on Counterterrorism was signed on June 21, 1995. It states the following: "…The United States shall reduce its vulnerabilities to terrorism at home and abroad."

"…The Secretary of "Transportation shall reduce vulnerabilities affecting security of all airports in the U.S. and all aircraft and passengers and all maritime shipping under U.S. flag or registration or operating within the territory of the United States and shall coordinate security measures for rail, highway, mass transit, and pipeline facilities…"

"…The Secretaries of States, Defense, Treasury, Energy, and Transportation, the Attorney General, the Director of Central Intelligence, and the Director, FBI, shall ensure that their organizations' counterterrorism capabilities within their present areas of responsibility are well managed, funded, and exercised."

PDD-39 also directed the Attorney General to "…chair a Cabinet Committee to review the vulnerability to terrorism of ... critical national infrastructure and make recommendations to [the President] and the appropriate Cabinet member or Agency head."

Executive Order (EO) 13010 signed on July 15, 1996 titled "Critical Infrastructure Protection" states that "…certain national infrastructures are so vital that their incapacity or destruction would have a debilitating impact on the defense or economic security of the United States." Transportation is one of these critical infrastructures. The Executive Order states further: "Because many of these critical infrastructures are owned and operated by the private sector, it is essential that the government and private sector work together to develop a strategy for protecting them and assuring their continued operation."

THE IMPORTANCE OF THE TRANSPORTATION INFRASTRUCTURE

Transportation is a national infrastructure that is vital to the continued security and economic growth of the United States. Public and private expenditures on transportation represent at least 17 percent of the GNP. Transportation makes it possible for materials to be moved to processing centers, for finished products to be moved to market, for commodities essential to transportation and to production and marketing to be distributed as necessary, and for the population to move to and from work and other commercial activities. Transportation also supports the activities of the Department of Defense and other governmental functions. It provides our citizens and residents a freedom of movement that is essential to the quality of life established in the United States. Accordingly, interruption of the domestic and international transportation systems that serve the United States would have a profound impact on the security and economic status of the country.

THE RECENT HISTORY OF THE RAILROAD INDUSTRY IN THE UNITED STATES

Until the end of World War II, the majority of inter-city passenger and freight transportation was provided by railroads. Freight service was provided on a competitive basis under Interstate Commerce Commission (ICC) regulation of rates and conditions. While there were many individual railroads, they were interconnected and, through extensive inter-company activities, their equipment was interoperable. More than half of all shipments moved on more than one railroad. This interchange created a national system with much competition between the companies to originate the loads. In addition, each railroad was franchised to provide specific passenger service over that railroad. However, interchange was not practiced with respect to passenger services. Therefore, rail passengers had to move from the equipment of one railroad to another for longer trips that could not be completed on the tracks owned by one company.

Although the railroad industry concentrated on competition between railroads, the growth of the highway system and the improvements in motor vehicles made truck competition more and more important. Shippers found that their high-valued goods could be moved more effectively by truck. This competition for freight business began to reduce rail freight business.

After World War II, when airplanes of sufficient size, speed, and range became available, commercial air transport was introduced. The speed and convenience of air travel quickly attracted business travelers. With the growth of personal income after World War II, personal automobile ownership and driver registration grew rapidly, and personal or family transportation by rail was dramatically reduced. The cities and states developed improved roads. The Federal government through the Bureau of Public Roads worked with the states to create an extensive network of high speed and safe inter-city roads.

The completion of parts of the interstate highway system increased the ability of the trucking industry to provide effective long distance service. At the same time, the railroads were losing increasing amounts of money on passenger service. As a result, the railroad industry faced very serious economic challenges. Since it was economically regulated, it could not increase its freight rates rapidly to meet inflation which reached 16 percent per year. Since it operated with labor agreements that were negotiated in earlier years when the technology of equipment and operations were much more labor-intensive and these labor agreements were difficult to change, it was not able to reduce its costs very rapidly. It moved toward being more efficient without sufficient understanding of the unintended consequences of the decisions to increase car and train sizes and weights.

In order to respond to these problems, two congressional actions were taken. One transferred all inter-city rail passenger service to the National Railroad Passenger Corporation (AMTRAK), and the other provided partial freedom from economic regulation. At about the same time, an enhanced research program sponsored by the industry began to provide a comprehensive scientific basis for the technical decisions made by the industry. The combination of these three circumstances made it possible for the railroads to adjust rates, reduce costs, and improve the effectiveness of their service.

At the present time, the railroad system in the United States is financially healthy. It earns profits and pays taxes. Its track structure is in the best condition ever. It is competing effectively for many commodities and services.

RAIL PASSENGER SERVICES

While there is a national network of passenger services operated by AMTRAK over the freight railroad lines by contractual agreement and in the Northeast Corridor over its own lines, AMTRAK only moves about one percent of inter-city passengers. However, in the Northeast Corridor, AMTRAK does provide about 40 percent of the business passenger travel in the corridor between Washington, D.C., and Boston. Interruption of that service and its replacement by air travel could present problems because the air corridor is already crowded. This may be a regional, not a national issue. It will be considered later when the air transportation and other passenger issues are discussed.

There are commuter passenger services provided on freight railroad lines in many cities, particularly New York, Chicago, the metropolitan area of Washington, D.C., and Boston. Interruption of rail commuter service would require transfer of those passengers to other rail services and to the highways which are already congested. This would create local and regional problems.

There are light and heavy rail services provided in those metropolitan areas served by subways or other rail services operated by mass transit operators. Interference with these rail services would require moving those passengers on the congested highway networks and would create local problems. This will be considered later when highway transportation issues are considered.

If all of the commuter rail and metropolitan area light and heavy rail services were stopped, the congestion could create a national problem. However, the resources required to destroy track or equipment, to damage the signal and dispatching systems, and otherwise to block services in the 50 or more congested metropolitan areas in the United States would go beyond what appears to be a reasonable threat.

On this basis, the balance of this report addresses freight rail transportation.

THE FREIGHT RAILROAD INDUSTRY

The freight rail transportation system consists of those private corporations that own, build, and maintain the rail infrastructure; the related supply and support industries; the government agencies that regulate rail transportation; and the public and quasi-private institutions that operate passenger service on the rail network that is now operated primarily for the movement of freight.

In the United States, there are 9 Class I railroads each with annual revenue of over $260 million per year that operate over an interconnected network of about 123,000 miles of track. In total, they operate about 18,000 locomotives and pull about 1,200,000 freight cars of various characteristics. They transport about 40 percent of the ton-miles of freight moved in the United States - primarily bulk commodities and trailers and containers.

There are 32 Class 2 (regional) railroads. Each has annual revenue between $20 and $260 million and operates over a minimum of 350 miles of track.

There are 487 short line railroads. Each has annual revenue of less that $20 million and operates less than 350 miles of track but does originate or deliver some traffic and therefore, is not just a switching railroad.

All track owned and operated by the three classes of railroads is built and maintained to a standard gauge and to dimensional standards of gauge and cross level in accordance with Federal Railroad Administration regulations.

Cars operated in interchange in the railroad system must be manufactured to Association of American Railroads (AAR) specifications. They must have an assigned car number that is stored by the AAR along with the characteristics of the car.

THE ASSOCIATION OF AMERICAN RAILROADS

In order to facilitate those aspects of the railroad industry dependent on very close working relationships, the companies in the industry established a number of joint bodies which in the 1930's were consolidated into the Association of American Railroads (AAR). The Board of AAR consists of the CEO's of the Class I Railroads. Its committees address those aspects of the industry that require joint oversight such as interchange agreements; other agreements essential to smooth operation of this interconnected transportation service; specifications for equipment for the industry; pre-competitive research supporting the safety and efficiency objectives of the industry; joint legal and economic concerns; and activities where joint processing of data is to mutual advantage without compromising the independent competitive posture of each company.

TRAIN DISPATCHING AND OPERATIONS

The unique aspect of the rail system is that every movement of a train on the system is tightly controlled. No train can enter the system from a switching yard or a siding without an "authority." This authority can be granted by a written train order, by a telephone or radioed train order, or by turning the red signal that blocks the train from entering the system to green. The locomotive engineer acknowledges the "authority" by voice radio.

In order to increase the efficiency of operations, the largest railroads have established centralized dispatching centers that assure all trains in the system operate efficiently. The dispatching center and the related customer service center receive orders for transportation, assign cars, establish the basis for assembling them into trains, allocate sufficient locomotive power to each train to assure its operation at scheduled speeds, assign crews to the train, and authorize the train to enter the railroad system.

When the train has been authorized to enter the system, it moves along the track in accordance with written instructions and under the control of signs and signals along the track. If there is maintenance work or a problem that has weakened the track, a "slow order" may be issued. Most of the traffic now moves in sections of track divided into blocks. These blocks are spaced by a distance that is established by the stopping distance of the longest and heaviest train. If the train has a green signal, it can operate at the maximum speed authorized for that equipment on that section of the track. If the train enters a block with a yellow signal, the train must be prepared to stop at the end of the block. If the signal is red, the train must not enter the block protected by the red signal. If the signal is red, the next block is occupied. If the signal is yellow, the next block is open but the succeeding block is occupied. If the signal is green, the next two blocks are open.

The signals are also affected by a break in the rail. The signals in a block constitute a circuit with a low voltage current in the rail that is shorted at the beginning and end of a block. If the block is shorted by a train, the signal is red. If there is a break in the rail, the signal is also red. If there is a failure of current, the signal system is fail-safe and turns to red through the action of vital relays.

This system provides the railroad engineers with solid knowledge about the conditions of the railroad and has led to very safe operations.

A newer system is being studied in order to increase the efficiency of railroad operations. Since the block spacing is based on the train that is hardest to stop and most trains can stop in a shorter distance, there is some loss of track capacity. It would be advantageous to have the trains spaced only by the stopping distance of the following train. That requires that the following train have a positive indication of the actions of the leading train. Positive Train Separation (PTS) is such a system. On-board computers calculate the stopping distance of the train based on those characteristics of the cars in the train. On-board communication systems establish the position of the train ahead and the following train. The engineer is advised, or an automatic system comes into play, when the distance between the trains is at the stopping distance of the following train.

As indicated earlier in this section of the report, the trains are dispatched and kept on the right track by action of dispatchers. The dispatching center and the crew-calling center assure that crews with permitted hours of service are available to operate trains when the trains must operate. In modern dispatching centers, the position of every train is shown. The size of the centers can be imagined for a railroad that has 15,000 miles of track with hundreds of trains in motion on the line or in switchyards or sidings. In summary, the dispatching center sends commands to operate the signals to authorize a train to enter the system. The train then comes under the control of the automatic block system. The dispatching center aligns switches remotely to move the train on the correct route. It allows for efficient use of a single track line with trains moving in opposite directions by putting trains in sidings in a timely fashion to allow for the movement of opposing traffic on the main line; and then, by turning a red signal to green, allowing the train in the siding to re-enter the main line when it is safe to do so.

THE MAKE-UP AND SWITCHING OF TRAINS

Since produce is loaded into cars and the cars are made up into trains going generally the same direction but not to the same destination, the railroads must stop and disassemble trains, and then assign cars to a new train going to in the direction of their final destination or to that destination. Switching is often done in a "hump" yard. The train is pushed to the "hump," the cars are disconnected at the hump, and roll by gravity to switching points where they are directed to the track on which a train is being assembled that is going in either their direction or their final destination. It is essential to keep accurate records on the destination of the cars and on the location of the car in the train to facilitate this "humping" activity. Since interchange began, each car was required to have a number that could be recorded and the cars in the train and their numbers in sequence made up the "consist." Now, the car also has a machine-readable "label." As the car passes a scanner, the scanner automatically prints out a consist list which is accurate provided that the label is on the car and readable. If it is absent, a photograph can be taken of the car to record the number that can be read on a video screen and used to establish the true consist.

THE ROLE OF GOVERNMENT IN RAILROAD TRANSPORTATION

The Federal Railroad Administration (FRA) was established in 1967 to assure that the newly created Department of Transportation would include agencies addressing all of the modes of transportation. Until that time, railroad issues of concern to the Federal government were addressed by the U.S. Department of Commerce.

In addition, the Interstate Commerce Commission (ICC) continued its responsibilities for regulation of the railroad industry. All rate changes had to be submitted for approval to the ICC with suitable and extensive justification.

When FRA was formed, other agencies of the Federal Government continued to deal with railroad matters, such as the Railroad Retirement Board, established long before the Social Security Administration. In addition, there is legislation that creates special handling of claims for damages by railroad employees. The Railway Labor Act recognizes the critical importance of railroad transportation services by providing emergency measures that come into play if a general strike is called. These measures mandate return of employees to work while disputes not resolved during collective bargaining negotiations are settled by agreement or legislation.

Of these agencies, only the Federal Railroad Administration is concerned with issues being addressed by the PCCIP.

The FRA issues and enforces safety regulations. It establishes the conditions of track that must be achieved before trains can operate at specific speeds. It establishes the criteria that must be met for equipment that operates on the railroads and assures compliance with those standards. It enforces the Power Brake Law. It studies signaling practices. It reviews the response of the industry to natural disasters. It conducts a small amount of research to assure that it is privy to those advanced technologies germane to its mission.

FRA safety regulations require the railroads to report all train accidents involving costs above a minimum threshold level or involving personnel injuries or fatalities and all train incidents involving personnel injuries or fatalities.

The FRA has no current security-related mandates. Security related incidents would be handled through existing emergency response and notification procedures.

The FRA maintains a relationship with the Police Committee of the Association of American Railroads (AAR) which comprises the chiefs of police for the Class I railroads, previously defined.

THE IMPACT ON THE ECONOMY IN CASE OF THE TOTAL LOSS OF RAIL SERVICE

The Federal Railroad Administration evaluated the impact on the U.S. economy of a prolonged event that would shut down the railroad system. Despite the availability of alternate transportation in the form of added barge and truck travel, many industries would have been forced to close because they could not receive required materials for operation or they could not ship their products.

- The automotive industry could not operate for more than a week or two without railroad services.
- Important segments of the paper industry would begin to shut down within a week of cessation of rail services.
- The coal mining industry would come to halt within about two weeks of a major interruption in rail service.
- The generation of power is less dependent on coal, but in a month or two, there could be serious shortages of fuel that would reduce the availability of electric power.
- Many lumber producers would shut down within weeks of the loss of rail transportation.

- The plastics industry would shut down in three or four days after the stoppage of rail services.
- The shipment of industrial inorganic chemicals and agricultural chemicals would be crippled by the loss of rail transportation.
- Glass manufacturing would be seriously affected by an interruption in rail movements of essential raw materials.
- There would be a significant impact on the food and the agricultural industries if there were a loss of transportation by rail.
- A large fraction of aggregate shipment is by rail. While trucks can also move the products, there is not much over capacity in truck transportation.
- Just-in-time inter-modal services including those bringing foreign goods to plants or to market would be very difficult to maintain if there were no double-stack container service.

Over the short haul, alternate modes could make up for some of these shortages. However, the fuel efficiency of the railroads is considered to be three or four times that of trucks. Thus, the demand for and the price of diesel fuels could increase. The highways are already crowded to the point of congestion in the fifty largest metropolitan areas. Adding trucks to the highways would have an impact on safety and on congestion. Thus, it can be seen that the rail system is a critical infrastructure that would be very difficult to replace.

THE RAILROAD POLICE FORCES

Physical security of U.S. railroads is provided through their in-house police forces. These forces include about 2,800 officers. They are commissioned in the state of their primary employment and are trained and licensed in the same manner as other state-certified peace officers. The FRA published a final rule in February, 1994, authorizing a railroad employee who is commissioned as a railroad police officer by any state to enforce the laws of all states in which the officer's employer owns property. The railroad police maintain a working relationship with other law enforcement agencies including the FBI, DEA, and INTERPOL.

DISRUPTION OF THE PHYSICAL FACILITIES OF THE RAIL SYSTEM

Despite the existence of railroad police, the railroad system is so extensive that it cannot be supervised in detail. Much of the track goes through remote areas that are not subject to regular inspection except by passing trains or by inspection cars and work crews with explicit assignments. Switches in the field are locked to prevent unauthorized activation, but, as a recent case of vandalism indicates, the lock can be broken and a switch thrown in such a fashion as to derail a train or cause a collision.

Properly informed personnel can remove joint bars holding two lengths of rail together. By reconnecting the track circuits, the break is not detected, and a train can derail at the weakened joint. But this kind of damage is local and does not incapacitate the system except on that line and only until the derailment can be picked up and the track repaired and returned to service.

There are many bridges and tunnels on the railroad that are not protected. In areas where rock slides are prevalent, the railroad provides warning systems that activate the signal system and deny access of a train to an area in which a slide has been detected as occurring until the track can be inspected and any debris removed.

Railroads have a long history of cooperation in the case of response to natural disasters. Since equipment is interoperable, the locomotives and cars of one railroad can operate on lines owned by another. Despite the fact that they compete for business, they have basic agreements to provide trackage rights to other railroads in case of natural disaster. While this may lead to longer routes at higher cost, essential service can be continued in the face of major disruptions to the infrastructure.

CAUSES OF INTERRUPTION OF TRAIN SERVICE

TRAIN ACCIDENTS

Equipment failures leading to accidents and disruptions of service have occurred over the years in the railroad system. In early years, boilers blew up, rails cracked, bridges collapsed, braking systems

failed, etc. One by one, the railroad industry, with inputs from its suppliers, solved these problems. When the problems were acute, the government sought and was granted authority to issue safety regulations. Compliance was assured by inspection.

In more recent years, other classes of failures have led to accidents and delays. In simple derailments, tank cars have ruptured violently and required evacuations. Dynamic interaction of the train with the track structure has led to derailments. Bearings have overheated. Wheels and rails have failed. But each of these causes has been studied and major improvements instituted. The results have been a significant reduction in accidents in recent years.

GRADE CROSSING ACCIDENTS

Railroads pre-dated most highway crossings. When it was necessary for a highway to cross the rails, everyone understood that the train would not stop at the crossing because it took so long to stop and then to re-accelerate. The train service schedules could not be maintained if the train had to stop at the grade crossings. The train would sound its whistle. At night, it would have a headlamp illuminated. The passing vehicle was instructed by a Cross Buck to: Stop, Look, and Listen!

Over time, highway intersections became far more important to the highway traveler. A different system was introduced at these intersections. Stop signs were introduced. Motorists who failed to stop were in violation.

As more traffic developed on the highway system, automatic signals were installed at high density highway intersections and flashing lights and gates were installed on very high density grade crossings. There was active law enforcement of highway signal violations. There was no enforcement of grade crossing signal violations.

When train speeds reach 125 mph, no grade crossings are permitted.

At gate-protected crossings, some motorists appear to regard them as a challenge because they drive around the gates and try to beat the train. They were not always successful. Grade crossing accidents constitute the cause of the largest loss of life associated with railroad operations. In order to address this problem, a program called Operation Lifesaver has been established. This program provides for public education concerning the risks of failure to obey the grade crossing warning systems. It has contributed to some reduction in accidents. It represents an example of a successful public-private partnership.

NATURAL DISASTERS

LANDSLIDES

In the case of landslides, in extreme cases, it has been necessary to relocate the track and build necessary tunnels and new track to reestablish the continuity of the line. In the interim, by joint trackage agreements, railroads operate on track owned by other railroads and provide continued service to customers. As the railroads increase in size, there are parallel routes on the same railroad that permit continued service with some delays and at higher costs.

FLOODS

The alignment of most railroads was established long before heavy earth moving equipment was available. Therefore rail lines traversed the flood plains of many rivers including the Mississippi and the Missouri. In the times of great floods such as in 1994 and 1996, there were as many as 40 washouts in a 135-mile line. The railroads were able to fill those washouts with tens of thousands of cubic yards of fill, add ballast, lay ties and track, and begin operation in a matter of weeks. Meanwhile, essential services continued on alternate routes through joint trackage agreements.

RESPONSE TO PUBLIC PROTESTS

During the 1970's and 80's, there were public protests about hazardous materials (HAZMAT) and nuclear materials. When protesters learned of the routes of trains carrying those products, they attempted to block the trains. Through the input from the intelligence community, sufficient advance information was available that protective measures could be taken or alternate routes used.

VANDALISM

It has been shown that vandalism can lead to incidents such as derailments. Failure to operate other systems correctly can lead to such problems as the impact of a barge on a bridge sufficient to misalign the track but not sufficient to break the track and activate the protective signal system.

POSSIBLE VULNERABILITY OF VITAL STRUCTURES

It is clear that certain structures are vital to the network including large bridges over major waterways such as the Mississippi.

It is evident that removal from service of major railroad dispatching centers as a result of physical destruction or successful cyber attack would have a significant impact on the efficiency of operations.

ACTIONS TO ANTICIPATE NATURAL DISASTERS

The railroad industry is aware of the need to anticipate natural disasters.

Some of its western lines traverse dry water courses that can flood quickly when rail falls in the adjacent hills. The railroads contract with ranchers to notify them of local rains in the hills in order that they can be prepared to respond to flash floods that may come three days later.

In the northeastern part of the United States, there are old culverts. The railroads are aware that in flood season, beaver dams upstream can be destroyed, and the debris can block the culvert. The railroads have regular programs to remove the beaver dams in the range of potential damage to avoid this problem.

THE RAILROAD SUPPLY INDUSTRY

Many of the products used by the railroad industry are available from the general market. However, there are some products unique to the railroads that are made by a supply industry dedicated to serve the railroad market. These include:

ROLLING STOCK AND INSPECTION EQUIPMENT

- Locomotives and freight cars.
- Wheels, axles, roller bearings, couplers, etc.
- Required hot box detectors, etc.

TRACK AND TRACK MAINTENANCE

- Rail, ties, fasteners, track lubricators, ballast. etc.
- Specialized track maintenance equipment
- Tampers and stabilizers
- Rail grinding equipment
- Rail flaw detection equipment
- Track geometry cars

While there are multiple suppliers of these kinds of equipment, in some cases there are only two and the capacity of one supplier would probably not fill the needs of the industry for very long. The railroad industry does not keep large inventories of equipment or components. Accordingly, orders are placed with only limited lead times.

It does not appear that cyber threats are important to the railroad supply industry except as they affect its internal ability to design and analyze and as they affect its external communications with the balance of industry. The supply plants are large industrial enterprises. They are subject to physical attacks.

A concerted effort to cripple the railroad supply industry would require a major well-planned campaign. Concealment of the plans for such a large effort should be difficult. Therefore, the role of the intelligence community in alerting the railroad supply segment of the industry to potential threats would be very important.

SUMMARY OF PHYSICAL THREATS

It is clear that there can be many minor incidents created on a railroad system that can interrupt traffic. However, the experience of the industry indicates that it can respond quickly to physical disruption to the system (except in case of loss of a major structure such as a large bridge) and continue service on alternate lines while reconstructing the damage area quickly and efficiently. The extent of damage already experienced by the railroad industry during some major natural disasters is probably as great or greater than that to be expected from a terrorist attack. Since the railroads have continued service during disasters and have rapidly restored service on the damaged parts of the system, the same response should be expected in the case of terrorist attacks.

It would take simultaneous attack on a very large number of sections of track or a smaller number of switching yards to have a major impact on rail service.

There is a notable exception. A determined physical attack on a small number of major facilities such as bridges or central dispatching centers could lead to their destruction and delays before they could be replaced. No natural disasters have involved such major losses. It may become necessary to monitor the potential for attacks and, in extreme cases, to station official guards at those exceptionally vulnerable and important sites to try to prevent attacks. Railroads already have backup plans in case of temporary loss of dispatching centers.

SPECIAL ASPECTS OF PHYSICAL THREATS

If frequent random attacks were made on the physical infrastructure that required the institution of physical inspection on a daily basis by high rail cars before trains were allowed on the track, there would be a major impact on productivity. Thus, a campaign to disrupt service might not have to inflict major damage, but only damage frequently enough to require new practices that led to significant delays.

CYBER VULNERABILITIES

During natural disasters, the signal system is also affected. Loss of power renders the signal system inoperable because it depends on power to light the signal lights, operate the power switches, and support other signal components that indicate the presence of a train or a break in the rail.

The response to the loss of the signal system requires restoration of power and checking of the signal system to detect any other requirement for maintenance.

If communication-dependent signal systems such as Positive Train Separation (PTS) replace the current conventional automatic block systems, they would require continuous operation of such a location system as the Global Positioning System (GPS) and a highly reliable radio frequency (RF) communication system between the trains and wayside. They would also depend on reliable computer services. Thus, hackers could plant viruses to destroy programs. Terrorist attacks could reduce the number of operational satellites or the integrity of RF communications by appropriate jamming technology. Thus, the PTS system may be more subject to cyber threats than the existing system.

Another aspect of more advanced railroad operations is their dependence on major dispatching centers. If terrorist attacks destroyed the programming and the communications capabilities of these centers, the railroad would have to revert to a simpler operating system unless it had a backup computer and communications system ready to be activated on short notice. Of course, it would be essential to preserve the staff of that center to operate the backup system. If the staff that made these simpler systems work were incapacitated, it would take longer to restore effective dispatching and operational control. If there were successful attacks on several centers, simultaneously, the entire railroad system could be affected. Extensive traffic delays would be expected until alternate systems were up and running or the primary systems were restored to service.

Other centralized functions create some potentially vulnerable sites. The AAR operates a wholly-owned subsidiary known as "Rail Inc", which provides a number of essential services. It supports interline railroad settlements, the Universal Machine Language Equipment Register (UMLER), inter-railroad car repair billing services, and one-point-of-contact for shippers to trace the movement of a car through the railroad system.

Interline settlements relate to the fact that more than half of the shipments move on more than one railroad, and the revenue must be divided appropriately.

UMLER contains a file of each car in the system that is interchanged with its physical characteristics. Thus, if the car numbers in a consist are known, it is possible to calculate the train length and other train characteristics. The file in UMLER assures that new cars coming into interchange service comply with interchange requirements. Railroads use UMLER very frequently. Loss of the integrity of the system would make for some potentially serious problems. Individual railroads maintain an UMLER file that satisfies their needs and reduces their dependence on the AAR.

The car repair billing service receives charges from each railroad for repairs down to cars owned by other railroads. This service balances the charges and submits an adjusted bill to each railroad, thus saving a major accounting headache. If UMLER or the car repair billing communication system were disrupted, it would confuse the system by making it difficult to reconcile accounts between railroads for repairs and adjustments.

If shippers could not trace the movement of a car through AAR, they go to each railroad to get information on a car. Since more than half of all shipments move on more than one railroad, the shippers have set up more complicated systems to track the car because cyber disruption of these systems could affect just-in-time services to the detriment of the economy.

IMPORTANCE OF COMMUNICATIONS FOR EMERGENCY RESPONSE TO HAZMAT INCIDENTS

In case of derailment and spill or leak of HAZMAT, immediate emergency response is required. In-house ability for the railroad to respond ranges from full-time HAZMAT response capabilities, with full database information and responders, to basic information about the correct response procedures. Shippers must be notified of a spill. If a company needs additional information about the correct emergency response, that data can be obtained from Chemtrek, a service provided by the Chemical Manufacturers Association (CMA). Loss of communications would make it impossible to follow these procedures and to have the advantage of Chemtrek advice on the correct handling of a HAZMAT spill.

In case of a derailment of a car carrying nuclear materials, no action to clean up the derailment or restore service on the line can be taken unless DOE certifies that there has been no leak of nuclear materials or no loss of shielding integrity and therefore that the radiation from the nuclear materials is contained. Immediate communications are necessary with the DOE to arrange for inspection and clearance to restore the line to service. Until these communications are available and the certification has been made, no action can be taken to restore the line to service.

IMPORTANCE OF THE INTEGRITY OF DATA TO RAILROAD OPERATIONS

If there were a series of random attacks on the development of good consist data that affected the Automatic Equipment Identification system or the back up systems associated with that system, they could lead to a requirement for clerical checking of every consist. This would reduce service and increase potential hand entry errors that would further delay humping operations.

SUMMARY OF CYBER THREATS

Cyber threats are real but railroad executives, aware of the problem, have instituted measures to protect their operating centers. They also are instituting competent back-up systems that could allow for rapid reinstallation of operating systems and databases, and have outlined strategies to assure early restoration of service after a successful attack. The full consequences of cyber threats have not been fully analyzed. However, cyber threats are real, and careful study is necessary to assure that all prudent measures have been taken to protect the integrity of those essential elements of railroad operations that are subject to cyber attack.

The possibility of random but frequent threats that interfered with the integrity of data could have a major impact on the efficiency of the railroad system.

THE DIFFERENCES BETWEEN THE OLD THREATS AND THE NEW ONES

The railroad industry has long faced problems that affected its service. As noted above, these include accidents arising from equipment and track failures, accidents resulting from human failures, incidents caused by natural disasters that destroyed facilities, disruption of facilities as a result of trespassing and vandalism, and interference with services caused by protesters. It has learned how to respond to these problems. All of them create problems in dealing with shippers. The railroads work very hard to assure that their services are of such uniform high quality that shippers will continue to do business with them.

One of the most difficult accidents to deal with is that occurring at grade crossings. Here, the railroad interacts with the highway system and with drivers who are not disciplined in the way that locomotive engineers are. This solution of this problem requires much more government-industry interaction than other kinds of accident and natural disaster problems that the railroads confront.

The new threats to the infrastructure that led to the establishment of the PCCIP are problems that the railroad industry can address to some extent within its own resources. It can harden its facilities. It can increase its ability to resist penetration of its cyber systems by hackers and others. However, since these threats constitute an organized and purposeful intent to do harm, they do not fall easily within threats that the industry alone can address.

Coping with these threats requires some careful consideration of their nature and extent. A joint study by those in industry who face the threat and those in government who have intelligence sources tracking threats as well as those in government who also have faced these kinds of threats could increase the basis on which to develop responsive programs.

Some of these resources are not available to industry. By law, they cannot engage in the kinds of intelligence necessary to identify the potential of the threat. While they can retain consultants to deal with hardening of their systems, many government agencies have been addressing this problem for a long time because they constitute an obvious target for such threats.

Since unique talents relating to these new threats reside in government and since the railroad industry has demonstrated its capability to respond to many kinds of incidents and threats that have affected service, it should be possible to join forces and address both national and corporate concerns. This appears to create a new opportunity for special institutions that preserve the best of the past and bring the best resources of the country to bear on these new threats before they begin to have a crippling impact on the corporate and national economies.

COST OF ADDED PROTECTION

The freight railroad industry is highly competitive. It has sensitive relationships with its customers. It recognizes that when it is necessary to reduce staff, it can face reprisals from disgruntled former employees. For all of these reasons, the railroads are committed to uninterrupted service. Major facilities are hardened against natural disasters and casual intrusion or vandalism. While there can be small acts of vandalism, to date they have caused no more problems than a derailment or a delay in service. The establishment of greater control over entry to railroad facilities reflects the concern of the industry for damaging acts. The adoption of increasingly more complex cyber protection has worked toward the same objective. Firewalls are established. Password access is rigidly controlled. Complex

and multi-based programming has been adopted to thwart attempts at penetration of databases and operating programs. These are paid for as a cost of doing business.

The issue of physical and cyber threats from terrorists is a different matter. With substantial resources and long-term planning, a terrorist could find weaknesses in the present system that could be removed by sufficient investment. However, the threat is not against the railroad per se but against the railroad in the hopes that the damage will affect the economy or security of the country. Therefore, protection against these threats is a public not a narrow commercial concern. It will be necessary to determine how to pay for these added costs necessary for protection against terrorist attacks.

INTERDEPENDENCE

The railroad system is highly dependent on the commercial network of communication services. It may become dependent on a very reliable Global Positioning System (GPS). It requires high quality diesel fuel. It is also dependent on the continued availability of high quality electrical services to power its signals, its switches, its maintenance shops, its computer centers, etc. While some of these have short-term back-up systems, not all of them can reasonably be provided with emergency power. Therefore, continuity of service from other critical infrastructures essential to the continued operation of the railroad system needs to be considered and addressed.

FINDINGS

- The railroad freight system is a critical national infrastructure.
- The industry is extremely robust, and has a long history of restoring and maintaining service after accidents and major natural disasters by using in-house and contract staff to restore the system operations, and, when necessary, routing trains over tracks of other railroads by agreement. Thus, serious disruption of the rail system having a national impact is unlikely.
- The industry has dealt with trespassers for many years. Railroad police now have arrest authority in any state in which the railroad owns property. These police forces cooperate with local authorities in the pursuit of their duties.
- Several key facilities are essential to the continued operation of the railroad system. If as a result of physical attack, these facilities were destroyed, full rail transportation service could not be provided until they were replaced or backup systems became available. To the extent deemed feasible, these facilities are hardened and would be very difficult to attack successfully. Plans have been made for

continued operation in case these facilities are not in service. Better intelligence and information on physical threats to such vital structures, and coordinated plans for their surveillance and protection would improve contingency plans, increase reaction time, and minimize the threat.

- The industry is aware of cyber threats to the integrity of its operating and management programs and databases. Also, to the extent deemed commercially feasible, the industry has protocols and stored copies of data in place to assure back up and alternative systems available in case of damage or loss of the primary system. The industry requires better intelligence and information on the threat and vulnerabilities to assist security managers with additional justification for funding improved security systems to protect vital systems.

- Physical attacks on the railroad supply industry could interfere with timely delivery of some components but it is anticipated that the damage can be rather quickly addressed. The exception is in the case of certain major facilities and structures. The railroad industry can extend the life of many systems and components during the period of rebuilding of the supply industry.

- Random and repetitive physical or cyber attacks that degrade service or require a return to simpler and less efficient operating systems could have a major impact on the ability of the railroad industry to play its proper role in the economy of the United States.

- The railroad industry would benefit from intelligence gathered by government regarding the expected timing and extent of physical and cyber threats. The railroad industry could benefit from knowledge on the responses by government to physical and cyber threats as it works to enhance its capability for the development of ways to counter and mitigate the consequences of terrorist attacks. Government - industry partnership in this endeavor could lead to productive programs of mutual benefit.

- The railroad industry has hardened many critical sites and introduced cyber protection systems as a necessary cost of doing business to protect itself against unauthorized intrusion. New threats from terrorists could require major increases in security systems that could not be justified from a business perspective. Since those threats are not aimed at the industry as such but at the industry in order to affect the defense and the economy of the United States, alternative funding methods may be required to pay for those protective systems.

- The railroad industry is highly dependent on other infrastructures. It requires continuous supplies of electric power for many of its support operations. It requires reliable and robust communications systems. It requires assured and timely supplies of fuel. It requires high integrity in the banking and financial systems. It depends on a reliable and operating governmental structure. Thus, it cannot operate in a vacuum. It is a part of the interdependencies inherent in our complex economy.