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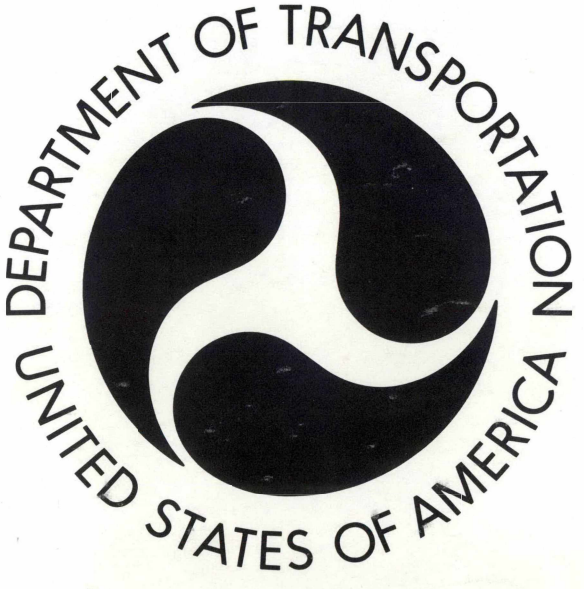
DEPARTMENT OF TRANSPORTATION SYSTEMS SAFETY

Plan for Improving the Management of Railroad Safety Programs

A Report to The United States Congress



December 1981

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PREFACE

This report is the Department of Transportation's plan for improving the management of programs to implement the railroad safety laws.

The report has been developed for transmittal to Congress to comply with the following provisions from Section 16 (c) of the Federal Railroad Safety Authorization Act of 1980:

(1) The Secretary of Transportation shall submit to the Congress a system safety plan relating to the activities of the Department of Transportation in carrying out rail safety laws. . .

2) As part of the plan submitted to the Congress under paragraph (1) of this subsection, the Secretary of Transportation shall develop a methodology to determine frequency and schedules of safety inspections, giving appropriate priority to track and equipment involved with passenger trains and hazardous cargos. Such methodology shall further take into consideration safety records of the rail carriers, location of track and equipment in population centers, volume of usage of track and equipment, and any other factors that the Secretary considers relevant to railroad safety.

EXECUTIVE SUMMARY

This report has been prepared by the Federal Railroad Administration (FRA) which has responsibility for railroad safety laws within the Department of Transportation (DOT). The report describes goals for improved railroad safety and the approach FRA has adopted to meet those goals. In preparing this report, FRA examined each of the major categories of rail accidents to develop a plan for systemwide application to improve railroad safety. The thesis of the Systems Safety Plan is that safety is best enhanced when government and industry resources are combined in a cooperative rather than an adversary spirit. The Plan establishes priorities for applying FRA, State, and industry resources in the joint effort to reduce rail accidents.

This report includes an outline of the steps taken to incorporate Systems Safety Plan concepts into FRA's management process. The report also describes the method that is being used to establish schedules for inspecting track, motive power and equipment, signal and train controls, operating practices, and hazardous materials shipments. The methodology used to develop these schedules is described in Appendix A. Other ongoing special activities in aid of railroad safety are described in Appendix B.

Until recently, FRA has relied on an expanding regulatory program, complemented by an extensive enforcement effort, to ensure railroad safety. When violations were discovered by FRA inspectors, carriers were cited and penalties were assessed. Often, these fines were paid long after a violation, and the relationship between the violation and the fine had only a limited impact at the railroad operating level.

The Plan's new direction makes greater use of the fact that the Nation's railroads are aware of the importance of safety. Most railroads are quick to respond by correcting defects or improper procedures that have been brought to their attention by government monitoring. This being the case, fines and similar sanctions should be used only after other methods of encouraging safety improvements have proven ineffective.

FRA has established as its goal over the next five years a 20 percent reduction in the following types of accidents:

- hazardous materials releases;
- serious passenger train accidents;
- railroad employee casualties;
- rail-highway crossing accidents; and
- trespasser fatalities.

The effectiveness of FRA's plan relies on:

- industry, labor, and government coordination;
- technical research in safety related areas;
- specific performance standards for key FRA managers; and
- a yearly national inspection plan detailing FRA railroad safety management activities.

INSPECTION

A primary focus of government efforts to improve railroad safety continues to be railroad inspections.

A national inspection plan has been developed and will be revised annually. FRA and State inspectors will inspect, at least once annually, the 92,000 mile network of track over which all Amtrak service and 95 percent of the total ton-mileage of hazardous materials are handled.

Improved procedures for recruiting and training of inspectors have been identified through a State participation task force established in June 1980.

TRAINING

Employee training remains an important element in FRA's effort to improve railroad safety. FRA is able to identify those railroads and operating divisions which have a high incidence of accidents involving human error. Specific employee training programs will be targeted for those railroads.

RESEARCH AND DEVELOPMENT

An essential component of FRA's goal to improve rail safety is continuing research to effect technological and operational change. Continuing research on metallurgy, thermal insulation, and safety valves will improve the safe transport of hazardous materials.

Similarly, FRA is conducting two studies concerning the transportation of nuclear wastes. One

study concerns the requirements needed for spent nuclear fuel casks. The other study concerns the routing of nuclear wastes generated by nuclear power plants. FRA is also analyzing rerouting hazardous materials traffic away from major population centers.

The FRA uses two operational facilities for testing rail equipment and track.

- The facility for Accelerated Service Testing evaluates the effects of car axle loads on track and car maintenance and is used to determine the safe life of track and railbeds.
- The Rail Dynamics Lab is used to determine the dynamic behavioral characteristics of various car types and control devices. Cars with stable dynamic characteristics that are less likely to cause accidents are identified. Control devices are evaluated to determine their effectiveness in reducing derailments.

The Track Train Dynamics Program is designed to determine how existing cars in the present fleet can be improved to be more stable when operating over poor track.

The Truck Design Optimization Program is designed to develop performance and test specifications for safer and more stable freight car trucks.

The Locomotive Research and Train Handling Evaluator will be used to evaluate operating procedures and control devices to ensure that long trains can be operated as safely as short trains. Conditions which tend to increase the possibility of a car derailing will be identified by evaluating car action under various train configurations and operating scenarios. Similarly, methods for car handling or placement of cars in trains which enhance safety by reducing undesirable car action will be identified.

REGULATIONS AND ENFORCEMENT

FRA has instituted a review process which updates or eliminates regulations when industry conditions justify a rule change. These changes are processed through rulemaking channels.

FRA has a statutory obligation to apply civil penalties for safety violations. Safety violations will continue to be cited whenever railroad cooperation is not forthcoming and safety is impaired.

RAILROAD SAFETY GOALS

The number of railroad fatalities has declined markedly over the past 50 to 75 years. Annual fatalities involving railroad employees now average around 100; grade crossing fatalities average less than 1,000; and trespasser fatalities average less than 500. Table 1 illustrates this improvement.

TABLE 1
Comparison of Railroad Fatalities

	1907	1928	1980
Employee Fatalities	4,534		100
Fatalities/Million Work Hours	1.3		.10
Grade Crossing Fatalities		2,568	833
Fatalities/Exposure Index[1]		12.7	1.07
Trespasser Fatalities	5,612		457
Fatalities/Million Train-Miles	5.0		.5
Passenger Fatalities	610		4
Fatalities/Billion Passenger Miles	22.0		.4

Source: FRA Office of Safety Accident/Incident Reporting System

[1]Exposure Index = $\frac{\text{Train-miles} \times \text{vehicle miles}}{10^{18}}$

The rail-highway exposure index provides a relative measure of the theoretical opportunity for a collision between a railroad train and highway vehicle. The index for a given year is derived by multiplying the number of train miles by the number of vehicle miles, and dividing by a constant to make display purposes clear.

The railroad accident rate decreased 13.6 percent in 1979 from 1978. In 1980, the railroad safety picture continued to improve with an additional decrease of 13.2 percent in accidents, 12.7 percent in reportable property damage, and 15.7 percent in casualties over 1979.

Fatalities involving passenger trains have averaged 12 deaths per year over the last decade. An average of 5 deaths per year has been associated with rail transportation of hazardous materials over the same period. However, the possibility of a serious incident still remains and safety efforts cannot be relaxed because of improved statistics.

The Systems Safety Plan described here has been developed over the past several years, and many of its elements have already been implemented. The Plan describes broad railroad safety goals of the Department and FRA's specific efforts to establish schedules for inspecting both track and equipment.

The methodology for determining these schedules is described in Appendix A. Ongoing support programs are discussed in Appendix B.

FRA has established a 20 percent improvement as its goal for railroad safety over the next five years. This 20 percent goal is being applied to each of the five priority elements of FRA's safety program. Specifically, the individual 20 percent improvement goals will be measured by comparing the five year average for 1976-1980 to a projected five year average for 1981-1985 in the following manner:

- *Improve safety in the transport of hazardous materials.* Reduce the rate of hazardous materials releases per million hazardous materials car-miles from 0.3 to 0.2.
- *Improve safety in passenger train operations.* Reduce the rate of passenger fatalities per billion passenger miles from 0.5 to 0.4.
- *Improve safety for railroad employees.* Reduce the employee fatality rate per million work hours from 0.10 to 0.08.
- *Improve safety at rail-highway grade crossings.* Reduce the number of fatalities, as measured by the exposure index[1] from 1.3 to 1.0.
- *Improve safety involving railroad trespasser fatalities.* Reduce the number of trespasser fatalities per million train-miles from 0.5 to 0.4.

[1]Exposure index — see explanation with Table 1.

The statistical base for these data is a 5-year average (1976-1980); the goals are a 5-year average for 1981-1985. Multiple-year averages are used because accident or casualty figures for any single year can be misleading due to normal statistical variance.

FRA views the goals and objectives presented in this Plan as industry goals and objectives. Attainment cannot be accomplished by government alone. Safety will be affected to a much greater degree by the attitudes and commitment of railroad management and rail labor to these goals.

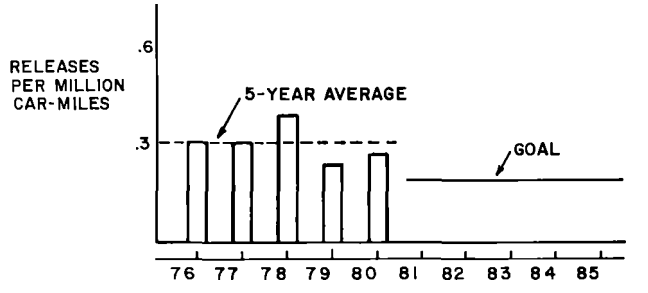
Rail Transport of Hazardous Materials

The FRA's primary concern in the transport of hazardous materials is to reduce the possibility of a catastrophic accident. There have been relatively few hazardous materials fatalities in railroad transportation, as shown in Figures 1 and 2. Nevertheless, every reasonable precaution should be taken to minimize the chance of such an occurrence.

There are significant year-to-year variations in hazardous materials fatalities. In 1978, two derailments, one caused by a defective wheel and the other by vandalism, caused 24 fatalities. However, in 1979 there were no fatalities from rail hazardous materials releases.

FIGURE I.

RELEASES[1] PER MILLION CAR-MILES

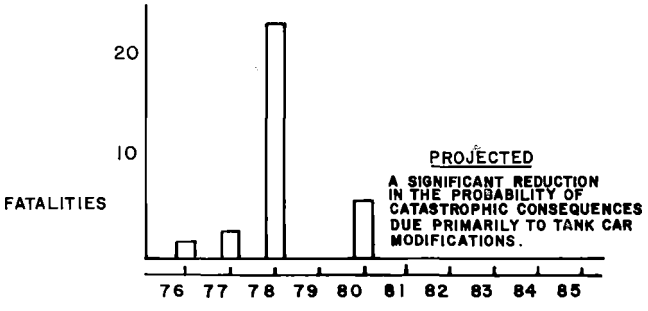


SOURCE: FRA OFFICE OF SAFETY ACCIDENT/INCIDENT REPORTING SYSTEM

[1]A RELEASE IS ANY DISCHARGE OF HAZARDOUS MATERIALS FROM A RAIL CAR.

FIGURE 2.

FATALITIES DUE TO HAZARDOUS MATERIALS RELEASE BY YEAR



SOURCE: MATERIALS TRANSPORTATION BUREAU HAZARDOUS MATERIALS INCIDENT SYSTEM.

Since the number of fatalities involving hazardous materials transportation is subject to year-to-year variations, the standard adopted to measure real progress is releases per million car-miles of hazardous material carriage.

The decrease projected in releases of hazardous materials is largely due to the new tank car safety requirements. FRA's increased emphasis on inspection by its field forces of routes over which such materials travel is a second element of this program.

Passenger Train Operations

As with hazardous materials, FRA's primary concern in rail passenger safety is to reduce the

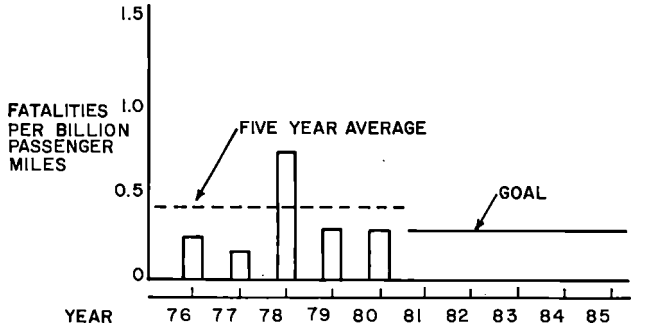
possibility of a catastrophic accident. In the past decade, passenger fatalities have ranged from a low of 3 in 1977 to a high of 47 in 1972. Rail passenger travel includes Amtrak intercity service and rail commuter service.

In the past five years, Amtrak has replaced nearly all of its passenger equipment. As a result, the potential for accidents due to equipment failure has been reduced. At the same time, many of the commuter authorities are replacing or rebuilding their equipment.

Fatalities per billion passenger-miles and the actual number of railroad passenger fatalities from 1976 through 1980 are shown in Figures 3 and 4, respectively:

FIGURE 3.

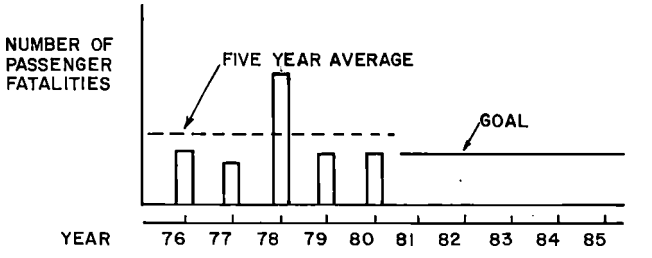
PASSENGER FATALITIES PER BILLION PASSENGER-MILES



SOURCE: FRA OFFICE OF SAFETY ACCIDENT/INCIDENT REPORTING SYSTEM.

FIGURE 4.

PASSENGER FATALITIES BY YEAR



SOURCE: FRA OFFICE OF SAFETY ACCIDENT/INCIDENT REPORTING SYSTEM.

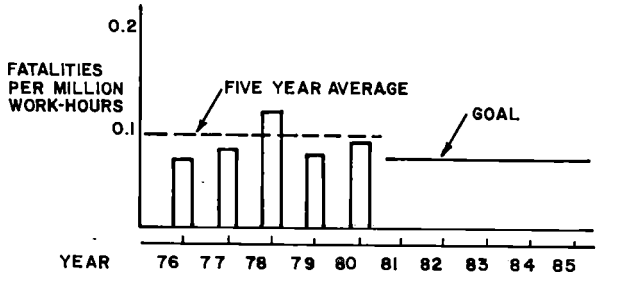
Employee Safety

Significant progress has been made in railroad employee safety. There are currently about 100 employee fatalities and over 55,000 injuries each year. A large number of these injuries are minor. By concentrating on a goal of reducing the rate of employee fatalities, the number of severe and disabling injuries of railroad employees will also be reduced.

Most employee casualties occur in yard and maintenance work. Many occur in high risk job categories, such as brakemen, flagmen, and yard helpers, and often involve human error. Over 50 percent of all railroad employee fatalities occur during switching operations. A combination of both FRA inspection and improved training is expected to reduce the rate and severity of employee casualties. Figure 5 illustrates recent employee fatality rates:

FIGURE 5.

RAILROAD EMPLOYEE FATALITIES PER MILLION WORK-HOURS



SOURCE: FRA OFFICE OF SAFETY ACCIDENT/INCIDENT REPORTING SYSTEM.

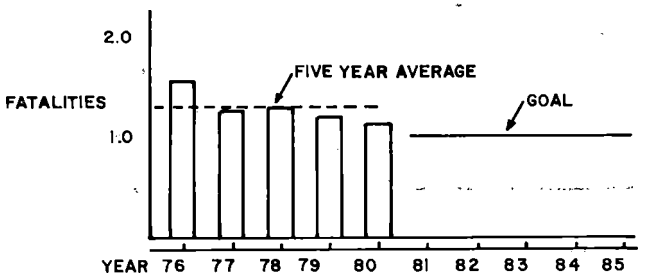
Rail-Highway Grade Crossings

Rail-highway grade crossing accidents are responsible for the single largest number of railroad fatalities. Together with trespasser fatalities, these two categories account for approximately 90 percent of all railroad fatalities. Figure 6 shows rail-highway crossing fatality trends.

Grade crossing safety can be enhanced through the installation of improved warning devices and the continuation and expansion of media campaigns to alert and educate the public.

FIGURE 6.

GRADE CROSSING FATALITIES BY EXPOSURE INDEX[1]



SOURCE: FRA OFFICE OF SAFETY ACCIDENT/INCIDENT REPORTING SYSTEM.

[1] EXPOSURE INDEX: SEE EXPLANATION WITH TABLE I.

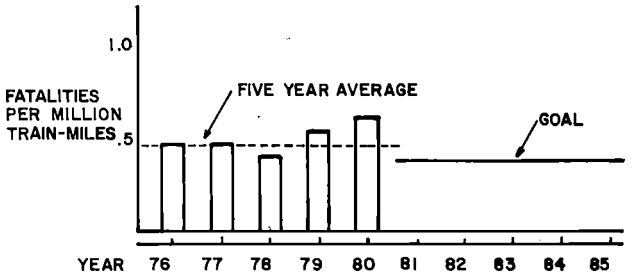
In the past 10 years, rail-highway crossing fatalities have decreased 39 percent, from 1,356 killed in 1971 to 833 in 1980, the lowest number on record. If crossing fatalities are expressed in terms of the index, the decrease is 68 percent.

Railroad Tresspassers

FRA's objective is to achieve a 20 percent reduction in trespasser fatalities per million train miles over the next five years, as shown in Figure 7:

FIGURE 7.

TRESPASSER FATALITIES PER MILLION TRAIN-MILES



SOURCE: FRA OFFICE OF SAFETY ACCIDENT/INCIDENT REPORTING SYSTEM.

Railroads devote considerable effort to reducing trespasser fatalities and vandalism. During 1980, railroad security forces arrested 36, 316 adults and 2,408 juveniles for trespassing. In addition, 412,101 persons were warned. Signs are also used to deter or caution trespassers. However, weathering, vandalism, and changes in land use or site visibility may reduce the effectiveness of signs unless they are replaced frequently.

THE SYSTEMS APPROACH TO RAIL SAFETY

The achievement of FRA's goals is dependent on continuing participation by railroad management, labor, and the Government and a variety of other organizations concerned with railroad safety. The ultimate success of FRA's inspection, training, research and development, and regulation and enforcement efforts is determined by the effectiveness of this government/industry relationship.

Prior to the development of the Systems Safety Plan, FRA's safety goals were not clearly defined. Railroad safety was largely assessed in terms of the overall number of railroad accidents with little emphasis on the relative importance of different kinds of accidents. The Systems Safety Plan establishes a new priority order for concentrating rail safety efforts on those categories of rail accidents that pose the highest risk of fatalities, injuries and property damage. Although hazardous materials and passenger safety had previously been regarded as important, the Systems Safety Plan asserts that safety in these two areas will receive first inspection priority. Next in importance under the Plan is employee safety where special emphasis will be placed on accidents involving human error. Rail-highway crossing and trespasser safety continue to be important goals. The Federal Highway Administration (FHWA) is the lead agency in DOT for rail-highway crossing safety issues. The railroad trespasser safety issue has not been addressed by the Federal government to any great extent in the past, but FRA will explore possible programs to reduce trespasser accidents.

INSPECTION

FRA's inspection program includes the publication of minimum safety standards which specify proper operating procedures and safety tolerances for railroad equipment and track. The inspection program also prescribes frequencies for inspections by railroad personnel and establishes a system for Federal and State inspectors to monitor compliance.

Through the inspection program, FRA aids the railroads in finding and alleviating unsafe conditions or operations. FRA maintains an extensive national data base enabling the railroads and government to identify specific safety problems.

Comprehensive safety appraisals of a railroad's entire operation in addition to routine inspection efforts have proved to be an effective means to reduce accidents. Systemwide assessments of three railroads' operations, involving comprehensive appraisals of all aspects of safety, were performed by FRA during 1979. These safety assessments resulted in reductions in the number of accidents of 45, 44 and 5 percent on these railroads. The railroad which experienced only a 5 percent improvement was in bankruptcy and did not have the funds to correct the problems identified in FRA's assessment.

Railroad management has demonstrated a positive attitude toward comprehensive safety assessments. As a result, safety assessments generate more rapid improvements in safety than do routine inspection efforts. Part of the success can be attributed to the personal involvement of a railroad's top management in the assessment process. FRA will continue to stress carrier assessments as part of its inspection program.

National Inspection Plan

In 1980, FRA developed a National Inspection Plan for 1981. This was the first time such a plan had been developed and it will be updated each year in response to changing conditions.

An annual inspection plan is developed by each of the eight FRA regional offices. The regional offices incorporate the State safety inspection plans to avoid duplication of effort and assignments. These regional inspection plans are consolidated by FRA into the National Inspection Plan.

The National Inspection Plan identifies the number and type of inspections to be conducted by Federal and State inspectors in each discipline (such as track inspection, mechanical inspection, and signal inspection). In developing the plan, the FRA Regional Directors are provided with detailed instructions for making their determination of the required inspections. This detailed methodology is included in Appendix A.

Track inspection is an important element of the effort to reduce the risk of catastrophic accidents. FRA has scheduled its inspectors to annually inspect some 92,000 miles of track which handles all Amtrak passenger traffic and 95 percent of hazardous materials traffic. In addition, 34,000 miles of this track will be reinspected. The track planned for reinspection carries 75 percent of all the U.S. carmiles of hazardous materials of particular concern. These categories are non-flammable compressed gases, flammable compressed gases, flammable liquids, and Class A and B poisons.

The scheduled inspection of the 92,000 mile network also covers 90 percent of *all* freight traffic. FRA inspection efforts beyond this 92,000 mile network will involve track which has been identified as potentially unsafe.

Other FRA inspection activities are also focused on the 92,000 mile network. Operating practices inspectors evaluate train operations on these lines, equipment inspectors concentrate on repair facilities and dispatching points serving these lines, and signal and train control inspectors monitor the maintenance of signal systems on these routes. These lines are of particular concern to hazardous materials inspectors, especially at points where hazardous materials shipments originate or terminate.

Because the accident data show that employee casualties occur primarily in yard switching operations, safety inspectors will examine switching yards as well as the 92,000 mile priority network. They will use the methodology described in the National Inspection Plan to further target those yards and terminals which have the poorest safety records. This approach offers the greatest potential for reducing employee injuries and fatalities.

TRAINING

Since 1966, there has been a steady increase in the percentage of accidents caused by human error. Many of these accidents can be attributed to inadequate training. Accidents due to human error are responsible for more fatalities than accidents attributed to either track or equipment defects. In 1980, 28 percent of all railroad accidents (other than those at rail-highway crossings), 45 percent of the fatalities, and 53 percent of the injuries were caused by human error.

Proper training of employees, particularly those who work on and around moving equipment is extremely important. This training must be included in a new employee's orientation. Retraining or refresher courses for experienced personnel are also important to maintain or rekindle safe work habits and practices.

The railroads are primarily responsible for employee training. To assist the railroads, FRA will identify those operating divisions or locations which could benefit most from training programs.

The three railroad systemwide safety assessments described earlier illustrate the advantages of good training programs. Although the systemwide safety assessments led to a decline in the number of accidents in all areas, the sharpest reductions were in the number of accidents caused by human error. This improvement can be attributed largely to changes made by the railroads in their operating practices training programs. Instruction in better train handling for engineers and improved maintenance procedures for mechanical employees were particularly important.

FRA's Office of Safety has developed a program of courses covering all rail safety regulations. These courses are designed to increase understanding of the regulations in order to promote uniform compliance. The courses are open to railroad industry personnel as well as to Federal and State enforcement personnel.

FRA conducts training studies in cooperation with railroad management and unions. This enables FRA to make efficient use of limited resources and, most importantly, to gain support and acceptance of results. FRA is currently engaged in a joint project with the Louisville and Nashville Railroad and the Brotherhood of Locomotives Engineers to define locomotive engineer training alternatives.

FRA investigations indicate that the majority of employee casualties are caused by failure to follow established operating rules. The four major causes of operating practices accidents have been:

- failure to observe rules;
- incorrect use of switches;
- failure to use brakes properly; and
- improper operating speeds.

The most effective way to reduce accidents caused by human error is through the improvement of railroad training programs coupled with strict railroad enforcement of operating rules.

Educating the Public

The majority of the casualties at rail-highway grade crossings and those involving trespassers are caused by the general public, not by the railroad. Motorists fail to heed warning devices. Trespassers walk along the track, or wander around yards. The general public lacks a clear understanding of such things as the distance it takes to stop a train or the impact of a collision with a moving train.

The Federal Highway Administration (FHWA) has taken the lead in grade crossing safety. FRA and the railroads will continue to cooperate with FHWA in this area. "Operation Lifesaver" is a highly successful program designed to educate the public to the danger of rail-highway crossings. This program was initiated by the Union Pacific Railroad and communities in Idaho in 1972. The program is designed to warn motorists about the hazards associated with rail-highway crossings and to explain the crossing warning devices. The success of the initial program caused several other states and railroads to begin similar education programs. In 1977, the National Transportation Safety Board recommended that the National Safety Council serve as a national focal point and coordinator for a nationwide "Operation Lifesaver" program. FRA, FHWA, the Association of American Railroads (AAR), Amtrak, and many railroads and states actively support the program. Today, 29 states have "Operation Lifesaver" programs.

During the next few years, FRA will conduct a demonstration project in the Northeast Corridor to assess the merits of fencing and warning signs as a method of reducing trespasser fatalities. Beginning in 1981, FRA field forces will selectively visit schools and other facilities located near railroad lines in order to educate students and the general public about the trespasser problem. FRA will conduct followup evaluations of all railroad trespasser educational programs to determine the cost effectiveness of these programs.

RESEARCH AND DEVELOPMENT

The FRA's research and development program has two fundamental objectives:

- to continue a cooperative program with the railroads and the supply industry to develop and test new safety concepts; and
- to ensure the development of technical knowledge on which to base safety procedures, regulations, and standards.

FRA has provided several of its facilities to the industry for testing rail equipment. The major facilities are:

- The Facility for Accelerated Service Testing evaluates the effects of car axle loads on track to determine the safe life of track and roadbeds.
- The Rail Dynamics Lab is used to determine the dynamic behavioral characteristics of various car types and control devices. Cars with stable dynamic characteristics are identified. Such cars will be less likely to cause accidents. An evaluation of control devices can determine the effectiveness of such devices in reducing unstable dynamic behavior.

In addition to the tests performed at these facilities, FRA conducts a number of tests on the tracks of individual railroads to assure that safe track conditions exist.

FRA has acquired valuable data from studies of various train configurations and operating scenarios. These findings provide a means to formulate train make-up and handling methods which reduce undesirable car actions. Some of the tools used to conduct these studies are:

- The Track Train Dynamics program examines ways the existing equipment fleet can be improved to withstand track irregularities.
- The Truck Design Optimization program generates performance and test specifications for freight car trucks.
- The Locomotive Research and Train Handling Evaluator will evaluate operating procedures and control devices in order to ensure that car performance in longer trains is as good as that in shorter trains. This facility will become operational in 1983.

Hazardous Materials

A major focus of the FRA research and development program has been and will continue to be the transportation of hazardous materials. Much of this effort has been concentrated on equipment specifications.

The majority of hazardous flammable gas commodities transported by rail are carried in tank cars that are designated as DOT Specification 112, 114 and 105. In October 1977, FRA and the Materials Transportation Bureau (MTB) of the Research and Special Programs Administration issued a rule which requires the installation of thermal protection, shelf couplers, and head shields on DOT Specification 112 and 114 tank cars. Thermal protection reduces the risk of a tank car rupture from expanding gas due to external heat. The shelf couplers and head shields reduce the likelihood of a coupler puncturing a tank car in the event of accident. There are approximately 18,000 DOT Specification 112 and 114 tank cars in service. FRA and MTB issued a final rule in January 1981, which extended the protective requirements to newly-built DOT Specification 105 tank cars.

The task of upgrading tank cars has been a cooperative effort that began with joint industry/government research on basic metallurgical and thermal resistance. The technical information produced by this research resulted in realistic and practical retrofit designs that are now present on most large tank cars carrying hazardous materials.

FRA has developed a methodology to determine the relative costs and risks associated with shipping spent nuclear fuel casks. The methodology may be used to estimate the radiation exposure in the event of an accident. The optimum routes for radioactive shipments may then be determined.

In another study, FRA is participating in a joint effort with the Department of Energy to develop requirements for spent nuclear fuel casks. This study is scheduled for completion in December 1982 and follows an earlier analysis involving impact testing of spent fuel casks.

FRA is also examining the possibility of rerouting hazardous material traffic away from major population centers. A case study approach is being utilized to determine both the expected reduction in risk to the public and the economic implications of rerouting. This study will be concluded in 1981.

Rail-Highway Grade Crossings

FRA is involved in several research efforts dealing with rail-highway grade crossing safety. In cooperation with the FHWA, FRA is sponsoring research at the Transportation Systems Center for the development of a resource allocation model. The model is being used by railroad program managers and State governments to analyze a large number of rail-highway crossings before specific crossings are nominated for upgrading. The recommendation concerning which crossings should be improved and the level of improvement (flashing lights or gates) is based on warning device effectiveness, costs, and the predicted number of accidents at the crossing.

The resource allocation model is designed to maximize the number of accidents prevented per dollar expended.

In January 1981, FRA completed a study of warning systems that are designed to provide a constant warning time to the motorist regardless of train speed or direction. At present, the warning time at many crossings can be as little as a few seconds or as long as several minutes. The FRA study developed two concepts, acoustic and magnetic, which appear to be promising techniques for providing constant warning time. The feasibility of testing these concepts and of conducting a field demonstration is now being examined.

REGULATION AND ENFORCEMENT

FRA's approach to regulation and enforcement is to minimize the regulatory burden on railroads and to limit the use of fines as the major technique for correcting safety violations. The Office of Safety has a review process that updates or eliminates existing regulations when industry conditions justify a rule change. This policy assures an efficient safety program that changes with new technology and updated railroad operating procedures.

In recent years, FRA has increasingly recognized the value of well founded cost-benefit analyses of Federal regulations. Executive Order 12291 strengthens the requirement for such analyses. As a result, FRA safety regulations are now being reviewed for cost effectiveness.

In the past, the FRA emphasis in railroad safety was to encourage safe operations through the imposition of fines when inspections revealed that safety regulations had been violated. It is not clear that this emphasis has been the optimum approach to improving railroad safety. The Systems Safety Plan shifts the emphasis away from the mechanical imposition of fines for technical violations toward a more cooperative working arrangement with the railroads. Nevertheless, where a cooperative approach between safety inspectors and industry personnel fails to achieve safe railroad operations, FRA will not hesitate to impose financial penalties required by law. The combination of a cooperative working relationship and the imposition of fines when warranted is expected to enhance the effectiveness of FRA's entire safety program.

APPENDIX A

NATIONAL INSPECTION PLAN METHODOLOGY

The purpose of this methodology is to provide FRA safety regions and individual inspectors with more clearly defined direction concerning the prioritization of their activities. It is not intended as a blueprint for detailed scheduling. Rather, it is a guide to developing an overall plan for inspections in the forthcoming year. Field personnel are in the best position to assess underlying safety problems and railroad efforts to improve their safety performance. Railroad responsiveness, the skill of its personnel, and its budget allocations are among the many factors that an inspector must also consider in developing his inspection plan.

It is important to recognize that the impact of the various factors used in determining priorities can vary considerably from region to region. For example, Amtrak passenger traffic is very heavy in the Northeast Corridor. Hazardous materials traffic is high throughout the Gulf States. In the western States, passenger and hazardous materials traffic is generally much lighter. Other required factors stem from differences in railroad maintenance practices, terrain, and climate.

The methodology provides a guide to establishing priorities based on three types of factors: major goals, special requirements, and safety indicators. It is the combined influence of these three factors which determines the frequency of inspection. For example, improving the safety of hazardous materials transport is one of FRA's key goals. A route with a large volume of such traffic is likely to be selected for inspection. However, if compliance with FRA regulations and the railroad operating rules is found to be high, and there is a good accident record, a repeat inspection may not be done for some time. The relative weight given to various items contained in each of the three factors varies among inspector disciplines. The five inspector disciplines are track, equipment, operating practices, signal and train control, and hazardous materials.

Three priority categories are used in the following discussion. "High priority" considerations are viewed with urgency. In many cases, the presence of a single such factor will justify reinspection during the course of the year. "Priority" factors are those which would normally justify at least one inspection during the course of the year. The presence of several such factors may be cause for reinspection. "Significant" factors are used in determining how the balance of an inspector's time is utilized.

Major Goals

The major goals are the key priority areas identified in FRA's Systems Safety Plan. Hazardous materials safety is a primary concern. All routes carrying more than 2,700 cars per year of hazardous materials "of special concern" are considered to be of high priority for track, equipment, signal and train control, and operating practices inspectors. The five categories of hazardous materials designated "of special concern" are non-flammable compressed gases; flammable compressed gases; flammable liquids; Class A poisons; and Class B poisons, organic flammable. There are about 24,000 miles of U.S. rail routes in this category (34,000 track-miles), accounting for 75 percent of all the U.S. car-miles of these hazardous materials "of special concern." Of course, there are generally a considerable number of other hazardous materials cars passing over these routes.

Routes carrying more than 2,000 cars per year of any type of hazardous material cars are considered priority routes. These lines account for an additional 46,000 miles of U.S. rail line (53,000 track-miles). If the traffic of the high priority and priority hazardous materials lines are added together, they account for approximately 95 percent of all hazardous materials car miles. In addition, the 52,000 miles of track over which the balance of the hazardous materials traffic passes is of significant concern, and is inspected to the maximum extent feasible.

Estimates of hazardous materials traffic on specific rail lines are developed using the one percent waybill sample and the FRA network model.[1] The relative traffic estimates have been displayed on State maps showing railroad lines. Inspectors can use these maps as an aid in planning their inspections.

[1]The one percent continuous carload waybill sample requires all railroads whose average annual operating revenue exceeds $3 million to file terminated waybills numbered "1" or "01" with the ICC. The FRA network model is a representation of station and track configurations of U.S. railroads, consisting of over 16,000 intersecting points and 17,000 links.

Equipment inspectors also give priority to the inspection of hazardous materials tank cars. Operating practices inspectors accord similar priority to rail operations involving hazardous materials.

Hazardous materials inspectors assign high priority to those shippers, consignees, and freight forwarders which handle explosives, tank car loading or unloading, or a large volume of hazardous materials. Other shippers, consignees, and freight forwarders receive priority treatment. Rail carriers and container manufacturers are also given priority in inspections.

Population density is considered in conjunction with hazardous materials traffic since it directly affects the potential for a catastrophe. Hazardous materials lines with more than 1,000 persons per square mile are considered a high priority by track, equipment, and operating practices inspectors. Only 9 percent of the mileage of routes carrying hazardous materials are near population densities of this magnitude. About 11,000 miles of rail line are included in this category. Hazardous materials routes with a population density of 300 persons per square mile are considered priority routes. An additional 13,000 miles of rail line are included in this category. Population density information on specific lines will not be available until FY 1982. In the interim, inspectors are expected to use their own judgment concerning population density near rail lines.

Railroad routes with passenger traffic in excess of 20 trains per day are considered high priority routes by track, equipment, signal and train control, and operating practices inspectors.

All Amtrak and commuter train routes are given priority treatment by track, equipment, signal and train control, and operating practices inspectors. Amtrak routes have been identified on the State railroad maps depicting hazardous materials traffic. The feasibility of including commuter traffic on these maps is now being examined.

Railroad operating employee performance is the primary concern of operating practices inspectors. Safety evaluations are made by checking for conformance with railroad operating rules, safety rules, and special instructions. Yard brakemen, flagmen, and helpers are the job categories given highest priority, since these areas pose the highest risk of a fatality or serious injury. Road crews in these three job categories are given priority treatment.

Signal and train control inspectors have responsibility for promoting rail-highway crossing and trespasser safety. Formal involvement by FRA inspectors in these areas began in 1981, and the nature of that involvement is purposely limited for the present. Signal inspectors will be assessing the frequency of failures in crossing signals. In addition, they will review plans for the installation of warning devices upon state request. Signal inspectors will also talk to local groups, particularly schools near rail lines, concerning rail-highway crossing safety and the possible dangers of trespassing on railroad property.

Special Requirements

There are five types of special requirements common to several inspector disciplines. A severe accident is dramatic evidence of a safety failure. The cause of that failure must be identified and a determination made as to whether Federal regulations of railroad operating rules were violated. The quicker an inspector arrives on the scene, the fresher the details of the circumstances surrounding the accident will be in the minds of the people interviewed.

Complaint investigations are given a high priority where they involve a serious risk to human life. Other complaints are given priority treatment. Most complaints concern track or operating practices. Relatively few equipment, hazardous materials, or signal complaints are received.

Petitions for waivers are also processed according to their relative urgency, with those posing a serious risk to human life processed first. There are very few petitions for waivers relating to hazardous materials.

Training is an important means of maintaining and improving inspector skills. It is particularly important where FRA regulations have been significantly revised.

Meetings with the railroads are considered a high priority. In these meetings, FRA discusses where it has found problems concerning the railroad's maintenance practices or employee compliance with operating rules. Supporting accident statistics concerning the railroad or railroad division

may also be adduced. This permits a full and frank exchange about the seriousness of the problem and what can be done to improve the situation. The involvement of mid-level and upper management in these meetings increases the likelihood that the resources needed to accomplish those improvements will be provided.

Priority is given to inspection requests by the FRA Office of Federal Assistance and the Department of Defense. Inspections for the Office of Federal Assistance are conducted to assess the condition of a line proposed for rehabilitation, or to evaluate the acceptability of rehabilitation work completed. Inspections for the Department of Defense are conducted on track inside military bases.

Equipment inspectors conduct blue signal observations and noise level tests during their inspections. Blue signals must be displayed when an employee is working on, under, or around a car. Noise regulations specify noise limits for locomotive cabs and for sleeping quarters for crews provided by the railroad. Limits on the amount of noise to which a railroad can expose nearby communities are also set by Federal regulations. The standards are set by the Environmental Protection Agency.

Operating practices inspectors give priority to inspections concerning rear end markers, radio rules and train operations observations. These categories are important in reducing the possibility of collisions. Train operations observations are conducted to ensure that trains are operated in accordance with carrier and FRA rules.

Operating practices inspectors give significant attention to hours of service violations, efficiency tests, and blue signal violations. If a railroad requires an employee to work more than the statutorily defined maximum, it is an hours of service violation. Efficiency tests are conducted by the railroad to determine the level of compliance with the railroad's operating rules. Operating practices inspectors are also concerned with ensuring that the blue signals are placed to indicate that employees are working around rail cars.

Signal and train control inspectors give very high priority to a pattern of "false proceeds." False proceed signal indications are situations in which a signal device does not function as intended. This could lead to a train entering a block occupied by another train resulting in a collision or a switch not properly positioned resulting in a derailment.

Safety Indicators

Railroads with an accident rate 50 percent above the average for all railroads are given priority in inspections by track, equipment, and operating practices inspectors. The accident rate is not an important factor in determining signal and train control inspections since there are few signal accidents. Although they can contribute to the severity of an accident, the presence of hazardous materials rarely causes accidents. Therefore, the railroad accident rate is not pertinent to scheduling hazardous materials inspections; rather, incidents of hazardous materials releases are used in scheduling hazardous materials inspections.

Railroad divisions with accident rates more than 50 percent higher than the average for all divisions of the railroad are given priority. If a railroad's accident rate increases 25 percent in one year, or shows a steady increase in accidents over several years, it is given inspection priority.

Complaints are helpful in alerting inspectors to possible safety problems. Complaints which describe situations posing a serious risk to human life are investigated immediately.

Defects ratios are the primary means of determining signal and train control inspections. Defect ratios are calculated by dividing the number of noncompliance items (defects) by the total number of units inspected. Cases in which the defect ratio is greater than 25 percent are given high priority while defect ratios of 20 percent are given priority treatment.

Track	High Priority	Priority	Significant
MAJOR GOALS			
1. Hazardous Materials (HM)			
a. Traffic	2700 cars/year of HM "of special concern"	2000 cars/year of any HM	Any identified HM
b. Population Density	1000 persons/square mile (HM lines)	300 persons/square mile (HM lines)	
2. Passenger Traffic	20 passenger trains/day	All other Amtrak and commuter train routes	
SPECIAL REQUIREMENTS			
1. Accident Investigations	Fatalities; hazardous materials car derailments Regional Directors' discretion		
2. Complaints	Immediate danger to human life	Other complaints	
3. Petitions for Waivers	Immediate danger to human life	Other petitions	
4. Training — FRA/State		Technical training FRA	Administrative training
5. Requests for Inspections		Office of Federal Assistance, Department of Defense	
SAFETY INDICATORS			
1. Railroad accident rate		50% greater than national average	Greater than national average
2. Accidents on a railroad division		50% more than the average for divisions on that railroad	Higher than the average for divisions on that railroad
3. Relative increase in accidents on a division		25% increase in accidents in one year or steady increase for several years.	
4. Complaints	Immediate danger to human life	Other complaints.	

Equipment	High Priority	Priority	Significant
MAJOR GOALS			
1. Hazardous Materials (HM)			
a. Traffic	2700 cars/yr of HM "of special concern"	2000 cars/year of any HM	Any identified HM
b. Population Density	1000 persons/square mile (HM lines)	300 persons/square mile (HM lines)	
c. Tank cars		Inspect HM tank cars	
2. Passenger Traffic	20 passenger trains/day	All other Amtrak and Commuter train routes	
SPECIAL REQUIREMENTS			
1. Accident investigations	Fatalities, hazardous materials car derailments; Regional Director discretion		
2. Complaints	Immediate danger to human life	Other complaints	

3. Petitions for waivers	Immediate danger to human life	Other petitions	
4. Training — FRA/State		Technical training	Administrative training
5. Other			Motive power and equipment, blue signal, and noise level
SAFETY INDICATORS			
1. Railroad accident rate		50% greater than national average	Greater than national average
2. Accidents on a railroad division		50% more than the average for divisions on that railroad	Higher than the average for divisions on that railroad
3. Relative increase in accidents on a division		25% increase in accidents in one year or steady increase for several years	

Operating Practices	High Priority	Priority	Significant
MAJOR GOALS			
1. Hazardous Materials (HM)			
a. Traffic	2700 cars/yr of HM "of special concern"	2000 cars/year of any HM lines)	Any identified HM
b. Population Density	1000 persons/square mile (HM lines)	300 persons/square mile (HM lines)	
c. Tank cars		HM operations	
2. Passenger traffic	20 passenger trains/day	All other Amtrak and commuter train routes	
3. Employees	Yard brakemen, flagmen, and helpers	Road — Brakemen, flagmen, and helpers	Other transportation employees
SPECIAL REQUIREMENTS			
1. Accident Investigations	Fatalities; hazardous materials car derailments; Regional Directors' discretion		
2. Complaints	Immediate danger to human life	Complaints other than Hours of Service	Hours of Service
3. Petitions for Waivers	Immediate danger to human life	Other petitions	
4. Training — FRA/State			Administrative training
5. Other		Rear End Markers; radio rules; train operations observations	Efficiency tests; blue signal violations
SAFETY INDICATORS			
1. Railroad accident rate		50% greater than national average	Greater than national average
2. Accidents on a railroad division		50% more than the average for divisions on that railroad	Higher than the average for divisions on that railroad

3. Relative increase in accidents on a division		25% increase in accidents in one year or steady increase for several years	
4. Complaints	Immediate danger to human life	Complaints other than Hours of Service	Hours of Service
5. Railroad personal injury rate		30% greater than national average	Greater than national average

Hazardous Materials	High Priority	Priority	Significant
MAJOR GOALS			
1. Hazardous Materials	Shippers/consignees/freight forwarders with high HM volumes	Other shippers/consignees/ freight forwarders. Rail carriers	
	Tank car loading/unloading explosives	Container manufacturers	
SPECIAL REQUIREMENTS			
1. Accident Investigations	Fatalities; hazardous materials car derailments; Regional Directors' discretion		
2. Complaints	Immediate danger to human life	Other complaints	
3. Training FRA/State	Technical training	Administrative training	
SAFETY INDICATORS			
1. Incident investigations		Hazardous materials releases	
2. Complaints	Immediate danger to human life	Other complaints	

Signal & Train Control	High Priority	Priority	Significant
MAJOR GOALS			
1. Hazardous Materials Traffic			2000 cars/year of any HM
2. Passenger Traffic		20 passenger trains/day	All Amtrak and commuter train routes
3. Rail-highway crossings			Survey failures in grade crossing signals, examine crossing projects upon state request, speak at schools near railroads
4. Trespassers			Speak at schools near railroads
SPECIAL REQUIREMENTS			
1. Accident Investigations	Fatalities; hazardous materials car derailments; Regional Directors' discretion		
2. Complaints	Immediate danger to human life	Other complaints	

3. Petitions for Waivers	Immediate danger to human life	Other petitions	
4. Training — FRA/State		Technical training FRA	Administrative training
5. Other	Pattern of false proceeds		Evaluation of new equipment and devices

SAFETY INDICATORS

1. Defect ratio	0.25	0.20	
2. Complaints	Immediate danger to human life	Other complaints	

APPENDIX B

SUPPORT PROGRAMS

Some safety improvement needs dictate programs which may be carried on as adjuncts to the regular FRA railroad safety program or as special projects. Examples of such special activities follow.

Emergency response efforts are an important part of reducing the severity of hazardous materials releases.

1. The Materials Transportation Bureau (MTB) has prepared a DOT *Emergency Response Guidebook* for distribution to State and local emergency response personnel. The guidebook provides brief information by type of hazardous material concerning potential health hazards, the possibility of fire or explosion, appropriate initial emergency action as well as guidelines geared specifically for either a fire or spill, necessary protective clothing or breathing apparatus for emergency personnel, and preliminary first aid for victims. The book is intended as a guide for initial actions for emergency personnel to protect themselves and the public. Additional assistance for the most effective handling of an incident involving a specific material can be obtained from the Chemical Transportation Emergency Center. Over 200,000 copies of the guidebook are expected to have been distributed by the end of 1981.
2. The MTB funds the Colorado Training Institute (CTI) in Denver, Colorado. The CTI is the first professional school of its kind in the country devoted totally to promoting hazardous materials safety through education. In addition to courses for emergency response personnel, seminars are now offered for shippers, carriers, and dispatchers.
3. The MTB Office of Operations and Enforcement funds demonstration projects to improve management of hazardous materials transportation, storage, and emergency response. MTB's funding of the first project, conducted by the Puget Sound Council of Governments, was concluded in FY 1981. In that same year, similar projects were initiated in the following six metropolitan areas: San Francisco, Memphis, Indianapolis, Niagara Falls, Boston, and New Orleans. These projects have three primary objectives.
   a. Identification of all hazardous materials moving through the region in any substantial quantity or with any regularity, and the routes and carriers modes which are used;
   b. Identification of capabilities, methods, and effectiveness of existing prevention and response systems;
   c. Development of a comprehensive regional prevention and response program incorporating various government units and available industrial resources.

   A 55 member advisory panel has been established for this project. It includes representatives of major regional industries and major commercial carriers as well as government agencies.
4. The Coast Guard, in conjunction with the Environmental Protection Agency, operates the National Response Center, a 24-hour response network to assist local officials in dealing with hazardous materials accidents. Accident notification is also provided to Federal "on-scene coordinators" who assist local and industry officials.

Rail-highway crossing programs are directed toward reducing the number of rail-highway crossing accidents and fatalities.

1. FRA maintains the U.S. DOT-AAR National Rail-Highway Crossing Inventory. This inventory is used by the Federal Highway Administration (FHWA), State and local governments, and railroad program managers.
2. FHWA reviews each State's rail-highway crossing inventory and encourages each State to update information concerning its rail-highway crossings. FHWA works with FRA, the States, and the railroads to develop reporting procedures. FHWA has encouraged each State to implement Statewide sign and pavement marking programs. This involves the installation of crossbucks, advance warning signs and pavement markings at those crossings where such warning devices are required.
3. FHWA administers several programs which provide Federal funding for rail-highway cross-

ing improvement. The Federal Government's share of the cost of these projects varies from 75 to 100 percent, with the balance being paid for by the States, local communities, or the railroads. Approximately one-half of all Federal crossing improvement funds is spent on grade separation. The primary purpose is to improve motor vehicle traffic flow at crossings. The balance of Federal crossing improvement funds is spent on active warning devices, signs, improved crossing surfaces, and other safety improvements.

Guidelines concerning the ability of equipment to protect passengers have been developed by Amtrak officials. These guidelines are being followed by Amtrak for new and rebuilt equipment. FRA is evaluating the possibility of formalizing these guidelines to apply to all passenger cars. A decision is expected by August 1982. There are three major types of design and construction requirements being studied.

1. Structural strength requirements are being examined to determine whether current requirements provide adequate protection against rear-end collisons, train separation, and rollover. The structural strengths of underframes, car ends, and the attachment of trucks to cars are being reviewed. Reports from passenger train accident investigations have provided information which has been useful in these studies.
2. FRA is determining whether the fire resistance of materials used in passenger cars is adequate and whether guidelines should be issued to ensure that manufacturers use non-toxic and fire-resistant materials to construct passenger cars. While passenger car fires are rare, the risk of such an occurrence does exist.
3. Past train accidents have shown that heavy baggage in overhead racks can cause serious injuries and hamper evacuation if thrown about the car during an accident. Research studies, presenting various guidelines for securing baggage, have been completed and are available to rail carriers and manufacturers.

FRA recently issued standards establishing minimum safety requirements for glazing materials in the windows of locomotives, passenger cars, and cabooses. These standards require that passenger cars built or rebuilt after June 30, 1980 be equipped with certified glazing to reduce the risk of death or serious injury from flying objects, including bullets, and four exit windows to provide adequate emergency exits for passengers and crew. Passenger cars built before July 1, 1980 must meet these standards by June 30, 1983.

Department of Transportation Systems Safety: Plan for Improving the Management of Railroad Safety Programs - A Report to the United States Congress, 1981, 12-Safety