DEPARTMENT OF TRANSPORTATION

Federal Railroad Administration

49 CFR Parts 223, 229, 232, and 238

[FRA Docket No. PCSS–1; Notice No. 1]

RIN 2130–AA95

Passenger Equipment Safety Standards

AGENCY: Federal Railroad Administration (FRA), Department of Transportation (DOT).

ACTION: Advance Notice of Proposed Rulemaking.

SUMMARY: FRA announces the initiation of rulemaking on rail passenger equipment safety standards. FRA requests comment on the need for particular safety requirements and the costs, benefits, and practicability of such requirements. FRA anticipates this rulemaking will address the inspection, testing, and maintenance of passenger equipment; equipment design and performance criteria related to passenger and crew survivability in the event of a train accident; and the safe operation of passenger train service, supplementing existing railroad safety standards. FRA also announces the formation of a working group to assist FRA in developing this rule. FRA makes available preliminary safety concepts that have been placed before the working group. This notice is issued in order to comply with the Federal Railroad Safety Authorization Act of 1994, to respond to concerns raised by the General Accounting Office and the National Transportation Safety Board, to respond to public concerns, to respond to petitions for rulemaking, and to consider possible regulations derived from experience in application of existing standards.

DATES: (1) *Written comments:* Written comments must be received on or before July 9, 1996. Comments received after that date will be considered to the extent possible without incurring additional expense or delay.

(2) *Public Hearing:* Requests for a public hearing must be made on or before July 9, 1996.

ADDRESSES: Address comments to the Docket Clerk, Office of Chief Counsel, RCC–30, Federal Railroad Administration, 400 Seventh Street, S.W., Room 8201, Washington, D.C. 20590. Comments should identify the docket and notice number and be submitted in triplicate. Persons wishing to receive confirmation of receipt of their comments should include a self-addressed, stamped postcard. The dockets are housed in Room 8201 of the Nassif Building, 400 Seventh Street, S.W., Washington, D.C. 20590. Public dockets may be reviewed between the hours of 8:30 a.m. and 5:00 p.m., Monday through Friday, except holidays.

FOR FURTHER INFORMATION, CONTACT: Edward W. Pritchard, Acting Staff Director, Motive Power and Equipment Division, Office of Safety Assurance and Compliance, RRS–14, Room 8326, FRA, 400 Seventh Street, S.W., Washington, D.C. 20590 (telephone 202–366–0509 or 202–366–9252), or Daniel L. Alpert, Trial Attorney, Office of Chief Counsel, FRA, 400 Seventh Street, S.W., Washington, D.C. 20590 (telephone 202–366–0628).

SUPPLEMENTARY INFORMATION:

Introduction

Mandate

FRA requests comment on possible regulations governing rail passenger equipment. FRA believes such regulations are necessary for several reasons. In particular, effective Federal safety standards for freight equipment have long been in place, but equivalent standards for passenger equipment do not currently exist. The Association of American Railroads (AAR) sets industry standards for the design and maintenance of freight equipment that add materially to the safe operation of this equipment. However, over the years AAR has discontinued the development and maintenance of passenger equipment standards.

Worldwide, passenger equipment operating speeds are increasing. Several passenger trainsets designed to European standards have been proposed for operation at high speeds in the United States. In general, these trainsets do not meet the structural or operating standards that are common practice for current North American equipment. The North American railroad operating environment requires passenger equipment to operate commingled with very heavy and long freight trains, often over track with frequent grade crossings used by heavy highway equipment. European passenger equipment design standards may therefore not be appropriate for the North American operating environment. A clear set of safety and design standards for future passenger equipment tailored to the North American operating environment is needed to provide for the safety of future rail operations and to facilitate sound planning for those operations.

The Federal Railroad Safety Authorization Act of 1994 (the Act), Pub. L. 103–440, 108 Stat. 4619 (November 2, 1994), requires FRA to develop initial rail passenger equipment safety standards within 3 years of enactment and final regulations within 5 years of enactment. The Act also gives FRA an important tool to be used to help develop these safety standards: FRA is allowed to consult with the National Railroad Passenger Corporation (Amtrak), public authorities, passenger railroads, passenger organizations, and rail labor organizations without being subject to the Federal Advisory Committee Act (5 U.S.C. App.).

Approach

FRA established a Passenger Equipment Safety Standards Working Group (Working Group) comprised of representatives of the types of organizations listed in the Act to provide the consultation allowed by the Act. The Working Group first met on June 6, 1995, and continues to meet to assist FRA in developing passenger equipment safety standards. This ANPRM describes the issues before the Working Group, and seeks the assistance of other interested persons in providing information and views pertinent to this effort. FRA intends to use the Working Group throughout this rulemaking. The minutes of the Working Group meetings and the materials distributed at these meetings to date have been placed in the docket. FRA intends to keep a current record of the Working Group's activities and decisions in the docket.

Topics Covered

Specific topics discussed by this ANPRM include:

(1) System safety programs and plans;
(2) Passenger equipment crashworthiness;
(3) Inspection, testing and maintenance requirements;
(4) Training and qualification requirements for mechanical personnel and train crews;
(5) Excursion, tourist and private equipment;
(6) Commuter equipment and operations;
(7) Train make-up and operating speed;
(8) Tiered design standards based on a system safety approach;
(9) Fire safety; and
(10) Operating practices and procedures.

FRA solicits suggestions for other matters related to passenger train safety standards that should be considered in order to promote safe and efficient train operations. FRA also solicits suggestions for alternate approaches or ways to structure passenger equipment safety standards.

Purpose of Notice

Section 215 of the Act (49 U.S.C. 20133) requires the Secretary of Transportation to prescribe minimum standards ‘‘for the safety of cars used by railroad carriers to transport passengers.’’ The Act specifically requires the Secretary to consider—

(1) The crashworthiness of the cars;

(2) Interior features (including luggage restraints, seat belts, and exposed surfaces) that may affect passenger safety;

(3) Maintenance and inspection of the cars;

(4) Emergency procedures and equipment; and

(5) Any operating rules and conditions that directly affect safety not otherwise governed by regulations.

Given the breadth of the specific items listed in the Act, it is clear that the Congress intended the agency to consider the safety of rail passenger service as a whole, determining the extent to which existing regulations should be supplemented or strengthened. Existing regulations affecting the safety of rail passenger service include standards for signal and train control systems, track safety, power brakes, glazing, programs of testing and training for railroad operating rules, and hours of service of safety-critical personnel, among others. While existing locomotive safety regulations address the structural characteristics of multiple-unit powered cars, non-powered cars are not subject to the same standards. In addition, FRA has not issued regulations addressing interior features of passenger equipment.

The Act requires issuance of initial passenger safety regulations within 3 years and final regulations within 5 years. FRA intends to establish a reasonably comprehensive structure of necessary safety regulations for rail passenger service in initial standards. Where further research is needed to develop a technical foundation for safety improvements, rulemaking may be completed over the 5-year period referred to in the Act.

The Act permits FRA to apply new requirements to existing passenger cars, but requires FRA to explain why any such ‘‘retrofit’’ requirements are imposed. FRA believes that passenger equipment operating in permanent service in the United States has established a good safety record, proving its compatibility with the operating environment. Many of the structural design changes identified during preliminary analyses are likely to be cost effective only if implemented for new equipment. Appropriate analysis should be conducted to evaluate whether selected safety measures can be applied to existing equipment or to rebuilt equipment on a cost-effective basis.

Collaborative Rulemaking and This Advance Notice

FRA is committed to the maximum feasible use of collaborative processes in the development of safety regulations. As a means to allow the industry to collaborate with FRA to develop this rulemaking, FRA established the Passenger Equipment Safety Standards Working Group, as described earlier. FRA structured the Working Group to give a balanced representation of the types of organizations listed in the Act.

A list of the private sector members of the Working Group is given in Table 1.

TABLE 1.—RAIL PASSENGER EQUIPMENT SAFETY STANDARDS; WORKING GROUP MEMBERSHIP LIST

Organization represented	Representative	Mailing address	Telephone	Fax
Amtrak	George Binns, General Manager for Compliance and Standards.	National Railroad Passenger Corporation, 30th Street Station, 4th Floor South, Philadelphia, PA 19104.	(215) 349–2731	(215) 349–2767
United Transportation Union	David Brooks, Conductor	15200 Brooksview, Brandywine, MD 20613.	(301) 888–1277	
National Association of Railroad Passengers.	Ross Capon, Executive Director	900 Second Street, N.E., Washington, DC 20002–3557.	(202) 408–8362	(202) 408–8287
American Public Transit Association.	Frank Cihak, Chief Engineer	1201 New York Avenue, N.W., Washington, DC 20005.	(202) 898–4080	(202) 898–4049
Federal Railroad Administration	Grady Cothen, Deputy Associate Administrator for Safety Standards.	400 Seventh Street, S.W., Washington, DC 20590–0002.	(202) 366–0897	(202) 366–7136
Electro-Motive Division, General Motors Corporation.	Harvey Boyd, Senior Research Engineer.	9301 West 55th Street, La Grange, IL 60525.	(708) 387–6013	(708) 387–5239
Federal Transit Administration	Jeffrey Mora, Office of Technology.	400 Seventh Street, S.W., Washington, DC 20590–0002.	(202) 366–0215	(202) 366–3765
American Association of State Highway and Transportation Officials.	William Green, Senior Railroad Inspector.	New York State Dept of Transportation, 120 Washington Avenue, Albany, New York 12232.	(518) 457–4547	(518) 457–3183
Safe Travel America	Arthur Johnson, Chairman	10600 Red Barn Lane, Potomac, MD 20854.	(301) 762–7903	
Brotherhood of Locomotive Engineers.	Leroy Jones, International Vice President.	400 North Capitol Street, N.W., Suite 850, Washington, DC 20001.	(202) 347–7936	(202) 347–5237
Brotherhood Railway Carmen	Hank Lewin, Vice President	AFL/CIO Building, Suite 511, 815 16th Street, N.W., Washington, DC 20006.	(202) 783–3660	(202) 783–0198
Siemens Transportation Systems, Inc..	Frank Guzzo, Director Rolling Stock.	700 South Ewing, St. Louis, MO 63103.	(314) 533–6710	
Bombardier Corporation, Transportation Equipment Group.	Larry Kelterborn, Consultant	1084 Botanical Drive, Burlington, Ontario, Canada L7T 1V2.	(905) 577–1052	(905) 577–1055
National Transportation Safety Board.	Russ Quimby, Investigator	490 L'Enfant Plaza, S.W., Washington, DC 20594.	(202) 382–6644	(202) 382–6884
American Public Transit Association.	Dennis Ramm, Chief Mechanical Officer, Metra.	547 W. Jackson Blvd., Chicago, IL 60661.	(312) 322–6575	(312) 322–6502

TABLE 1.—RAIL PASSENGER EQUIPMENT SAFETY STANDARDS; WORKING GROUP MEMBERSHIP LIST—Continued

Organization represented	Representative	Mailing address	Telephone	Fax
Federal Railroad Administration	Brenda Moscoso, Economist, Office of Safety Analysis.	400 Seventh Street, S.W., Washington, DC 20590–0002.	(202) 366–0352	....
Federal Railroad Administration	Thomas, Tsai, Program Manager, Office of Research.	400 Seventh Street, SW., Washington, DC 20590–0002.	(202) 366–1427	....

TABLE 2.—PASSENGER TRAIN OCCUPANT CASUALTIES; TEN YEAR PERIOD 1985–1994

	Train accidents		Grade crossing accidents		Non-accident passenger train incidents		Total passenger train occupants	
	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured
1985	0	287	0	30	3	424	3	741
1986	1	409	0	72	4	269	5	750
1987	17	258	0	20	1	261	18	539
1988	2	160	0	39	2	246	4	445
1989	1	103	2	123	8	253	11	479
1990	0	238	1	41	3	280	4	559
1991	9	61	0	29	0	333	9	423
1992	0	48	1	114	3	299	4	461
1993	54	171	1	86	9	402	64	659
1994	3	129	0	96	3	343	6	568
Totals	87	1864	5	650	36	3110	128	5624

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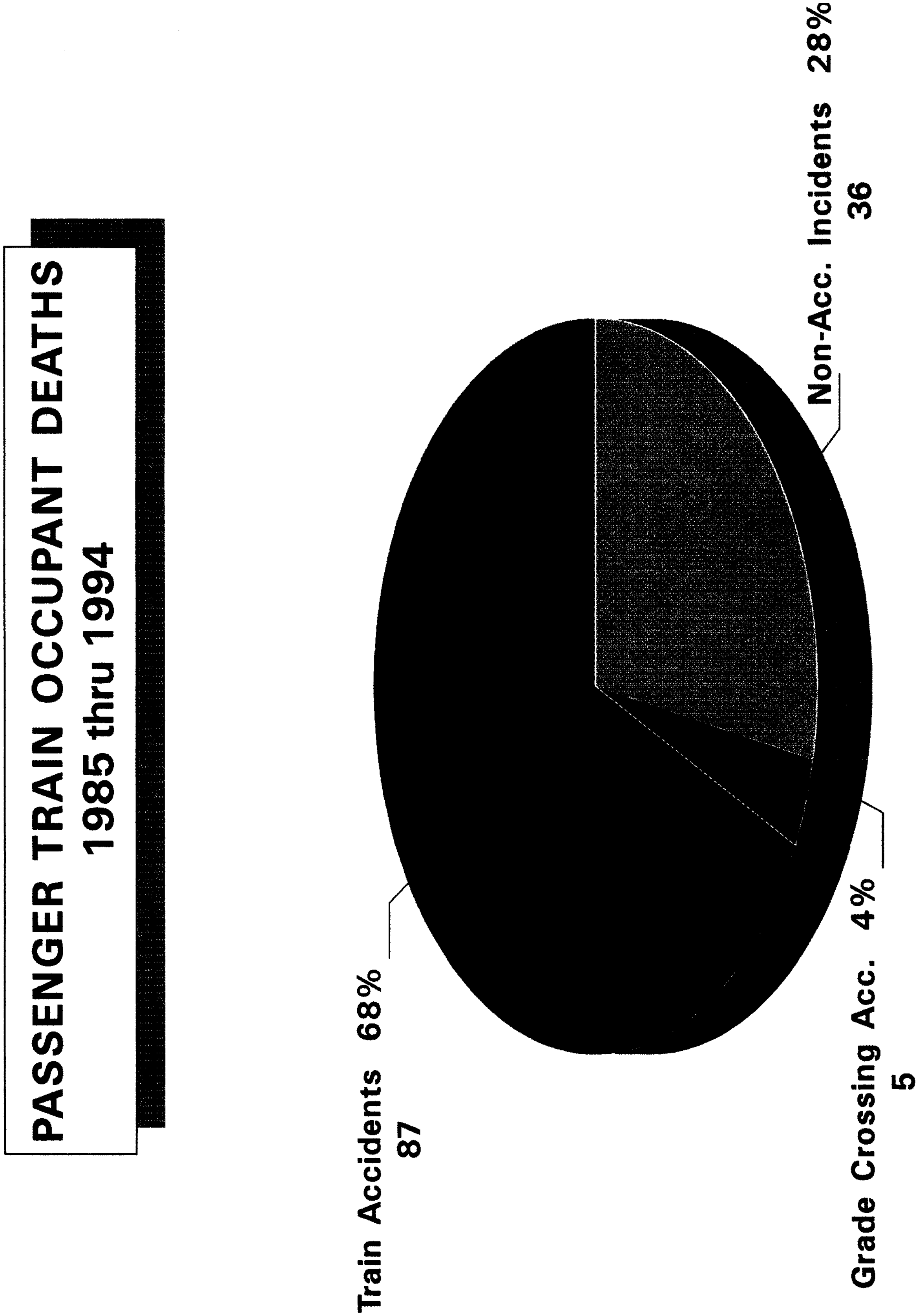

Figure 1

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An FRA representative chairs the Working Group, and a representative of the Federal Transit Administration (FTA) serves as associate member. Staff members from the National Transportation Safety Board (NTSB) also attend and assist the Working Group. In addition, the Working Group is supported by FRA program, legal and research staff, including technical personnel from the Volpe National Transportation System Center (Volpe Center). Vendors of equipment to passenger railroads constitute another essential source of information about rail passenger equipment safety. Accordingly, FRA has included vendor representatives designated by the Railway Progress Institute (RPI) as associate members of the Working Group. As one of its first tasks, the Working Group developed a statement of its charter and scope of effort.

The Working Group is broadly representative of interests involved in intercity and commuter service nationwide. This service is regularly scheduled, employs contemporary electric multiple-unit (MU) equipment, electric or diesel electric power, is often intermingled on common rights-of-way with freight movements, and often involves maximum speeds in the range of 79 to 125 miles per hour (mph) with speeds up to 150 mph projected in the near future.

FRA also regulates approximately 100 additional railroads that provide service often characterized as historic, excursion, or scenic. These ''tourist'' or ''museum'' railroads often employ steam locomotives or older generation diesel power, and historic coaches or freight equipment modified for passenger use. Tourist and museum railroads vary widely in the nature of their operating environment, personnel, train speeds, and other characteristics. FRA intends to form a small, separate working group comprised of tourist and museum operators and freight or passenger railroads that host or provide this type of service. FRA will request that the Tourist Railway Association, the Association of Railway Museums, and AAR provide representation for this effort.

Regulations governing emergency preparedness and emergency response procedures for rail passenger service will be covered by a separate rulemaking and are being addressed by a separate working group. Persons wishing to receive more information regarding this separate effort should contact Mr. Dennis Yachechak, Operating Practices Division, Office of Safety Assurance and Compliance, RRS–11, Room 8314, FRA, 400 Seventh Street, S.W., Washington, D.C. 20590 (telephone 202–366–0504) or David H. Kasminoff, Trial Attorney, Office of Chief Counsel, FRA, 400 Seventh Street, S.W., Washington, D.C. 20590 (telephone 202–366–0628).

FRA's commitment to developing a proposed rule through the Working Group necessarily influences the role and purpose of this ANPRM. FRA sets forth in this ANPRM numerous preliminary ideas regarding approaches to safety issues affecting passenger service. These are ideas that have already been placed before the Working Group as concrete, illustrative approaches to possible improvements in the safety of passenger service. They are provided in this ANPRM as information to any interested person not involved in the Working Group's deliberations. FRA wishes to emphasize, however, that these concepts do not constitute specific proposals of the agency in this proceeding, nor do they represent the position of the Working Group. In addition, issuance of this ANPRM should not be considered a diminution of FRA's intent to prescribe passenger equipment safety regulations within the 5-year period required by the Act.

FRA expects that the Working Group will develop proposed rules based on a consensus process. The proposals will be based on facts and analysis flowing from the Working Group's deliberations. Accordingly, FRA has requested that the Working Group's members and the organizations that they represent refrain from responding formally to this ANPRM.

Just as FRA will not prejudge the outcome of the Working Group deliberations, FRA asks organizations represented on the Working Group to avoid adopting fixed positions that could polarize the discussion within the Working Group. Rather, the deliberations of the Working Group should be permitted to mature through a careful, fact-based dialogue that leads to appropriate recommendations for cost-effective standards. The evolving positions of the Working Group members—as reflected in the minutes of the group meetings and associated documentation, together with data provided by the membership during their deliberations—will be placed in the docket of this rulemaking.

FRA invites other interested parties to respond to the questions posed in this ANPRM, submitting information and views that may be of assistance in developing a proposed rule. All comments provided in response to this ANPRM will be provided to the Working Group for consideration in preparation of the proposed rule.

Working Group's Scope of Effort

The Working Group will focus on developing safety standards for rail passenger equipment by applying a system safety approach—where practical—to:

(1) Determine and prioritize safety risks;

(2) Determine steps or corrective actions to reduce risks; and

(3) Optimize safety benefits.

The Working Group will recommend future research or test programs when a technology appears to have the potential for a safety benefit, but is not yet mature enough to be applied with confidence.

The Working Group will provide advice to FRA on all phases of the rulemaking process, to include:

(1) Recommending what issues or requirements must be covered by Federal regulations, and what issues or requirements can be effectively handled outside the body of Federal regulations by industry standards or some other means;

(2) Reviewing the written comments in response to the ANPRM, and recommending those comments that should affect a Notice of Proposed Rulemaking (NPRM);

(3) Providing cost information to support FRA's economic analysis of the proposed rule;

(4) Providing information and advice on the potential benefits of the proposed rule and its individual elements;

(5) Providing advice regarding critical assumptions required for the economic analysis;

(6) Reviewing and critiquing a draft NPRM prepared by FRA based on Working Group guidance;

(7) Reviewing the oral and written comments to the NPRM and recommending those comments that should affect a final rule;

(8) Reviewing and critiquing a draft final rule prepared by FRA based on Working Group guidance; and

(9) If requested by FRA, recommending actions to take to respond to any petitions for reconsideration received as a result of the final rule.

The Working Group will also assist FRA in drafting a second NPRM for passenger equipment power brake standards.

To ensure full development of the issues, the Working Group will attempt to draw on all sources within the industry to collect information necessary to conduct comparative analyses and reach decisions.

The Working Group will establish a procedure for considering ideas, approaches, and performance standards for use as part of the safety standards. This procedure should be based on the concept of reaching an overall consensus. Overall consensus means represented organizations may object—even strongly—to individual ideas, approaches, or standards, but the organization can accept and ''live with'' the evolving set of standards as a whole. FRA believes the success of this entire innovative approach to rulemaking depends on the ability of the group to reach overall consensus.

The Working Group will consider whether to continue to meet on a periodic basis after final rulemaking to consider changes necessary to keep any rules or other standards current and responsive to the needs of the industry.

Background

Need for Passenger Equipment Safety Standards

Rail passenger service is currently operated with a high level of safety. However, accidents continue to occur, often as a result of factors beyond the control of the passenger railroad. Further, the rail passenger operating environment in the United States is rapidly changing—technology is advancing; equipment is being designed for ever-higher speeds; and many potential new operators of passenger equipment are appearing. With this more complex operating environment, FRA must become more active to ensure that passenger trains continue to be designed, built, and operated with public safety foremost.

The General Accounting Office (GAO) recognizes this need in Report GAO/RCED–93–196, entitled ''AMTRAK Should Implement Minimum Safety Standards for Passenger Cars.'' In addition, NTSB has issued several recommendations to FRA and to the railroad industry concerning the crashworthiness of locomotives. Although the recommendations directly apply to freight locomotives, the same concerns exist for passenger train locomotives or power cars.

NTSB's Crashworthiness Concerns

NTSB's interest in locomotive crashworthiness dates to 1970, and NTSB has made several safety recommendations to FRA and the industry concerning increased protection for crew members in the cab based on the following accidents:

- On September 8, 1970, a collision between an Illinois Central (IC) and an Indiana Harbor Belt (IHB) train occurred at Riverdale, Illinois. The collision caused the IC caboose to override the heavy under frame of the IHB locomotive demolishing the control cab of the locomotive. Two following cars continued in the path established by the caboose, completing the destruction of the locomotive cab. The IHB engineer was found dead in the wreckage. NTSB recommended that FRA and the industry expand their cooperative effort to improve the crashworthiness of railroad equipment (NTSB Safety Recommendation R–71–44).
- An accident on October 8, 1970, involving a Penn Central Transportation Company freight train and a passenger train near Sound View, Connecticut, again demonstrated the weakness of the locomotive crew compartment. This collision caused NTSB to reiterate its recommendation to improve the crash resistance of locomotive cabs (NTSB Safety Recommendation R–72–005). This recommendation was ultimately classified as ''Closed-No Longer Applicable'' following the issuance of Safety Recommendation R–78–27 which addressed the same issue.
- The investigation of the collision of three freight trains near Leetonia, Ohio, on June 6, 1975, again prompted NTSB to recommend increased cab crashworthiness, including consideration of a readily accessible crash refuge (NTSB Safety Recommendation R–76–009). This recommendation was classified as ''Closed-Acceptable Action'' on August 6, 1978, following FRA's assurance that studies were continuing in this area.
- On September 18, 1978, a Louisville and Nashville freight train collided head-on with a yard train inside yard limits at Florence, Alabama. The lead unit of the yard train overrode the lead unit of the freight train. The cab provided no protection for the head brakeman and engineer, who jumped but were run over by their train.
- On August 11, 1981, a Boston and Maine Corporation freight train and a Massachusetts Bay Transportation Authority commuter train collided head-on near Prides Crossing, Beverly, Massachusetts. The lead car of the commuter train overrode the freight locomotive, pushing components of the locomotive into the cab killing three people.

NTSB's investigations of the above accidents resulted in recommendations to FRA regarding crashworthiness protection to the locomotive operating compartments (NTSB Recommendations R–77–37, R–78–27, R–79–11, and R–82–34). As a result of the FRA-sponsored report ''Analysis of Locomotive Cabs,''[1] NTSB classified these four recommendations ''Closed-Acceptable Action'' on November 24, 1982.

- A rear-end collision of two Burlington Northern (BN) freight trains occurred near Pacific Junction, Iowa, on April 13, 1983. The operating compartment of the lead locomotive on the striking train, BN train 64T85, was overridden by the caboose of train 43J05 when the trains collided. The locomotive operating compartment was crushed. (In general, when a locomotive strikes a caboose or a light freight car, the lighter vehicle overrides the locomotive, frequently with devastating results.) As a result of this accident, NTSB issued a recommendation that FRA initiate and/or support a design study to provide a protected area in the locomotive operating compartment for the crew when a collision is unavoidable (NTSB Recommendation R–83–102). This recommendation was subsequently classified as ''Closed-Unacceptable Action/Superseded'' based on a future investigation that reiterated similar concerns regarding locomotive crashworthiness.
- On July 10, 1986, Union Pacific (UP) freight train CLSA–09 struck a standing UP freight train near North Platte, Nebraska, at a speed of approximately 32 mph. Three locomotives and eleven cars from both trains derailed, and the accident resulted in one fatality and three injuries. This accident, in which the locomotive cab section of train CLSA–09 was destroyed on impact, probably would have resulted in fatal injuries to the engineer and head brakeman of train CLSA–09 had they not jumped from the cab prior to the collision. As a result, NTSB issued Safety Recommendation R–87–23, which recommends that FRA:

> Promptly require locomotive operating compartments to be designed to provide crash protection for occupants of locomotive cabs.

NTSB believes that locomotive collision investigations continue to demonstrate that improvements are needed in the crashworthiness design standards of locomotives.

As a result of investigations of numerous accidents involving passenger trains over the past 20 years, NTSB has recommended that FRA or the passenger railroad industry:

(1) Prescribe regulations requiring emergency means of escape from railroad passenger cars;

(2) Prescribe regulations requiring emergency lighting for railroad passenger cars;

(3) Initiate studies to determine the relationship between passenger car design and passenger injuries;

[1] ''Analysis of Locomotive Cabs.'' (Report No. DOT/FRA/ORD–81/84, National Space Technology Laboratories, September 1982.)

(4) Prescribe regulations requiring passenger cars with secured seats and luggage retention devices;

(5) Apply system safety principles to the acquisition, design, construction and renovation of passenger cars;

(6) Prescribe regulations to require back-up power for emergency lights and doors that can be opened in the event of loss of power;

(7) Require that rail passenger equipment be fitted with roof escape hatches;

(8) Promulgate regulations to establish minimum standards for the interior of commuter cars so that adequate crash injury protection and emergency equipment will be provided;

(9) Promulgate regulations to establish minimum standards for the design and construction of interiors of passenger cars so adequate crash injury protection will be provided;

(10) Promulgate regulations to establish minimum safety standards for the inspection and maintenance of railroad passenger cars; and

(11) Amend the power brake regulations to provide appropriate guidelines for inspecting power brake equipment on modern passenger cars.

Accident/Incident Data

FRA has compiled a 10-year history of passenger equipment accidents/incidents that railroads have reported to FRA. FRA supplied this information to the Working Group and placed it in the docket. Table 2 summarizes the deaths and injuries reported to FRA by railroads for occupants of passenger trains during this 10-year period. The ''train accidents'' column of Table 2 includes all collisions, derailments, or fires involving passenger trains that resulted in more than $6,300 damage to on-track equipment, signals, track, track structure, or road bed. The ''grade crossing accidents'' column of Table 2 includes all reported impacts of a passenger train with cars, trucks, busses, farm equipment, or pedestrians at grade crossings. The ''non-accident passenger train incidents'' column of Table 2 includes all reports of injuries or deaths of passenger train occupants not caused by a train accident or grade crossing accident.

Figure 1 is a pie chart depicting the percentages of deaths to passenger train occupants caused by train accidents, grade crossing accidents, and non-accident incidents. Figure 2 shows the 10-year trend for each of these causes of deaths.

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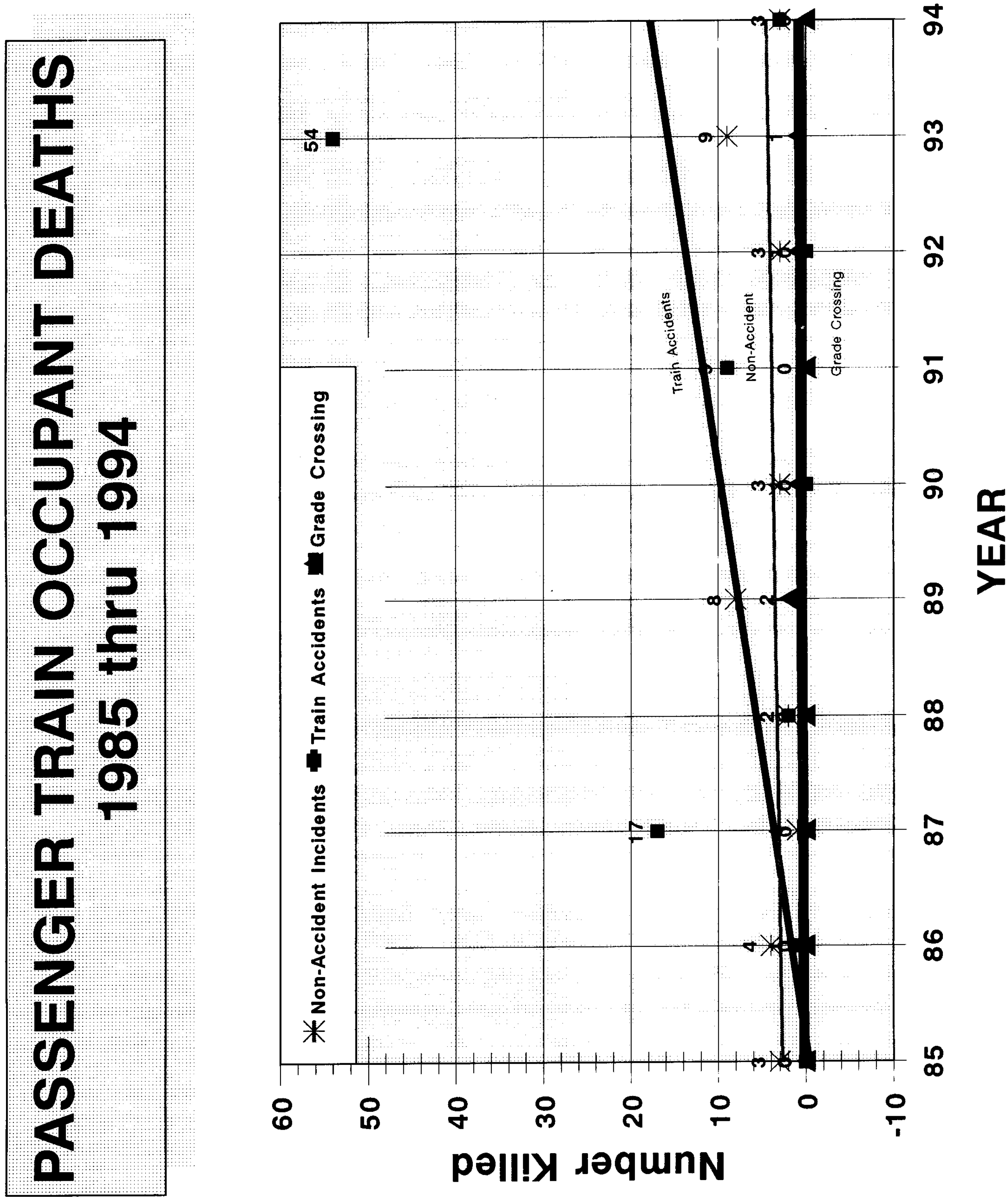
PASSENGER TRAIN OCCUPANT DEATHS
1985 thru 1994
Non-Accident Incidents
Train Accidents
Grade Crossing
Number Killed
60
50
40
30
20
10
0
-10
85
86
87
88
89
90
91
92
93
94
YEAR
Train Accidents
Non-Accident
Grade Crossing
54
17
3
4
0
2
8
2
3
0
3
9
1
3

Figure 2

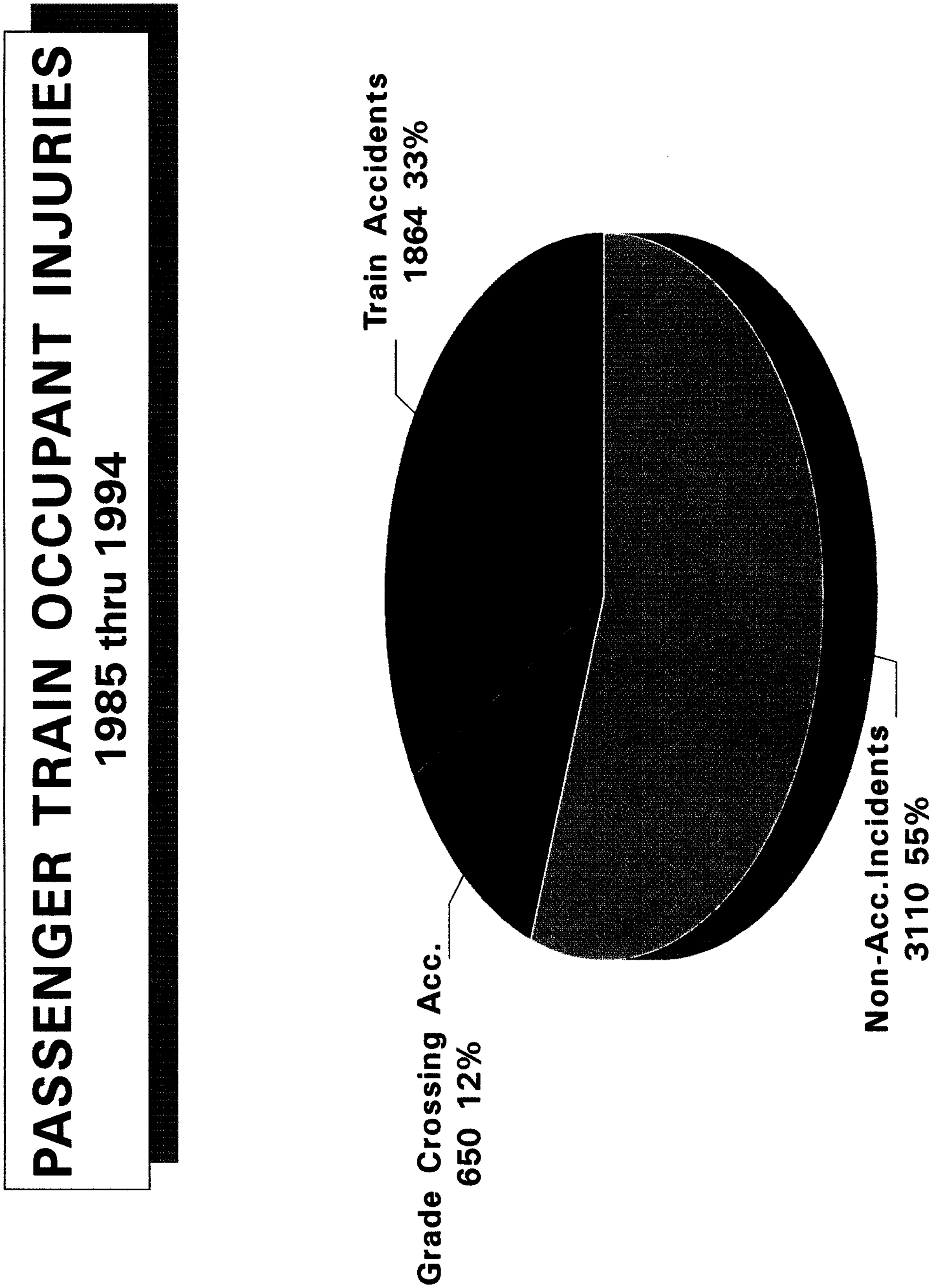

Figure 3

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Figure 3 is a pie chart depicting the percentages of injuries to passenger train occupants caused by train accidents, grade crossing accidents, and non-accident incidents. Figure 4 shows the 10-year trend for each of these causes of injuries to occupants of passenger trains. (Amtrak has noted that the showing of only 10 years of accident data is somewhat distorted in that two accidents account for over 80 percent of the deaths, and one of the accidents had substantial intermodal implications.)

Comment is requested regarding the significance of this data, elements of societal and railroad cost not included in the reported data, and factors to be considered in evaluating the risk of future catastrophic passenger train accidents.

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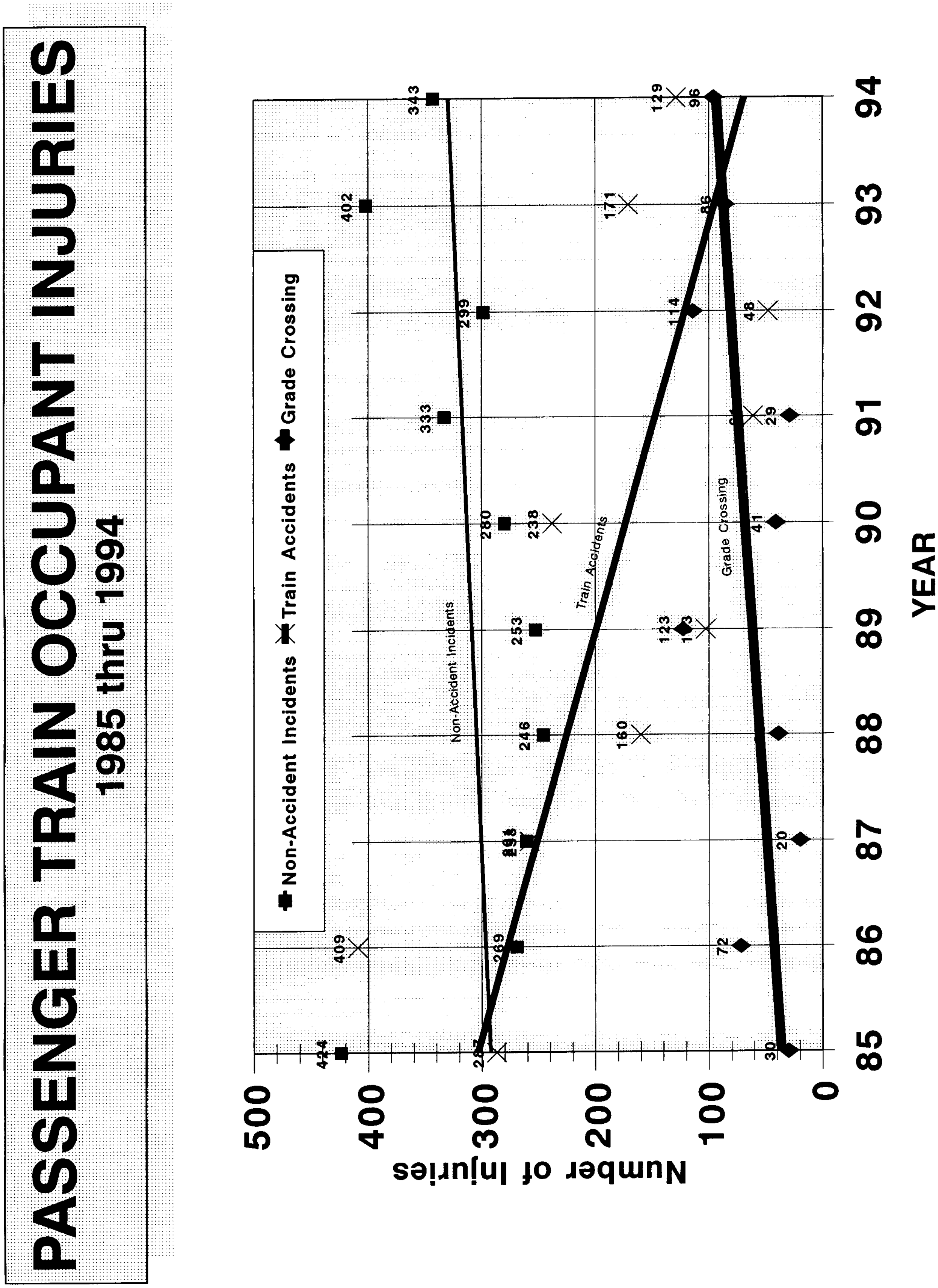

Figure 4

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Approach/Structure for Safety Standards

Scope and Context

FRA recognizes that safety standards that apply only to passenger equipment provide only a partial solution to improving rail passenger safety, and the best way to increase rail passenger safety is to keep trains on the track and spaced apart.

Keeping trains on the track and apart requires a systems approach to safety that includes railroad track, right-of-way, signals and controls, operating procedures, station- and platform-to-train interface design, as well as equipment. FRA has active rulemaking and research projects ongoing in a variety of contexts that address non-equipment aspects of passenger railroad system safety.

While reflecting the other aspects of passenger railroad system safety, this rulemaking will focus on:

(1) Equipment inspection, testing, and maintenance standards;

(2) Equipment design and performance standards;

(3) Platform- and station-to-train interface design and procedures to promote safe ingress and egress of passengers; and

(4) Other issues specifically related to safe operation of rail passenger service not addressed in other FRA regulations, proceedings, or program development efforts.

Existing Rail Passenger Operations

FRA intends to structure any proposed actions to cause a minimum of disruption to existing safe operations of passenger equipment. This notice is designed to bring to FRA's attention the special situations and problems confronting tourist and excursion railroads, private passenger car owners, commuter railroads, and the existing operations of Amtrak, which all have a long history of safe operation. FRA believes the first objective of this rulemaking should be to construct common sense minimum safety floors under these existing operations. To the extent new technology or innovative approaches might offer opportunities for improving safety performance on a cost-effective basis, FRA seeks the appropriate means to exploit these opportunities.

A common sense safety floor under existing safe operations includes a complete pre-departure (or daily) safety inspection of each departing train conducted by skilled inspectors, and a well-planned test and preventive maintenance program for safety-critical components of the system triggered by time, mileage, or some other reliability-driven parameter. (A ''safety critical component'' is a component whose failure to function as intended results in a greater risk to passengers and crew.) One of the main purposes of this ANPRM is to solicit information concerning:

(1) The steps necessary to conduct a complete pre-departure or daily safety inspection of the equipment;

(2) A means to demonstrate (*e.g.*, training, testing, supervision, certification) that safety inspectors have the knowledge and skills necessary to perform effective inspections or tests;

(3) The minimum planned or periodic maintenance program required to keep the equipment in safe operating condition;

(4) The frequency of required planned or periodic maintenance; and

(5) The costs and benefits associated with the requirements under consideration.

Special Consideration for Tourist and Excursion Railroads

Tourist and excursion railroads generally provide passenger rail service as entertainment or recreation, often at low speed on track dedicated to that service alone. FRA recognizes the extensive service provided by this growing sector of the railroad industry, and the need to tailor appropriate safety requirements to the level of risk involved. Accordingly, FRA will work to identify appropriate criteria for creating relatively simple system safety plans and programs for tourist and excursion railroads that recognize the special needs of this sector of the industry.

Speed and distance limits may be helpful to define tourist and excursion railroads excepted from many of the effects of any proposed passenger equipment safety standards. For instance, less stringent requirements might be applied to a railroad with a maximum operating speed of 30 mph and a maximum trip distance of 250 miles. In addition, operations segregated from the general railroad system may warrant consideration for less stringent requirements. FRA seeks comment on these proposed limits and, as noted earlier, will request assistance of an appropriately representative working group to develop these issues.

Special Consideration for Private Passenger Cars

FRA recognizes private passenger cars as another segment of the industry that may need special consideration. However, some important differences between the two types of operations exist that need to be taken into account. Private passenger cars often operate as part of freight, Amtrak, and commuter trains at track speeds over long distances. Providing regulatory relief to private passenger car owners through speed and/or distance limitations could severely restrict current operations. The host railroads often impose their own safety requirements on the private passenger cars and have a strong interest in any Federal safety standards that apply to private passenger cars. FRA intends to fully involve Amtrak, the American Association of Private Railcar Owners, and the American Public Transit Association (APTA) as standards for private passenger cars are developed.

Does the simple system safety program proposed for tourist and excursion railroads make sense for private passenger cars? If not, why? Do alternate means exist to provide regulatory relief to private passenger car owners without imposing restrictive speed and distance limits? How should railroad business or observation cars be treated?

New Rail Passenger Service or Systems

FRA intends the main thrust of any proposed safety standards for equipment design to be focused on new equipment and new rail passenger service. New equipment and new service present the opportunity to analyze the proposed equipment and its intended use to ensure that a systematic approach is taken to design safety into the operation. However, some of the safety enhancements that the final rule resulting from this ANPRM deem necessary for new equipment may have the potential to be applied to existing or to rebuilt equipment. Without such consideration, opportunities to increase safety that stand up to a cost/benefit analysis could be lost. In addition, not requiring rebuilt equipment to meet the latest standards provides an incentive to rebuild equipment rather than purchase new equipment, thus delaying the full benefit of the new standards.

Passenger Equipment Power Brakes

On September 16, 1994, FRA published a notice of proposed rulemaking on power brakes. 59 FR 47676. Much of the public testimony received in response to the NPRM emphasized the differences between freight operations and passenger operations, and the differences between freight equipment brake systems and passenger equipment brake systems. In light of this testimony, and because passenger equipment power brake standards are a logical subset of passenger equipment safety standards, FRA will separate passenger equipment power brake standards from freight equipment power brake standards. The Working Group will assist FRA to develop a second NPRM that covers passenger equipment power brake standards. Since power brakes have already been the subject of a recent ANPRM, NPRM, and supplementary notice, FRA is not seeking additional information on passenger equipment power brakes, and they will not be addressed in this ANPRM.

Regulatory Flexibility

FRA conducts this proceeding to determine how best to meet the need to assure the public of continued safe operation of passenger trains in a more complex operating environment. Although FRA is required by law to issue minimum standards for passenger equipment safety, FRA recognizes that the level of detail properly embodied in regulations can and should be powerfully influenced by the presence of voluntary standards adhered to by those participating in their development. FRA encourages the formation of a rail passenger industry forum (similar to AAR in some functions, but more representative of all segments of the rail passenger industry) to establish supplementary safety standards developed through industry consensus. Such an organization could reduce the need for detailed Federal regulations beyond such basic requirements as may be appropriate to provide for safety.

FRA desires to structure regulations to provide the flexibility necessary for introduction of new technology or new operating concepts that could improve service and safety. Use of performance standards—where feasible—can best achieve this objective.

FRA desires this ANPRM to stimulate discussion focused on how FRA can meet its responsibility to the public while imposing a minimum regulatory burden on the rail passenger industry. Does the industry have plans to establish a forum with the charter and authority to develop safety standards by consensus for the industry, or can an existing organization serve this function? If such a group can be established, what safety concerns have a high potential of being resolved through industry consensus and voluntary action? What time frame would be required to develop industry safety standards by consensus? What role could/should rail labor organizations, equipment builders, component suppliers, and state agencies play in developing these safety standards? What assurances could be provided that the industry would adhere to these safety standards? What role could/should FRA play to assist the industry in developing these standards? When consensus cannot be reached or is not adequate, and Federal regulations are required, how can the flexibility/adaptability of the regulations to meet a dynamic operating environment and changing technology be maximized? To what extent might development of voluntary industry guidelines limit the need for highly detailed or prescriptive Federal standards?

Discussion of Issues

An introductory discussion of several concepts—crucial to rail equipment safety—may convey a better understanding of the approach FRA is considering to develop safety standards for new passenger equipment. These concepts are:

(1) system safety plan and program;

(2) rail vehicle crashworthiness;

(3) crash energy management;

(4) suspension system performance; and

(5) wheel thermal stress.

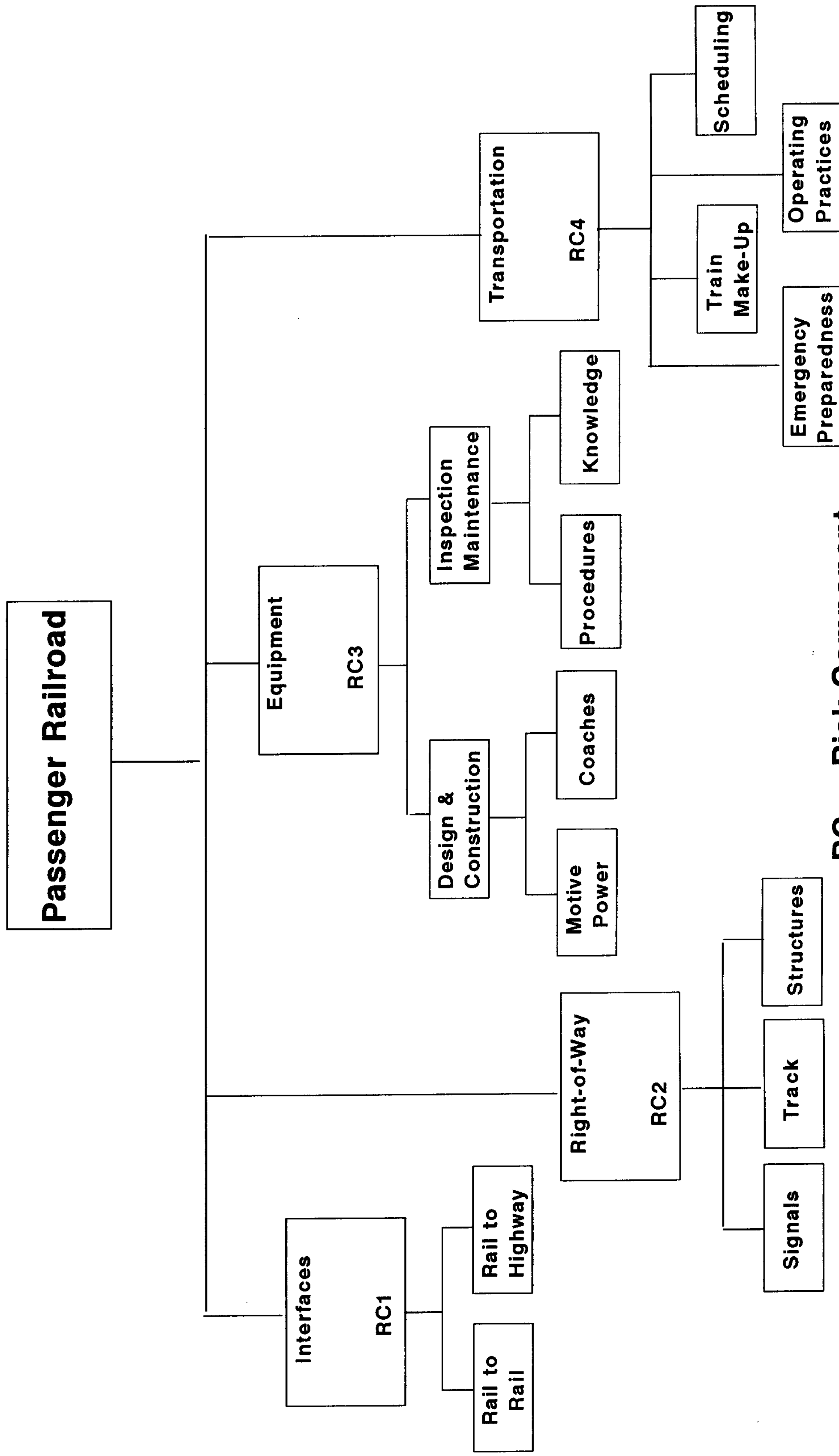
System Safety Plan and Program

The heart of the approach to new passenger equipment safety standards will be a system safety program. A system safety plan is a document developed by the operator—with a large input from the builder of new equipment—to describe the system safety program. The plan should lay out a top-down approach to how the system—including the equipment, the inspection, the testing and maintenance program, the routes over which the equipment will operate, and the operating rules that will be applied to it—will be designed, tested, and verified to meet all safety requirements and provide a safe operation.

A true and complete system safety approach begins at the top level of the system—in this case, the ''system'' is the entire railroad operation. For the purpose of risk analysis, the railroad system must be broken down into its component systems. No one—or right—way exists to perform this breakdown. It can be done many ways. Figure 5 is just one logical example.

BILLING CODE 4910–06–P

Partitioning Passenger Railroad into Subsystems for a System Safety Risk Analysis



RC = Risk Component

Total Risk = RC1 + RC2 + RC + RC4

Figure 5

BILLING CODE 4910–06–C

Many passenger railroads operate at least partially as a tenant on the right-of-way and property of another railroad. In this case, the passenger railroad may have little or no control under the contractual terms of the tenancy arrangement, and little or no prospect of gaining future control over some of the major risk components of the risk analysis. The actions of the passenger railroad cannot change these risk components, and for the purpose of performing a system safety analysis, they must remain fixed and be accepted as a given unless subject to separate changes in Federal standards.

For example, a passenger railroad that operates largely as a tenant would have little or no control over the Interfaces (RC1) and Right-of-Way (RC2) risk components. By holding these risk components fixed, the system safety approach degrades to a systems approach applied to the remaining two subsystems rather than to the railroad as a whole. The ''systems'' methodology still has considerable merit when applied to the remaining subsystems, but a true system safety approach cannot be applied to a system that has major risk components that are constrained. This analysis could help define the equipment crashworthiness features required for its intended purpose, or the operational limitations needed to improve or retain safety levels.

What practical constraints must be taken into account when applying a system safety approach to passenger railroads? When all practical constraints are taken into account, how should the system safety approach be applied to help develop passenger equipment safety standards?

The system safety plan can range from a relatively simple document—for conventional equipment being procured to continue an existing service—to a detailed document laying out a comprehensive approach for designing, testing, and operating state-of-the-art high-speed passenger rail systems. The outline of the system safety plan given in Appendix A applies to the procurements of new high-speed trainsets. For the less complex procurements of replacement equipment for existing service, the plan should be simplified and tailored to fit the particular need. It should be emphasized that the purpose of the system safety plan is to force a thorough thought process to ensure safety is optimized.

The purpose of a formal system safety program, among other things, is to ensure safety is adequately addressed during the design of passenger trainsets and during the development of the inspection, testing, and maintenance program that supports these trainsets. The system safety program also permits other high risk components in the system to be identified, including operational aspects and the signaling and grade crossing technology employed. The system safety program requires:

(1) Analysis of the trainset design for identification of safety hazards (risk assessment) and systematic elimination or reduction of the risk associated with these hazards (mitigating actions);

(2) Analysis of operational aspects for safety hazards and, where feasible, systematic elimination or reduction of the associated risk of these hazards; and

(3) Development of the inspection, testing, and maintenance concept in a step-by-step process to determine the procedures and maintenance intervals necessary to keep the trainset operating safely.

MIL–STD–882C defines the approach taken for system safety programs used by the United States military. A copy has been placed in the docket. This document is an excellent reference for how to plan and conduct a system safety program.

FRA solicits comments from all segments of the rail passenger industry on formal system safety programs. FRA is particularly interested in ways to tailor the program to meet the multitude of individual situations that exist in the industry. The purpose of the program is to ensure that safety is planned into new systems. FRA is searching for ways to ensure the system safety program is good business—not a regulatory burden. FRA seeks to determine the process necessary to ensure system safety is good business and allows flexibility in tailoring the planning to the level of the safety need.

Are any system safety plans currently in use? How much would it cost (in terms of time and effort) to update existing or develop new system safety plans? On average, approximately how often would system safety plans have to be updated? How would system safety plans improve safety? Specifically, what areas of safety would be improved, by how much, and why? Please provide copies of any studies, data, arguments, or opinions which support your answer.

Rail Passenger Equipment Crashworthiness

Since vehicle crashworthiness is one of the means to reduce safety risks, it is therefore a major subset of the system safety program. ''Rail passenger equipment crashworthiness'' means a system of interrelated vehicle design features intended to maximize passenger and crew survivability of collisions and derailments. Vehicle crashworthiness is the last line of defense or protection in the event all other precautions fail, and a serious accident occurs.

A risk assessment done by Arthur D. Little, Inc., (ADL) for Amtrak regarding operation of high-speed trainsets in the Northeast Corridor points to the need for attention to passenger equipment crashworthiness by showing that the following types of collisions could occur on the Northeast Corridor:

(1) Loaded freight equipment or locomotives might derail on adjacent track, overturning and fouling a high-speed main line. (The derailment could be caused by defective freight equipment or vandalism.)

(2) The braking system on a freight train or light locomotives could fail to operate properly, causing that consist to split a switch and occupy a high-speed main line immediately ahead of an oncoming high-speed passenger train.

(3) A high-speed passenger train could derail on a curve due to a track defect (*e.g.,* a broken rail initiated by the last freight movement) and strike a fixed object such as an abutment or pier.

Scenarios with substantially similar consequences are possible even after the installation of an enhanced train control system. These are the types of scenarios feared by freight railroads that allow passenger trains to operate on their systems, and have led the freight railroads to demand insulation from excessive tort liability.

To ensure crashworthiness, passenger equipment must:

(1) Maintain an envelope or minimum volume of survivability for passengers and crew which resists extreme structural deformation and separation of main structural members;

(2) Protect against penetration of the occupied compartments;

(3) Protect the occupants from being ejected from occupied compartments; and

(4) Protect the occupants from secondary impacts with the interior of the occupied compartments.

To make a passenger train accident survivable (1) the spaces occupied by people must be strong enough not to collapse, crushing the people; and (2) the initial deceleration of the people must be limited so they are not thrown against the interior of the train with unsurvivable force. Achieving these general objectives can be the most difficult challenge facing equipment designers.

Crash Energy Management

Crash energy management is a design technique to help equipment designers meet this challenge. The basic concept embodied by crash energy management is that designated sections in unoccupied spaces or lightly occupied spaces are intentionally designed to be weaker than heavily occupied spaces. This is done so that during a collision, portions of the unoccupied spaces will deform before the occupied spaces, allowing the occupied spaces of the trainset initially to decelerate more slowly and minimize the uncontrolled deformation of occupied space.

The docket contains two technical papers [2] by the Volpe Center that analyze the merits of crash energy management design techniques. These studies evaluate the effectiveness of alternative strategies for providing crashworthiness of passenger rail vehicle structures and interiors at increased collision speeds by comparing them to a design permitted by current standards.

Current regulations permit cars of essentially uniform longitudinal strength. Simplified analysis done using a lumped-mass computer model and an idealized load-crush curve predicts this type of design to be effective in maintaining survivable volumes in coaches for train-to-train collision speeds up to 70 mph. Further analysis needs to be done using a more complex distributed-mass computer model and a widely accepted load-crush curve to refine this prediction.

Using a simplified lumped-mass computer model, the assumed uniform longitudinal strength causes the predicted structural crushing of the train to proceed uniformly from the front to the rear of the train, through both the unoccupied and occupied areas of the train. Using a distributed-mass computer model, structural crushing of uniform strength equipment tends to be predicted to occur at both ends of the car, more in agreement with observations from actual accidents.

The crash energy management design approach results in varying longitudinal strength, with high strength in the occupied areas and lower strength in the unoccupied areas. This approach attempts to distribute the structural crushing throughout the train to the unoccupied areas to preserve the occupant volumes and to control and limit the decelerations of the cars. The crash energy management approach has been found to offer significant benefits. (Amtrak has noted that while this concept seems to work well for single-level equipment with vestibules at each end, its application to a bi-level design—which is now Amtrak's long distance standard—was not considered in these publications.)

The interior crashworthiness study evaluates the influence of interior configurations and occupant restraints on injuries resulting from occupant motions during a collision. For a sufficiently gentle train deceleration, compartmentalization (a strategy for providing a ''friendly'' interior) can provide sufficient occupant protection to keep widely accepted injury criteria below the threshold values applied by the automotive industry.

The Volpe Center reports show that, if installed properly and used, the combination of lapbelts and shoulder restraints can reduce the likelihood of fatality due to deceleration to near-certain survival for even the most severe collision conditions considered. However, individual restraints may have limited practical value on a train, where mobility within the vehicle is an important attribute of service quality, and times of most significant risk cannot be predicted. The most likely application of personal restraints could be in a control compartment located at the front of the train.

The value of a crash energy management design is not in the energy absorbed—only a few percent of the kinetic energy of a high-speed collision can be absorbed in a reasonable crush distance. The real safety benefit comes from allowing the occupied spaces to decelerate more slowly, while decreasing the likelihood that occupied spaces will fail in an uncontrolled fashion. If the occupied spaces are initially decelerated more slowly, people will be pinned to an interior surface of the trainset with less force, resulting in fewer and less severe injuries. Once pinned against an interior surface, occupants can then sustain much higher subsequent decelerations without sustaining serious injuries. Also, since unoccupied space is intentionally sacrificed, less occupied space will be crushed during the collision.

Crash energy management design involves a system of interrelated safety features, in addition to controlled crushable space, that could include: (1) design techniques to keep the trainset in line and on the track for as long as possible during the initial impact;

(2) Interior design that eliminates sharp corners and that pads, with shock absorbing material, surfaces that are likely to be struck by people thrown about by a collision;

(3) Attachment of interior fittings and seats with sufficient strength not to fail and thereby cause additional injuries; and

(4) A crash refuge for the vulnerable crew members in the cab.

To help maintain survivable volumes in passenger equipment, particularly during collisions at higher closing speeds, minimum standards for the following structural design parameters would be needed:

(1) Anti-buckling to keep the train in line and on the track for as long as possible after impact. (Prevention of buckling is not always possible, but it can be delayed);

(2) End structures and anticlimbers to prevent override and telescoping;

(3) Corner posts to deflect glancing collisions;

(4) Rollover strength;

(5) Truck to car body attachment; and

(6) A control cab crash refuge.

''Anti-buckling'' refers to trainset design techniques intended to prevent to a certain force level or delay both vertical (override) and/or lateral buckling. The current state-of-the-art in passenger rail equipment design will impose limitations on the extent to which anti-buckling can be achieved. (Devices that meet the anti-buckling requirements have not been developed or tested. Those devices that have been evaluated by the French National Railroad in actual crash testing of their latest TGV bi-level design are intended to prevent override similar to those devices currently required on North American equipment.)

Standards would be necessary to address the general design parameters to limit decelerations of passengers and crew, as well as flying objects striking passengers and crew. One possible approach is to define, under the dynamic conditions created by a specific collision scenario:

(1) Limits on the maximum and average deceleration of the crew in the control cab for the first 250 milliseconds after impact (assuming the crew had anticipated the collision and placed themselves in the crash refuge);

(2) Limits on the maximum and average deceleration of passengers in passenger cars for the first 250 milliseconds after impact;

(3) Minimum longitudinal, lateral, and vertical seat attachment strength;

(4) Minimum longitudinal, lateral, and vertical fitting attachment and

[2] ''Evaluation of Selected Crashworthiness Strategies for Passenger Trains.'' D. Tyrell, K. Severson-Green & B. Marquis, U.S. Department of Transportation Volpe National Transportation System Center, January 20, 1995; ''Train Crashworthiness Design for Occupant Survivability.'' D. Tyrell, K. Severson-Green & B. Marquis, U.S. Department of Transportation Volpe National Transportation System Center, April 7, 1995.

luggage stowage compartment strengths; and

(5) Minimum padding requirements for seat backs and interior surfaces. Achieving the second item requires careful design to create a differential in structural strength between passenger seating areas (''occupied volume'') and certain other areas that would be allowed to fail before the occupied volume. By contrast, permitting uniform rigidity throughout the trainset could result in unacceptably high initial accelerations of the passenger compartments and possibly make the accident non-survivable.

Suspension System Performance

A passenger train suspension system's purpose is to follow the track at all speeds of operation and to minimize the vibrations and motions transmitted to the passengers. An unsafe condition occurs whenever the suspension system:

(1) Allows a wheel to lift from a rail;

(2) Allows a wheel to climb over a rail;

(3) Transmits excessive vibration or motion to the passengers;

(4) Exerts excessive force on a rail causing it to shift or roll; or

(5) Allows unstable lateral hunting oscillations of a truck or wheelset.

The vehicle no longer safely follows the track when a wheel either climbs the rail or lifts from the rail. Wheel climb may occur in curves where large lateral forces are generated as the truck negotiates the curve. These lateral forces, particularly in combination with changes in vertical wheel load caused by track surface variations, can cause the wheel to climb the rail.

The ratio of lateral to vertical forces acting on a wheel (L/V ratio) is generally taken as a measure of the proximity of the wheel to derailment. If L/V remains less than Nadal's limit, which is 0.8 on clean, dry, tangent track, then wheel derailment is remote.

Whenever insufficient vertical force exists to support the lateral force acting on the rail, wheel climb can potentially occur under a broad range of track alignment and surface geometry combinations. If a wheel lifts due to excessive rolling, twisting, or other motions of the car body or truck, it will likely return to the rail as long as no excessive lateral forces exist to push it out of line with the rail. However, wheel lift represents a potentially unsafe condition, because there is no certainty of the absence of a strong lateral force that prevents the wheel's return to the rail. To assure that the wheel remains in contact with the rail, each wheel must maintain a minimum vertical load of 10 percent of the nominal static wheel vertical load on straight, level track.

Excessive lateral forces acting on a rail can cause the rail to rollover and/or shift outward, allowing a wheelset to drop between the rails. For this to happen, all wheels on one side of a truck must be pushing outward on a rail. The railroad industry generally accepts that if the ratio of the sum of the lateral forces to the sum of the vertical forces exerted by all the wheels on one side of a truck on the rail is less than 0.5, there is little danger of rail rollover or shift.

Excessive lateral forces, induced by a car traversing the track, can also cause the track as a unit to shift laterally on its ballast. To assure that the track does not get pushed out of alignment by a train, the ratio of the net lateral load exerted by each axle to the net vertical load exerted by that axle must remain less than 0.5.

Passenger ride quality is generally a comfort rather than a safety concern, unless ride quality deteriorates so that passengers are injured by a rough ride. To provide minimum protection for passengers from injuries due to being thrown about by excessive car body motions, FRA believes that equipment should be designed such that car body lateral accelerations are less than 0.30g peak-to-peak and the car body vertical accelerations are less than 0.55g peak-to-peak, while the square root of the sum of lateral accelerations squared plus the vertical accelerations squared (the vector sum) is less than 0.604g peak-to-peak. Compliance with this design standard would typically be established as part of an equipment qualification program.

Sustained lateral oscillations of the truck (''truck hunting'') can lead to derailment. Sensor technology allows the lateral accelerations of the truck to be constantly monitored under service operating conditions. FRA proposes that trucks be equipped with accelerometers to monitor for hunting so that corrective action can be taken when hunting is detected. FRA proposes to define ''hunting'' as a lateral acceleration of the truck frame in excess of 0.8g peak-to-peak repeated for six or more cycles.

Recent experience with the Massachusetts Bay Transit Authority's new bi-level commuter cars demonstrated the close relationship between suspension system performance and track geometry. The suspension system must be able to perform at low speed over track with relatively large surface variations, such as 3-inch cross level deviation, while maintaining stability and smooth ride quality at maximum service speeds.

FRA is concerned that suspension systems of all new passenger equipment maintain passenger safety over their entire range of intended operating conditions. The suspension system requirements, such as wheel equalization, must therefore be established for all equipment and service based on analysis from the system safety program. Compliance with this requirement would typically be established as part of an equipment qualification program.

Wheel Thermal Stress

FRA is concerned that frequent, repeated braking from high speeds could induce thermal damage in wheels that can result in cracking and potential wheel failure in service. New high-speed passenger equipment may include blended brakes which combine dynamic and friction braking (either on tread, disk, or both). Such blended systems typically maximize the available dynamic brake portion at all speeds to minimize wear and thermal input to the wheels, discs, and friction brake components. Wheel slide detection and prevention is typically available to minimize loss of wheel to track adhesion of individual wheelsets during deceleration.

Thermal demand on wheels due to frictional heating by tread brakes can be substantial when loaded cars are operated at high braking ratios. This scenario may apply to blended systems which use tread brakes more extensively to make up for the loss of failed dynamic brakes. Recent research has shown that for wheels on some types of passenger equipment operated at weights of 60 to 80 tons per car, at speeds from 80 to 100 mph and retardation rates of 2 to 3 mph/second, the brake horsepower which the wheel must absorb can flash-heat a shallow layer of the rim to a temperature high enough to damage the metal and possibly cause a change in its mechanical properties.

An operational test under simulated service conditions was conducted in October 1992 using wheels instrumented with thermocouples to measure temperatures in the rim. The test train was operated at near-empty weight (61 tons per car) and at speeds up to 100 mph. Wheel temperatures were measured during speed reductions and stops, at retardation rates from 1.3 to 1.9 mph/second, with tread braking only. Temperatures as high as 1000 °F. (538 °C.) were measured by the thermocouple closest to the tread surface (approximately 0.1 inch below the tread surface). The S-plate wheel design common in commuter service was used to obtain these results.

Current Federal safety standards for locomotives, under which MU cars are covered, define a defective wheel due to cracking as any wheel with ''[a] crack or break in the flange, tread, rim, plate, or hub.'' 49 CFR 229.75(k). Although the AAR Manual of Interchange Rules (1980) applies only to interchange freight service, it is often applied to equipment in passenger service and defines a wheel to be ''condemnable at any time'' if it contains ''thermal cracks: transverse cracks in tread, flange or plate * * *'' (Rule 41—Section A). The 1984 edition of the same manual adds a qualification as follows: ''Thermal or heat checks: Brake shoe heating frequently produces a fine network of superficial lines or checks running in all directions on the surface of the wheel tread. This is sometimes associated with skid burns. It should not be confused with thermal cracking and is not a cause for wheel removal.''

Heat checking is recognized by experienced failure analysts as a phenomenon distinct from thermal cracking. In the absence of other effects, heat checks are believed—at worst—to progress to minor shelling or spalling which can be detected and corrected well before they cause a risk to operational safety. However, recent research has shown that heat checks are unsafe if the affected wheel has also been subjected to rim stress reversal.

Wrought wheels used in commuter service are rim-quenched after forming to create a layer of residual compressive stress in the rim extending inward from the tread. Depths of penetration of the compressive layer are estimated at 1.2 inches (30 mm) by finite element simulations of the quenching process. This residual compressive stress is beneficial since compression tends to force cracks closed and retard crack growth.

Repeated wheel excursions to high temperatures can result in stress reversal in the wheel rim, especially in shallow layers near the tread surface where cracks are likely to originate. Estimates of residual stresses in new (as manufactured) wheels were obtained by application of an advanced finite element-based technique which uses stresses due to quenching as an input state and then calculates the final residual stress state after repeated simulated stop-braking from 80 mph at 2 mph/second. The results of this simulation predict stress reversal (reversal from circumferential compression due to quenching to residual tension) in a layer approximately ⅝-inch (16 mm) deep from the surface of the wheel tread.

This research causes FRA concern regarding the possibility of wheel failures due to cracking initiated in overbraked wheels. A visual estimation of thermal damage is difficult in the absence of cracks. Conventional practices based on wheel discoloration have been discredited as being unreliable indicators of wheel thermal damage. Within the limits of current sensor technology, the best means available to prevent wheel failure resulting from thermal damage is careful brake system design to limit the frictional heating of wheels to within safe limits.

Ad hoc recommendations identify the onset of thermal damage at wheel tread near surface temperatures of 600 to 700 °F. In order to better quantify the effect of temperature on wheel integrity, several metallurgical experiments of wheel material were done. The base material condition of a non-thermally abused wheel rim is normally a pearlitic microstructure hardened to approximately RC 35. Metallurgical examination near the treads of thermally cracked wheels shows a spheroidized microstructure with an increased hardness for a layer approximately ½-inch deep.

This microstructure form is usually associated with formation by a sequence of heating to extremely high temperatures (above 1400 °F.) followed by rapid quenching to produce martensite (an undesirable steel microstructure), followed by tempering at high temperature (800 to 900 °F.) to transform martensite to spheroidite.

Since field data indicated that wheel temperatures were not reaching the elevated levels necessary to produce the laboratory material transformation, more work was done to try to explain this inconsistency. This laboratory work involved testing of wheel steel samples that were exposed to combined rapid heating and high compression. The combination of heat and compression was used to simulate the environment of material near a wheel tread surface that is subjected to combined stop-braking (heat) and rail contact (compression). The results of these laboratory tests showed that the microstructure of the material can transform at temperatures below 1200 °F if the material is also compressed, and the transformed microstructure can have an appearance similar to that of spheroidite.

Based on this research, FRA is concerned that passenger equipment in service with frequent stops from high speeds can over brake wheels. Of particular concern is equipment that utilizes a high percentage of tread braking and blended brake systems that require a wheel tread friction brake to carry a greater portion of the braking load when the dynamic portion of the brake fails.

Disc brakes are commonly used on high speed passenger trainsets as a companion to the dynamic brake system to avoid some of the thermal problems that can be caused by tread brakes. Disc air brakes provide fail-safe braking and high levels of retardation. Disc brakes offer several advantages as opposed to tread brakes. Disc brakes are less sensitive to moisture and have more uniform coefficients of friction at high speeds. Disc brakes can also improve ride quality due to reduced jerk and less noise. In addition, disc brakes require lower brake forces than tread brakes, thus permitting smaller cylinders and lighter rigging. But the main advantage of disc brakes is that they allow braking heat to be dissipated using a heat sink other than the wheel.

Brake discs can be mounted directly to the wheel with bolts or can be axle mounted. Axle mounted discs are installed on the axle between the wheels. The disc consists of two friction rings interconnected by cooling fins, which exist in several forms, including a vane design and a ventilated design. The vanes and fins increase the convective cooling of the disc as it rotates. Retarding force is provided by means of a caliper—actuated by a pneumatic cylinder—that clamps brake pads against the rotating disc.

Substantial research and development effort has gone into the design of disc brakes, especially for European high-speed trains. While disc brakes are well suited for high-energy dissipation and high-temperature events, disc pad wear and thermally damaged discs are two of the cost drivers in maintaining high-speed passenger trainsets.

One manufacturer of disc brakes has recommended limiting disc pad temperatures to 750 °F. to prevent thermal damage to the wheels or brake pads during stop distance tests of a European trainset to be tested in the Northeast Corridor.

Based on these concerns and research, FRA wishes to explore requiring each railroad establish the maximum safe speed that each type of its equipment can be operated over a specific route, when the dynamic portion of the brake has failed or is disabled. These speed limits should be established as part of the system safety program.

Another possible concern involving disc brakes is wheel slide. Due to the high retardation rate that can be achieved with disc brakes, failure of the wheel slide protection system can cause the formation of martensite in the vicinity of the wheel/rail contact region. This can lead to wheel mechanical damage similar to that caused by excessive tread braking.

What steps have the passenger rail industry taken to prevent wheel damage due to over braking? What wheel thermal problems continue to occur in the field? How should thermal limits on wheels and discs be handled in safety regulations?

Tiered Equipment Design Standards Based on Risk Analysis

FRA believes there may be merit in a tiered approach to equipment safety standards based on a risk analysis of the operating environment in which the equipment will operate. (Tiers are levels of design requirements determined by system safety considerations.) The advantage of such an approach is that it takes into account system safety factors other than equipment design that reduce safety risks. The tiered approach also readily lends itself to amending the safety standards for a new type of service—a new tier could be added without changing the existing standards. The disadvantage is that such an approach can rapidly become very complex. Further, when applied to design performance criteria for new equipment, an excessively tiered approach could result in purchases of equipment that might be severely limited with respect to its future uses and marketability.

For simplicity, FRA had initially envisioned tiered safety standards based on operating speed alone. FRA suggested the following logical break points to the Working Group for tiered equipment standards:

- Level 1—up to 30 mph—Tourist and Excursion Railroads.
- Level 2—up to 79 mph—Conventional Passenger Operations.
- Level 3—up to 125 mph—Intermediate Speed Operations.
- Level 4—up to 150 mph—High Speed Operations.

However, discussions with the Working Group highlighted several objections to this approach based on tiering by maximum operating speed alone. Conventional intercity passenger trains operated by Amtrak, powered by diesel-electric locomotives, frequently operate at speeds up to 90 mph, and commuter railroads provide ''conventional'' service at speeds up to 110 mph. Both Amtrak and commuter railroads expressed a strong opinion that their ''conventional'' equipment had proven itself capable of operating safely at ''intermediate'' speeds.

The majority of the Working Group has expressed a preference for only two tiers of equipment standards for intercity and commuter service, and for basing the criteria for distinguishing between the tiers on a system safety approach rather than solely on operating speed. As a result, the discussion of tiered safety standards that follows centers around a two-tiered approach. FRA recognizes that approaches containing more than two tiers may be desirable. Accordingly, FRA will carefully consider alternate approaches received in response to this ANPRM that contain more than two tiers of safety standards. Such alternate approaches should attempt to explain the safety/economic advantages of safety standards based on more than two tiers, and should attempt to define and state the logic behind the criteria used to distinguish between these tiers. (A formal vote by the Working Group on the number of tiers to use has not been taken. Amtrak can envision the need for at least three tiers, as specified in the introduction of Appendix B.)

The basic concept behind a system safety approach for tiering is that safety risks can be reduced by controlling any number of operating environment factors in addition to equipment design, inspection, testing, and maintenance. Factors that should be considered when performing a risk analysis to determine the correct tier of equipment requirements include:

(1) Maximum operating speed;
(2) Presence of at-grade rail crossings;
(3) Type of protection at highway grade crossings;
(4) Number of at-grade rail crossings;
(5) Current and projected train traffic densities;
(6) Capabilities of current and planned signal systems;
(7) Tracks shared with freight trains;
(8) Shared rights-of-way with freight or light rail type operations;
(9) Wayside structures; and
(10) Special right-of-way safety features such as track separation distance, barriers or track obstruction detection systems.

If the risk analysis shows that the type of operation or non-equipment safety features result in a very low risk operation, less restrictive—or Tier I—equipment safety standards would be appropriate. If the risk analysis shows a higher risk of operation due to higher operating speeds, traffic densities, or some other factor, Tier II equipment safety standards—which reduce risk more than Tier I standards—would be used. A good example of a risk analysis of a passenger railroad operating environment is provided in a report prepared by ADL under contract to Amtrak, entitled ''Northeast Corridor Risk Assessment'' (August 26, 1994). A copy of this report is included in the docket.

One of the factors that will make an approach to equipment safety standards based on risk assessment difficult to implement is that the industry must quantify and make public the degree of risk that is considered acceptable. Is the level of risk per billion highway passenger miles the criterion? Is the level of risk per billion passenger miles in scheduled air carrier service the criterion?

FRA seeks industry comments on a tiered approach or alternate approaches to passenger equipment safety standards. Does the initial approach of speed break points suggested by FRA make sense? What would be the impact of imposing this set of break points? What existing commuter operations would be caught between conventional and intermediate speed standards? Should FRA grandfather the current equipment providing this service and apply the more stringent standards only to the new or refurbished equipment procured to provide service in this speed range? Should FRA also grandfather all of Amtrak's equipment providing service at speeds greater than 79 mph? Should other sets of break points be considered? If so, which and why? What should be the major change in equipment safety standards at each break point? What problems could be caused by the approach to grandfathering current equipment operating in each speed range?

Rather than the initial FRA approach, does the concept of tiered standards based on the outcome of a risk analysis make sense? Would such an approach be too complex? Is the industry willing to undertake the thorough risk analysis process necessary to make such an approach effective? What would the industry use as an acceptable level of risk to determine break points between tiers of requirements?

The discussion of possible safety standards that follows is based on a two-tiered approach. The question of exactly how to draw the line between the two tiers of requirements is not answered. For purposes of discussion, Tier I requirements are broadly applied to operations with a known low risk or record of proven safe operation, *e.g.*, passenger equipment operating at speeds of 110 mph or less. Tier II requirements are broadly applied to higher risk operating environments, *e.g.*, Amtrak's planned operation at 150 mph in the Northeast Corridor or perhaps cab-car-forward operations under some sets of higher risk operating conditions.

Although the discussion of possible safety standards that follows is based on a two-tiered approach, this does not mean FRA assumes a proposed rule will be based on two tiers. A discussion of a two-tiered approach serves only as the simplest means to present the concept of tiering. FRA remains open to alternate concepts based on more than two tiers, or concepts that define the break point between two tiers differently.

FRA recognizes the need to handle special equipment such as that operated by tourist and excursion railroads and private passengers cars outside this two-tiered system.

FRA also recognizes the possible future need for a third tier for equipment intended to operate at very high speeds—in excess of 150 mph. However, operations at such speeds would be considered only on dedicated rights-of-way with no at-grade highway or rail crossings. In such instances, FRA will review equipment safety criteria as an integral part of an overall system safety program, issuing a rule of particular applicability.

Discussion of Possible Safety Standards

Basis for Safety Parameters Under Consideration

In preparation for rulemaking, FRA considered the service history of general system railroads in the United States, research and technical advice from the Volpe Center (incorporating learning from human trauma studies in other modes of transportation), staff analysis, and learning gleaned from extensive consultations with knowledgeable persons (both within the United States and abroad) over several years of study. In addition, FRA has worked with Amtrak to develop safety features incorporated into Amtrak's specification for high-speed trainsets.

Safety features suggested by FRA to Amtrak for high-speed trainsets—intended for use in the mixed passenger/freight environment—serve as the basis for sample safety parameters used by FRA to evoke a discussion of Tier II equipment safety standards. Current North American passenger rail safety practice, recent NTSB recommendations, and selective use of requirements gleaned from recommendations made to Amtrak for high-speed trainsets serve as the basis for the sample safety parameters used to evoke a discussion of safety standards appropriate for a less challenging operating environment (Tier I equipment standards).

FRA made both Tier I and Tier II equipment safety concepts available to the Working Group for discussion and consideration. The safety parameters contained in these concepts draw upon AAR Specification S–580 for locomotive crashworthiness, existing regulations (49 CFR Part 229), NTSB recommendations, and an analysis of the forces produced as a result of realistic collision scenarios.

Appendix B outlines safety parameters provided for consideration for Tier I and Tier II equipment. Given that Tier II equipment is intended to operate in an environment that can create a greater safety risk than Tier I equipment, most Tier I parameters outlined in Appendix B also become Tier II parameters. To simplify the task of responding to this ANPRM, Appendix B contains only those Tier II requirements that are in addition to, or different from, Tier I requirements.

It is emphasized that neither FRA nor the Working Group has endorsed these safety parameters, except to the extent that they mirror existing regulations. FRA is not proposing their adoption; rather, FRA makes available for discussion the results of efforts by the technical staff to identify safety risks and to suggest possible means to address these risks.

While the basis for many of the safety parameters suggested for discussion will be self evident, certain of the more novel concepts warrant explanation. The following discussion addresses that need.

Limiting initial decelerations of passengers to 6g maximum and 4g average—as suggested in Appendix B—is based on automobile crashworthiness research. These decelerations are identified as levels that unrestrained people are likely to survive if the interior of the vehicle is designed to mitigate secondary impacts (*i.e.*, the compartmentalization design strategy). Analysis shows peak longitudinal deceleration of the occupied spaces of coach cars protected by a leading or trailing locomotive or power car is expected to be approximately 8g for a train-to-train collision at a speed in excess of 30 mph. Greater collision speed does not significantly increase the peak deceleration of the occupied coach volume, but it does increase the time over which the occupied volume is decelerated.

During the collision, unrestrained occupants of such a coach will be thrown into interior fixtures, such as seatbacks, with a force substantially greater than that associated solely with the deceleration of the train. This increase in force is due to the occupant striking the interior at a relative speed of up to 25 mph. If the seat is to remain attached during a train-to-train collision in excess of 35 mph, simulation analysis indicates that coach seat attachment strength must be able to resist the inertial force of 8g acting on the mass of the seat plus the impact force of the mass of the passenger(s) being decelerated from a relative speed of 25 mph.

FRA believes that sufficient potential crush distance is available in single-level equipment with end vestibules such that good crash energy management design can achieve the 6g-maximum and 4g-average limits for passengers (other than those riding in a leading control cab) even for a high-speed crash scenario. Other equipment types (bi-level, gallery, and food service with no vestibules) need to be studied to determine the limits of potential crush distance.

On the other hand, FRA recognizes the difficulty in limiting the initial deceleration of the crew in the cab to a survivable level during a high-speed collision because little unoccupied crush space is available forward of the control cab. As a result, Appendix B contains a design goal of limiting decelerations on the crew in the cab to 24g maximum and 16g average for the first 250 milliseconds of the crash pulse. (The 250-millisecond duration was selected as the time required for people to make their initial impact with an interior surface and be pinned by inertia against that surface. After this time, the peak deceleration can be greatly increased without causing extensive injuries.) Based on analysis results, the peak deceleration of a leading control cab is approximately 12g. Analysis indicates that this peak deceleration does not increase as collision speed increases, but it does increase the time over which this peak deceleration is exerted on the cab. During the collision, unrestrained crew members may be thrown against the interior of the cab with a force substantially greater than that associated solely with the deceleration of the train. This increase in force is due to the crew member striking an interior surface or object at a relative speed of up to 25 mph. Decelerations of this magnitude require restraint systems or a crash refuge to protect the crew in the cab.

FRA believes that many crash survivability issues can be resolved without great difficulty. However, protecting persons from secondary impacts is a considerable challenge. To limit the decelerations of people to survivable levels, high-speed trainsets must be designed with a crash energy management feature.

The greater the crush distance that can intentionally be designed into the trainset before reaching an occupied volume, the more survivable a collision will be. In equipment operated with a cab car forward, the control cab is necessarily near the leading surface of the trainset, so very little crush distance is available to protect people in the cab. As a result, the decelerations of people will be large, resulting in more numerous and more severe injuries.

An argument presented against increases in structural strength requirements for new passenger equipment is that the new equipment would be a hazard to existing passenger equipment operating in the same corridor. This argument is based, in part, on a 1972 rear-end collision between two passenger trains in Chicago. In this collision, an older, heavier car climbed over a newer car of lighter construction, telescoping into the passenger compartment of the lighter car, resulting in the deaths of many people.

Some have contended that increased structural strength for new passenger equipment would create an equivalent incompatible situation between new equipment and existing equipment. However, several differences between the situation in 1972 and today refute this argument. Today's passenger equipment has collision posts, anticlimbers, and strong truck-to-car body attachments—all intended to prevent climbing and telescoping. In addition, both existing equipment and new equipment will have the same basic static end strength (backbone). While new equipment may have a more substantial end structure, the crash energy management system will cause this end structure to be pushed back into the unoccupied space of the new equipment rather than forward into the existing equipment. Alternatively, some of the end structure strength characteristics might be placed inboard of the crush zones.

Once the crash energy management system crush distance is consumed, the full height of the collision posts and corner posts recommended for the new equipment will likely deflect the older equipment up over the new equipment rather than creating a telescoping situation. The fears expressed are therefore unlikely to materialize.

The basis of the concern for side impact strength and the point of application of side impact forces stems from two facts:

(1) Approximately 25 percent of all highway-rail crossing accidents involve a highway vehicle striking the side of a train; and

(2) Designs of some passenger equipment have floor levels low to the rail, creating the tendency for a heavy highway vehicle striking the side of the train to climb into the occupied passenger volume rather than being driven under the underframe of the passenger rail car.

Analysis shows that current single-level intercity passenger coach equipment is sufficiently strong, and will derail in collision scenarios similar to that described above before a significant amount of crushing of the occupied passenger volume occurs. FRA believes that future equipment should perform at least as well as current equipment in such collisions, and that a need exists to specify minimum side impact protection for rail cars with low floor levels such as bi-level equipment.

Other scenarios where reasonable side strength may be of value include side impacts at switches and at railroad crossing diamonds (when *e.g.*, a single freight car rolls free during switching).

A proposed concept for a side impact strength design requirement involves the ability of a car body to withstand—with limited deformation of the car body structure—the load applied by a loaded tractor trailer travelling at a selected speed which collides with the side of the car over an area and at a height typical of tractor trailer bumpers. What specific parameters should be used to implement this concept, or what alternate concepts can be proposed for a side impact strength design requirement?

FRA's concern for a minimum rollover strength requirement is based on accidents such as that which occurred to Amtrak's Lakeshore Limited in January 1994. The train derailed while travelling from Albany, New York, to Chicago, and several cars rolled down an embankment. Very little crushing of the occupied volumes of any of the cars involved occurred. The current design of single-level intercity passenger cars generally performs well when subjected to the impact loads associated with tipping on a side or rolling onto its roof from an upright position. While these loads may vary significantly depending upon the nature of the wayside where the rolling occurs, FRA believes that passenger cars should have minimum side strength and roof strength to help minimize the loss of occupied volume should a rollover occur. FRA also believes that locomotives and power cars should have sufficient side and roof structural strength to minimize loss of volume in the operator's cab under such conditions.

The sections of this ANPRM addressing design standards seek input from the industry on how to take advantage of the safety improvements offered by a crash energy management design approach for future passenger equipment.

Inspection, Testing, and Maintenance Requirements

Pre-Departure or Daily Safety Inspections

A pre-departure or daily safety inspection is an essential element of a system safety program for all trains that carry passengers. The pre-departure or daily inspection should include the steps necessary to ensure the train departs without mechanical, electrical, or electronic defects that could degrade the safe operation of the train.

Amtrak has voluntarily implemented a pre-departure safety inspection of all passenger trains. Amtrak developed the inspection procedures in close cooperation with FRA. The procedures combine a power brake inspection and test, a mechanical inspection similar to that required for freight cars, a safety appliance inspection, and spot checks by supervisors. Amtrak has been using these procedures since April 1994, and they do not appear to have an adverse impact on train schedule. Appendix C contains a copy of the inspection procedures used by Amtrak. These inspection procedures are offered as an example only. They are not a general solution to how to conduct pre-departure safety inspections of passenger trains.

Using the Amtrak procedures as a starting point, FRA solicits comments on how these procedures need to be tailored to fit the needs of each segment of the industry. What train schedule impacts will result from implementing a pre-departure or daily safety inspection program? Does FRA need to be made aware of any circumstances or reasons for not performing a pre-departure or daily safety inspection? What range of options should an operating railroad have when the safety inspection uncovers a defect? How should any proposed safety standards take into account and encourage the potential that technology provides to automate pre-departure or daily inspections of future equipment? As automated features are added to passenger trains, does a train information system that records and logs inspection and test results and maintenance status make sense?

In terms of labor, materials, etc., what additional resources would each operator need to perform a pre-departure inspection equivalent to Amtrak's? How many pre-departure or daily inspections are performed annually by each operator? What potential safety benefits could result from performing inspections equivalent to Amtrak's? Please explain or document estimates. For those currently performing inspections, what additional benefits could be realized by modifying those inspection procedures to meet Amtrak's? Please explain or document.

Tourist, Museum, and Other Special or Unusual Equipment

FRA recognizes that most tourist railroads are small businesses operating older equipment on a limited budget. As a basis for discussion, FRA postulates a simple system safety program for excursion and tourist railroads based on:

(1) A pre-departure safety inspection that takes into account the type of equipment being used;

(2) A periodic testing and maintenance program based on the type of equipment and the extent of its use; and

(3) Minimum qualifications for inspectors and maintenance personnel to ensure that they have the knowledge necessary to perform safety-critical tasks.

FRA needs the tourist and excursion railroad industry to address the following questions: What are the effects of such a simple system safety program on tourist and excursion railroad operations? How can the requirements for a pre-departure safety inspection be written so they are enforceable but provide necessary flexibility?

Information available to FRA indicates that there are approximately 100 excursion railroads subject to FRA jurisdiction, operating about 250 locomotives and 1,000 passenger cars. Is this information correct? What size crews operate excursion and tourist trains? What is the average annual passenger car mileage for tourist and excursion railroads? What human and physical resources are available to these railroads for inspection and maintenance of equipment?

What potential safety benefits are available from the proposed standards for tourist and excursion railroads? To what extent will they be realized under the proposal? Please explain.

FRA also solicits comments from the tourist and excursion railroad industry on how passenger equipment safety standards may impact them in unintended ways.

Private Passenger Cars

FRA believes a private passenger car should be held to the same basic inspection standards as the other equipment being hauled in the train hauling the private car. However, FRA intends to take into account the financial burden imposed by requiring private passenger car owners to modify their equipment to meet any new design standards included as part of proposed passenger equipment safety standards.

FRA needs private passenger car owners to address the following questions as part of their response to this ANPRM: What minimum set of inspection requirements should host operators impose on private passenger cars? How should these minimum standards be incorporated into Federal regulations? What effects are foreseen from the proposed passenger equipment safety regulations on the ability to operate this equipment? Take care to point out all potential unintended impacts.

How many private passenger cars are in operation? On average, how many miles do private passenger cars travel annually? What potential safety benefits are available from the proposed standards for private passenger cars operators? To what extent will they be realized under the proposal? Please explain.

Tier I Equipment

FRA believes standards for pre-departure and daily inspections of Tier I equipment should take into account the type of equipment being used and the type of service. Pre-departure safety inspection and test criteria implemented by Amtrak should be considered as a guide for developing a set of core inspection criteria for incorporation into Federal safety standards for Tier I equipment. These inspection criteria are given as Appendix C.

FRA recommends that each operator of passenger equipment use these criteria as a guide, and comment on how similar criteria could be—or have been—implemented as part of its operation. Members of APTA are encouraged to comment through the APTA members on the Working Group.

FRA recognizes that the pre-departure inspection need not be a complete safety inspection. The combination of the daily and the pre-departure inspections should be considered the complete safety inspection of the train.

To what extent would daily and pre-departure inspections vary from current practice? To what extent would these requirements impact passenger operations? How can the requirements for pre-departure and daily safety inspections be written so they are enforceable but provide the flexibility required to meet service requirements, hold down costs, and encourage innovation?

Tier II Equipment

Since Tier II equipment will be designed for operation in higher risk and/or consequence operating environments, FRA believes the safety inspection program to be used with the equipment should be developed from a thorough risk analysis done as part of the system safety program. This risk analysis should result in a set of inspection criteria, tasks, intervals, and skills required to develop a safety inspection program that reduces the overall risk of operation to an acceptable level.

Planned Testing, Preventive Maintenance, and Personnel Qualification Requirements

FRA believes planned testing and preventive maintenance requirements of safety-critical systems or components—triggered by time, mileage, or some other key reliability/safety parameter—are also an essential feature of a system safety program. A key step in the system safety program is to perform a reliability analysis or use accumulated reliability data to determine the planned tests and preventive maintenance tasks—as well as what should trigger them—that are required to maintain a safe operation. The system safety plan should also include an approach to accumulate the data necessary to justify changes in maintenance approaches or intervals for safety-critical systems and components.

Most passenger equipment operators already have testing and maintenance requirements for their equipment, though the extent to which they are based on formalized risk analysis is not clear. FRA searches for a means to ensure that all industry system safety programs include preventive maintenance and planned testing requirements while allowing the industry the flexibility needed to cope with various operating environments. FRA also recognizes the desirability of allowing maintenance or testing intervals to be changed based on accumulated operating experience with the equipment.

Currently, what equipment is tested and maintained periodically? How often (in terms of miles, time, or other parameters) is this equipment tested and maintained? How can standards be structured to allow testing or maintenance intervals to be changed based on either good or bad operating experience while maintaining adequate safety margins? What do periodic tests and maintenance currently entail—labor, materials, etc.? What benefit(s) would be associated with a periodic testing and maintenance requirement? Please explain.

FRA views the skills and knowledge of the people responsible for inspections, testing, and maintenance as one of the most important requisites of an effective system safety program. FRA seeks a means for passenger equipment operators to demonstrate that the people performing crucial safety inspections and maintenance tasks—whether they be mechanical forces or train crews—have the current knowledge and skills necessary for their jobs. As equipment incorporating new technology—to include remote sensing and automated testing—comes into widespread use, a better trained inspection and maintenance workforce will be required and minimum qualification standards will become more important.

GAO Report RCED–93–68 ‘‘Improvements Needed for Employees Who Inspect and Maintain Rail Equipment’’ highlights some of the concerns regarding the knowledge and training of personnel performing safety-critical tasks. GAO concludes that training programs for mechanical employees and foremen have weaknesses that leave passenger railroads vulnerable to skill shortfalls in the inspection, testing, and maintenance workforce. GAO points out that the personnel who inspect, test, and maintain European high-speed passenger trains receive much more training and generally are more skilled than their American counterparts. European railroads require mechanical employees either to pass an examination or to demonstrate their proficiency. An internal FRA assessment confirms the findings of this GAO report. Copies of both the GAO report and the internal FRA report documenting this assessment have been placed in the docket.

FRA seeks comment from all segments of the industry on how to require passenger equipment operators to demonstrate that the people (whether employees or contractors) performing safety-critical tasks have the knowledge and skills to do so. FRA does not wish to mandate specific training programs or experience requirements; FRA believes that these details are the purview of each individual operator and that each railroad should establish the minimum training and qualification requirements based on the equipment being operated. However, an important feature of proposed passenger equipment safety standards will be a means to measure or to demonstrate the effectiveness of individual training programs. Unless people with the necessary knowledge and skill perform safety-critical tasks, passenger equipment operators cannot have an effective system safety program.

How should the proposed safety standards be structured to ensure that each operator meets this important responsibility to demonstrate the skills and knowledge of personnel that perform safety-critical tasks on passenger equipment? Currently, how many employees/contractors are involved in inspecting, testing, and maintaining a passenger car or locomotive? How many of these people are mechanical personnel? Are there established minimum training and qualification requirements for employees and contractors performing inspections, tests, and maintenance? Approximately how many labor hours does each passenger service operator spend each year on these activities?

What are the potential benefits of increased training in periodic testing and maintenance? To what extent are expenditures on such training cost effective? Historically, does this type of training produce identifiable safety benefits? Please explain.

Tourist, Museum, and Other Special or Unusual Equipment

FRA believes that tourist and excursion railroads, museums, and other operators of special or unusual equipment that carry passengers should have:

(1) A planned testing program;

(2) A preventive maintenance program keyed to mileage, time, or some other triggering parameter; and

(3) A means to demonstrate that the people carrying out these programs have the knowledge and skills necessary to correctly perform the safety-critical tasks identified as part of these programs.

FRA seeks to establish a minimum program for operators of special or unusual equipment that takes into account the resource constraints placed on these operators, and yet recognizes that even equipment operated for short distances and at low speeds requires periodic maintenance attention by skilled individuals to maintain safety.

What should be the basis for scheduling planned tests and preventive maintenance, and what crucial tasks need to be performed? How should tourist and excursion railroads demonstrate to FRA that personnel performing safety-critical tasks have the knowledge necessary to do the job?

Private Passenger Cars

FRA believes that a private passenger car should be held to the same basic planned testing and preventive maintenance standards as the other equipment being hauled in the train hauling the private car. However, FRA anticipates that since private passenger cars tend not to be highly used equipment, the events that trigger planned tests or preventive maintenance (mileage, time, etc.) will occur less frequently than for equipment in regularly scheduled passenger or commuter service.

Since private passenger cars tend to be vintage equipment with parts, and testing and maintenance procedures that are no longer common in the rail passenger industry, the knowledge and skills necessary to conduct an effective planned testing and preventive maintenance program are likely to be possessed by only a few individuals.

What minimum set of planned testing and preventive maintenance requirements should host operators impose on private passenger cars? How should these minimum standards be incorporated into Federal regulations? What should be the basis for scheduling planned tests and preventive maintenance for private passenger cars, and what critical tasks need to be performed? How should owners of private passenger cars demonstrate to FRA that personnel performing safety-critical tasks have the knowledge necessary to do the job? To what extent does any third party monitor the quality of work performed on passenger cars by contract shops? (Amtrak currently operates a certification process for private passenger cars that desire to operate in Amtrak trains.)

Tier I Equipment

Since Tier I equipment will very likely be traditionally designed equipment that operates in environments with which railroads have a wealth of experience, planned testing and preventive maintenance programs should be based on that experience with the type of equipment and its extent of use. Operators of Tier I equipment should have a planned testing and maintenance program based on operating experience with the equipment. Changes to the program would also be based on operating experience.

As part of the operating experience on Tier I equipment, railroads need to identify the safety-critical maintenance tasks and the skills required to perform them. Railroads must use this knowledge to develop a training program to ensure inspection and maintenance personnel have these skills and are able to demonstrate them.

What should be the basis for scheduling planned tests and preventive maintenance for Tier I equipment? What critical tasks need to be performed? How should railroads demonstrate to FRA that personnel performing safety-critical tasks on Tier I equipment have the knowledge necessary to do the job?

Tier II Equipment

Because Tier II equipment will be new equipment designed for operation in higher risk operating environments, FRA believes the planned testing and preventive maintenance program for safety-critical systems and components should be developed from a thorough risk analysis done as part of the system safety program. This risk analysis should result in a set of planned testing and preventive maintenance criteria, tasks, intervals, and skills required to develop a program that reduces the overall risk of operation to an acceptable level. What is an acceptable level of risk in developing risk-based performance standards for this type of equipment?

Equipment Design Standards

Standards for Tier I Equipment

Current passenger equipment has certainly demonstrated its ability to operate safely at speeds up to 125 mph. However, the design of this equipment is largely based on loose industry standards that are no longer actively maintained or enforced. The design of new Tier I passenger equipment should not be left to a collection of similarly loose standards. A practical approach to establish minimum safety standards for new Tier I equipment would be to consolidate current safety related design standards or industry practices directly into the new regulation.

FRA believes train operation has significantly changed since the design requirements in 49 CFR 229.141 for trains of total empty weight of less than 600,000 pounds and AAR Specification S–034,‘‘Specification for the Construction of New Passenger Cars,’’ were first promulgated. Have these requirements outlived their usefulness, and should they be eliminated? Would a regulation based on the compilation of current North American industry structural design standards and practices provide the ‘‘minimum floor’’ crashworthiness requirements for Tier I equipment?

Initial analysis and computer modeling by the Volpe Center, using a lumped-mass model and idealized force-crush characteristics, predicts the conventional uniform longitudinal structural strength design approach to be as effective as a crash energy management design approach in providing protection for passengers and crew at speeds up to approximately 70 mph. Although crash energy management design can benefit passengers of equipment involved in lower speed collisions, this analysis suggests that the additional expense of a crash energy management design may not be justified for some new Tier I passenger equipment, depending upon the upper speed limit in this tier.

The Rail Safety Enforcement and Review Act (RSERA), Pub. L. No. 102–365, 106 Stat. 972 (September 3, 1992), requires FRA to report to the Congress on the crashworthiness of locomotives and the effectiveness of AAR Specification S–580, which is the current industry standard regarding crashworthiness of locomotives. Much of the research and analysis done to comply with this law can be applied to head-on and, potentially, rear-end collisions of passenger trains.

This analysis shows AAR Specification S–580 provides a significant increase in crashworthiness over locomotives built prior to implementation of this specification. However, the locomotive collision computer model developed to support the RSERA shows a weakness in the way locomotive builders implement the S–580 anticlimber requirement. The model shows—at all but very low collision speeds—that at the onset of override, the anticlimber of the locomotive being overridden is crushed and sheared or bypassed rather than loaded vertically by the anticlimber of the opposing locomotive. Evidence from several collision investigations tends to confirm this prediction. Examination of locomotives and cars equipped with anticlimbers that have been involved in collisions where override occurred shows evidence of bending of the anticlimber shelf due to high coupler loads. This bending appears to prevent the shelf from being capable of resisting a vertical load. Couplers designed to break away or load some part of the structure so that the anticlimber shelf is not deformed before being required to resist a vertical load appear to be necessary to allow the anticlimbers to function as intended.

FRA believes that if passenger equipment can be designed to fully involve (bend but not collapse) the underframe to resist collision forces before collision posts or end structures are loaded, the ability to maintain uncrushed, survivable volumes will be maximized. Properly designed anticlimbers can play an important role by allowing the significant structural strength of the underframe to resist the full collision forces during the initial phase of an impact. Bending the underframe before the collision posts or end structures take over the role of protecting the cab occupants can dissipate a large amount of the collision's energy that might otherwise cause crushing of occupied space.

Does other evidence exist to support or refute this computer model prediction of anticlimber effectiveness? What design analysis has been done on existing anticlimber designs under dynamic conditions simulating a collision? Are anticlimber design changes necessary to ensure that anticlimbers are loaded vertically as intended during collisions? Are practical design concepts available that may improve anticlimber performance during collisions? Can anticlimbers be designed that make bending (but not collapse) of the underframe likely before collision posts or end structures are required to bear significant loads? What would be the likely costs associated with alternative designs to ensure that anticlimbers are loaded vertically during collisions?

The computer model also predicts collision post designs currently used by North American manufacturers exceed the requirements of AAR S–580 by a factor of two for freight locomotives—weight restrictions can prevent such a large factor of safety in passenger locomotives—and that this additional strength provides significant additional protection to the crew in the cab. Should a modified version of AAR S–580 specifying a more effective anticlimber, stronger and full-height collision posts, and full-height corner posts be considered as part of the safety standards for new conventional passenger locomotives? What would be the likely impacts of such a standard on locomotive weight and performance? What costs would be associated with specifying full-height collision posts and full-height corner posts on conventional locomotives?

Rather than a standard similar to AAR S–580, should a unitized type of end structure with integral collision and corner posts that extend to the roof line be considered for a design standard for conventional passenger locomotives? Would it be feasible to develop a purer performance specification for train end structural strength that allows full flexibility in the design of structures? What collision scenarios and forces should be considered in such an approach? Such an approach could provide weight and performance advantages.

Fuel spills are both an environmental and a safety problem. Fires resulting from fuel spills can turn a minor accident into a major event. What is the experience of passenger railroads with fuel spills? What clean-up costs have been incurred? Should all diesel passenger locomotives—including self-propelled diesel cars—be equipped with the type of strengthened fuel tanks that meet the requirements in Appendix B proposed for Tier II equipment? If not, what performance standard should be used for Tier I diesel passenger locomotive fuel tanks?

How much would it cost to equip conventional passenger service locomotives with the type of strengthened fuel tanks discussed in Appendix B? What levels of safety benefits can be realized from strengthened fuel tanks? Please explain.

Based on the findings of recent investigations of accidents involving passenger trains, several factors have contributed to the number and the extent of the injuries suffered. Among these factors are:

(1) A lack of reliable backup emergency lighting for coaches;

(2) A lack of means to exit coaches and locomotives more easily—from both ends and all compartments—especially when they are resting on their sides;

(3) Seats that break loose from attachment points or that rotate; and

(4) Luggage and other objects thrown about the interior of coaches.

Amtrak believes that existing industry standards for emergency lighting are adequate and should become the Federal standard. NTSB would like a requirement for securing the batteries that provide power to emergency lights so connections to the emergency lights are not knocked loose during a collision.

During Working Group meetings, Amtrak pointed out several potential disadvantages of roof hatches in passenger equipment because they are difficult to maintain and are often a source of leaks. The hatches allow passengers or trespassers access to the roof which can be particularly dangerous in electrified territory. Amtrak has suggested inclusion of a clearly marked structural weak spot where properly equipped emergency personnel can quickly gain access to the interior of the coach or locomotive through the roof as preferable to roof hatches.

Should Tier I equipment safety standards include provisions for:

(1) Emergency lighting?

(2) Roof hatches or a clearly identified structural weak point where properly equipped emergency personnel can quickly gain access through the roof?

(3) Minimum strength of seat attachment?

(4) Minimum strength and enclosed luggage compartments?

To what extent does passenger equipment currently have backup power systems in place? What would it cost to install a backup power system? What safety benefits would result from backup power systems?

How many coach units have backup emergency lighting? What would it cost to install a backup emergency lighting system? What rationale is used to determine whether a unit will have backup emergency lighting? To what extent would potential safety benefits be realized? Please explain.

What would it cost to install roof hatches or access areas on cars?

What options exist for enclosing existing luggage compartments? At what cost? To what extent would potential safety benefits be realized from enclosing luggage compartments? Please explain.

Safety Glazing

One of the issues addressed by existing regulations that bears on the safety of passenger train occupants is exterior glazing. Because of the complexity of the issues in this proceeding, satisfaction with existing standards, and the need for coordination with freight interests not represented on the Working Group, the Working Group has expressed a reluctance to address glazing in this proceeding. In order to determine whether to renew its request to the Working Group or another advisory body to examine this issue, FRA seeks information on incidents of glazing shattering or spalling that caused injuries to occupants of passenger trains. Some perceived problems with current 49 CFR Part 223 requirements that have come to FRA's attention include the following:

(1) The witness plate used for testing is too thick, allowing spalling of pieces of glass large enough to cause injury;

(2) The impact test using a 24-pound cinder block is not repeatable;

(3) Vendors need to be periodically recertified by an independent testing laboratory; and

(4) The strength of the framing arrangement securing the glazing is neither specified nor tested. (Amtrak has noted that it currently requires glazing to be tested in its intended framing.)

Should FRA revise the glazing standards for conventional passenger equipment to:

(1) Require testing with a thinner witness plate?

(2) Require a more repeatable impact test? If so, what should the impact test requirement be?

(3) Require periodic recertification of vendors by an independent testing laboratory?

(4) Address the strength of the glazing frame? If so, how could this be practically done?

(5) Require increased strength, impact resistance, or bullet penetration resistance?

What would the impact on glazing thickness and weight be if FRA were to modify Part 223 as suggested above? To what extent should interior glazing be considered in this proceeding? Are appropriate reference standards already available? What benefits could be derived from modifying Part 223 as suggested? What would be the cost to realize these benefits?

Fire Safety

FRA does not have regulations covering fire safety of passenger equipment. Current industry practice is to follow FRA guidelines published in the Federal Register on January 17, 1989. (See 54 FR 1837, ''Rail Passenger Equipment; Reissuance of Guidelines for Selecting Materials to Improve Their Fire Safety Characteristics.'') Fire resistance, detection, and suppression technologies have all advanced since these guidelines were published. Amtrak follows more stringent specifications for fire safety than found in FRA's guidelines. A trend toward a systems approach to fire safety is evident in most countries with modern rail systems. Are Federal regulations or more in-depth guidelines needed to:

(1) Prevent fire or retard its growth?

(2) Detect and suppress fire?

(3) Protect occupants from the effects of fire?

Appendix B

To stimulate thought and generate discussion on passenger equipment design standards, FRA is providing for consideration the detailed set of equipment design provisions contained in Appendix B. From experience with past ANPRM's, FRA learned that such a strategy results in more and higher quality comments on the specific issues in the proceeding. FRA does not intend to implement the requirements given in Appendix B without significant change based on the deliberations of the Working Group, supplemented by information and views received in response to this notice. FRA strongly encourages comments on these provisions and proposals for alternative standards.

Standards for Tier II Equipment

For the past several years, FRA has held discussions with manufacturers of foreign high-speed rail equipment seeking a market for their equipment in the United States. These manufacturers sought a clear definition of the requirements that their equipment must meet to be allowed to operate in the United States. Because FRA recognizes existing North American passenger equipment standards were not intended to apply to equipment operating at speeds significantly over 100 mph, and because current Federal regulations do not cover such operations, FRA could not provide clear guidance. This has caused confusion, and has led to the perception that competition for the American market is risky.

Amtrak has hosted test and revenue service demonstrations of two foreign, high-speed trainsets in the United States. Operating experience gained in Europe and in the United States with these trainsets helped place Amtrak in a position to develop a system specification to procure trainsets to operate at speeds up to 150 mph in the Northeast Corridor. FRA reviewed drafts of the procurement specification for these trainsets and made safety-related recommendations. The resulting discussions between Amtrak and FRA highlighted the technical issues that must be resolved as part of the process for developing safety standards for high-speed trainsets.

Sample high-speed passenger trainset design requirements are outlined in Appendix B. FRA compiled this set of design requirements to prepare for the review of Amtrak's system specification for high-speed trainsets. FRA developed this set of proposed requirements based on discussions with manufacturers and operators of European equipment, research done or sponsored by the Volpe Center, experience gained in developing a concept for a proposed rule specifically applicable to the Texas TGV System, and the results of tests conducted jointly with Amtrak on high-speed trainsets in the Northeast Corridor. FRA recognizes that some of the requirements push the state of the art. Of particular interest to FRA are comments on the technical limits of crash energy management systems and on how best to define or specify crash energy management in a set of performance requirements. FRA attempted to specify a crash energy management system by placing limits on the acceleration experienced by passengers during the initial phase of a collision. To design to such a requirement requires a reference collision scenario with defined collision parameters. The advantage of such an approach is that it is tied directly to the parameter most responsible for injuries due to secondary impacts. Can an approach to designate crash energy management requirements tied to a specific design collision scenario be adequately defined to serve as the basis for trainset design?

An alternate approach, advocated as less complex, is to specify the minimum energy to be absorbed at each location in the trainset designed to crush before occupied space crushes. Such an approach has the advantage of not being tied to a design based on a collision scenario. However, FRA believes that the main value of a crash energy management design is to increase the duration of the collision, allowing train occupants to decelerate more slowly, and minimize the uncontrolled collapse of occupied space. The amount of energy absorbed is of secondary importance.

FRA also believes that using ability to absorb energy as a crash energy management design parameter does not focus on the real purpose of the crash energy management system. FRA invites comments in this area. Is the amount of energy that can be absorbed in a collision actually a secondary issue to slower decelerations and more controlled collapse?

If ability to absorb energy is used as the crash energy management system performance parameter, what are the limits on controlled crush distance and energy absorbed that can reasonably be expected to be achieved? What causes these limitations? How can a performance standard based on an ability to absorb energy be tied to an ability to decrease the initial acceleration of train occupants which is the key parameter for a crash energy management design? What flexibility is needed in end-strength requirements of occupied versus unoccupied volume to allow effective crash energy management system design?

A second safety-critical design feature of key interest to FRA is the strength and construction of the end frame (or end structure) of both power cars and coaches. As noted above, a unitized or monocoque end structure with vertical members (collision post(s) and corner posts) that extend to the roofline, with significant structural strength where they are tied into the roofline, may be capable of protecting crew space more effectively and with less weight penalty than more traditional designs. FRA believes such an end structure may play a significant role when override occurs to prevent crushing or penetration of the occupied volume that it protects. When combined with an effective crash energy management design, such an end structure would be pushed back as a unit (similar to being mounted on a spring) through the volume designed to crush.

Through the Working Group, FRA will pursue a thoughtful technical discussion of such an approach including suggestions on how best to set performance requirements and reasonable limits for design strengths. Should a monocoque end structure—or equivalent structure—that ties together the floor, collision posts, corner posts and roof into a single structure be required or authorized for high speed passenger trains? FRA welcomes proposed alternative approaches designed to provide equivalent protection. What costs would be associated with alternative approaches designed to prevent crushing or penetration of the occupied volume in power and coach cars? Please be specific in defining the alternative approach and its cost elements.

A third safety feature that needs a thorough technical review is how to design the trainset to stay in line and on the track during the initial phase of a collision to give the crash energy management system an opportunity to perform its intended function. If the trainset buckles laterally and leaves the track too soon, volumes designed to crush will not be crushed, resulting in higher decelerations of occupants, and possibly negating the significant structural protection provided by end structures. If the trainset buckles vertically causing early override, the protection provided by the underframe may be bypassed. A discussion of the design innovations necessary to delay buckling of the trainset as long as possible is needed.

What practical design techniques exist to delay either lateral or vertical buckling of passenger trainsets involved in collisions? How much would installation of alternative buckling delay systems cost in terms of labor hours and materials?

As train speed increases, the human decision and reaction time necessary to avoid potential calamity decreases. Automatic control techniques that briefly take the operator out of the control loop are a means to eliminate the human decision and reaction delays in situations where taking quick and positive action can be crucial. FRA believes technology can allow safety-critical parameters pertaining to the following high-speed trainset subsystems or events to be monitored by remote sensors:

(1) Truck hunting;
(2) Dynamic brake status;
(3) Friction brake status;
(4) Fire detection;
(5) Head-end power status;
(6) Alerter;
(7) Horn and bell;
(8) Wheel slip and wheel slide control; and
(9) Tilt control system, if equipped.

FRA intends to require monitoring of dynamic brake status. If the friction brake of the trainset is designed to be able to safely handle the entire braking load without assistance from the dynamic brake, the dynamic brake may not be considered a primary safety-critical system.

FRA considered including bearing overheat in the above list. However, the Working Group cautioned FRA that on-board bearing sensors have proven to be unreliable. In the Working Group's view, until on-board bearing sensor technology matures, the industry will continue to rely on wayside bearing overheat detection.

Should automatic monitoring for each of the above events/subsystems be required? Do other safety-critical subsystems/events lend themselves to monitoring by remote sensors? Could safety be enhanced by requiring an automatic response from the train control system—such as slowing the train—when a monitored parameter falls outside pre-determined safe limits? Which events/subsystems are prime candidates for some form of initial automatic response followed by a return to operator or manual control?

Seat arrangement design and passenger restraint systems have a potential to reduce the number and the extent of injuries in the event of a passenger train collision. This potential is present at all speeds, but becomes greater as speed increases. A copy of a technical paper[3] published by the Volpe Center describes a study of the occupant dynamics and predicted fatalities due to secondary impact for passengers involved in train collisions with impact speeds up to 140 mph. The principal focus of the paper is on the effectiveness of alternative strategies for protecting occupants in train collisions, including ''friendly'' interior arrangements and occupant restraints.

Three different interior configurations were analyzed: forward-facing seats in rows, facing rows of seats, and facing rows of seats with a table. Two of these three configurations—the forward-facing consecutive rows of seats and the facing rows of seats—were evaluated with the occupant unrestrained, restrained with a seat belt alone, and restrained with a seat belt and shoulder harness.

The injury criteria used to evaluate interior performance included Head Injury Criteria (HIC), chest deceleration, and axial neck load. Based upon these criteria, the probability of fatality resulting from secondary impacts was evaluated for each of the interior configurations and restraint systems modeled.

In some configurations, such as seats in rows, compartmentalization is shown to be as effective as a restraint system for the 50th percentile male occupant simulated. (As noted earlier, ''compartmentalization'' is an occupant protection strategy that requires seats or restraining barriers to be positioned in a manner that provides a compact, cushioned protection zone surrounding each occupant.) FRA intends to work closely with the Working Group to structure requirements for the interior of new passenger equipment that take advantage of the compartmentalization concept.

In cases where occupants are allowed to travel relatively long distances before impacting the interior, such as the facing-seats interior, restrained occupants have a much greater chance of survival. Fatalities from secondary impacts are not expected in any of the scenarios modeled if the occupant is restrained with a lap belt and shoulder harness.

Design approaches for passenger coaches that exploit this potential are needed. FRA briefed the Working Group on this research, and the Working Group has discussed the advantages and disadvantages of passenger restraint systems (primarily lap belts) and coach interior arrangement design to mitigate injuries. Effectiveness of restraint systems can be dependent on the strength of the seat attachment to the car body. A possible worst case scenario exists when a seat containing a belted passenger is struck from behind by an unbelted passenger. Such a situation can require the seat attachment design to carry a double load.

If the seat is to remain attached under the above conditions during a train-to-train collision in excess of 35 mph, analysis indicates that coach-seat attachment strength must be able to resist the inertial force of 8g acting on the mass of the seat, plus the mass of the belted passenger(s), plus the impact force of the mass of the passenger(s) in the following seat being decelerated from a relative speed of 25 mph against the seat back.

Should lap belts be required? Should all seating be rear facing? Should facing seating be allowed? What are the advantages and disadvantages of placing tables between facing seats? What are reasonable performance requirements for padding materials? Where should padding materials be located? What shock-absorbing characteristics should be required of padding material? What padding thicknesses are practical? What seat attachment strength can reasonably be expected to be achieved?

What seat configurations do passenger cars operating at speeds greater than 80 mph have? If configurations vary, please explain the differences and the reasons for the variations. How many seats does the average passenger car have? If there is no such thing as an average passenger car, how many seats do the different types of passenger cars have? How many cars of different types are there?

What costs would be involved with installing lap belts, shoulder harnesses, and other safety restraints on passenger cars? To what extent would safety benefits be realized from installing safety restraints? Please explain. A review of the technical papers placed in the docket may help with responses to some of these questions.

Due to the forward location of the operator of a high-speed passenger train, he or she is often the person closest to the point of impact and at most risk during a collision. Special provisions are required to protect the operator. How much crushable space can practically be located forward of the operator? Should a lap belt/shoulder harness combination be provided for each crew member in the cab? If lap belts/shoulder harnesses are provided for crew members, will they wear them?

NTSB has long advocated special protective crash refuges (protected areas) for locomotive crew members. ADL has done computer modeling to predict the effectiveness of two types of crash refuge concepts under dynamic conditions simulating locomotive collisions. One of these concepts is a padded trench in the floor of the locomotive in front of the electrical cabinets. Such a trench could be equipped with restraint systems. The other concept is a seat equipped with a lap belt and shoulder harness that rotates and locks in a reverse position allowing the operator to ride out the collision in a rear-facing position. (A report by ADL describing these concepts is part of the docket.[4]) Advanced versions of some European trains

[3] ''Train Crashworthiness Design for Occupant Survivability.'' See note 2.

[4] ''Locomotive Crashworthiness Research,'' Volumes 1–4, DOT–VNTSC–FRA–95–4.1, Final Report July, 1995.

employ a concept where the operator's position is designed to be pushed to the rear, relative to the rest of the cab, to provide the operator additional protection during a collision. Could any of these concepts be implemented into the design of new passenger equipment? Would they be effective? Would they be used?

What are some alternative concepts for the design of such protective refuges? Are they likely to be effective? Are they likely to be used? What impact would they have on locomotive or power car design? Should FRA require them as part of high-speed trainset design requirements? What other, perhaps more practical means exist to reduce the vulnerability of the cab crew to collisions? In terms of time, materials, and labor, what would installation of refuges in locomotives cost?

Lack of an accepted, recognized design tool (computer model) to predict changes in trainset performance as well as changes in the ability to protect people as trainset design parameters are changed inhibits exploiting new design techniques that could result in safer trainsets. Research by the Volpe Center on the structural response of portions of the vehicle to the extremely high loads associated with a collision, and research by AAR to accurately predict the performance of suspension systems to changing track conditions, have contributed greatly toward the goal of developing accepted analytical tools. However, efforts need to be increased and focused on a common goal.

Because full-scale crash testing of passenger equipment is prohibitively expensive, the development of a design tool that is widely accepted by the industry is essential. Such a tool could accelerate investigations of composite materials that hold promise for increased strength at less weight than current materials. A tool of this type could aid research into utilizing high-strength, light-weight composite materials and other technologies to provide operational and safety benefits.

FRA seeks comment from the industry on what the current state of the art is regarding modeling techniques for trainset collisions. Up to what trainset speeds are current models capable of predicting the collision mechanics of a trainset collision? What confidence levels can be expected with these models to predict the onset of override and train set buckling? Are these models capable of accurately predicting the acceleration levels in the trainset throughout the collision, particularly for the first 250 milliseconds?

FRA also seeks input from the industry on the potential for such models to replace full-scale crash testing. Have the current models that are being used been validated by full-scale, partial-scale or component impact testing? Will it be necessary to validate new models by test? Are there limitations as to what type of accident scenarios existing models are capable of analyzing?

The accuracy of the modeling techniques employed is dependent on the individual vehicle and trainset crush characteristics used as input to the models. What means should be used to quantify large deformation and dynamic crush characteristics of the various parts of a trainset? Can this be achieved through simulation alone? Has the industry developed dynamic force-deflection characteristics for existing North American rolling stock that could be used as a reference in FRA crashworthiness studies? If these characteristics are available, for what speeds of collision would they be valid?

What are the essential features of such a modeling tool? How can it be developed so it will receive wide acceptance, be credible and be used within the industry?

FRA outlines a sample set of detailed design requirements for high-speed passenger trainsets in Appendix B to provoke thought and discussion on these and other technical issues that need to be resolved to develop high-speed trainset safety standards. As with the conventional equipment design standards, FRA is pursuing an intentional strategy by providing this level of detail. From experience with past ANPRM's, FRA learned that such a strategy results in more and higher quality comments. FRA does not intend to implement the requirements given in Appendix B without significant change based on the recommendations of the Working Group, supplemented by the information and views obtained in response to this ANPRM. FRA strongly encourages comments on these provisions and proposals for alternative standards. Again, comments from interests represented on the Working Group should, to the maximum extent possible, be expressed through those representatives during the Working Group's deliberations.

FRA seeks comment from technically knowledgeable individuals on the initial set of design standards for high-speed passenger trainsets outlined in Appendix B. FRA recognizes that these standards would preclude operation of several existing high-speed trainsets in the United States without structural design changes. FRA believes that because these trainsets were designed for a much less severe operating environment, and because the American public demands and deserves the safest possible transportation system, attention is warranted for further development of North American standards. Do alternative approaches exist to safety standards for high-speed trainsets that could provide an equivalent level of safety at less cost?

Possibility of Design Standards for Other Tiers of Equipment

Amtrak and some commuter railroads have a long operating experience safely running trains of existing equipment at speeds between 80 and 125 mph. Much of this equipment is the same equipment—designed to the same standards—used for conventional service (herein defined as service at speeds less than 80 mph.) This practice supports the notion that the same set of design requirements used for conventional equipment is adequate for intermediate-speed equipment (*i.e.*, equipment designed for service at speeds up to 125 mph). However, components wear faster and are subject to higher dynamic, mechanical, and thermal stresses at higher speeds. Perhaps more steps need to be added to the pre-departure safety inspection for intermediate-speed equipment. Perhaps maintenance intervals need to be more frequent and/or have more tasks performed as part of the preventive maintenance program. FRA seeks information on how inspection, testing, and maintenance programs for intermediate-speed equipment should differ from those used for conventional equipment.

If the designation between tiers were based solely on operating speed, design or performance requirements for intermediate speed equipment should logically fall between the requirements for conventional equipment and the requirements for high-speed equipment (*i.e.*, equipment designed for service at speeds up to 150 mph). Analysis by the Volpe Center shows a crash energy management design provides significant benefits in terms of passenger and crew protection over conventional designs as collision speeds increase to over 70 mph. This suggests new intermediate-speed equipment would benefit from a crash energy management design approach.

If standards based on more than two tiers are developed, FRA currently believes design requirements for new intermediate-speed equipment should include the requirements for conventional equipment and some of the (possibly modified) requirements for high-speed equipment. The following criteria suggested for consideration for high-speed equipment may have applicability to intermediate-speed equipment:

(1) Glazing requirements;

(2) Crash refuge for cab crew;

(3) Crash energy management system—perhaps to modified performance standards;

(4) Interior arrangement or restraint systems to mitigate secondary impacts; and

(5) Emergency systems.

FRA seeks comment from builders and operators of intermediate-speed equipment as to where the design requirements for such equipment should be placed on the spectrum between the design requirements for conventional equipment and the design requirements for high-speed equipment.

Design Standards for Systems with Dedicated Rights-of-Way and No At-Grade Crossings

FRA recognizes that a system safety program that places emphasis on the prevention of collisions is highly desirable. However, fundamental changes are necessary in the North American railroad operating environment before accident prevention provisions allow equipment structural design standards to be relaxed. The main problem is North American passenger trains generally share, or operate adjacent to, the rights-of-way with an ever-increasing number of very heavy freight trains, and most passenger rail routes include at-grade crossings used by heavy highway vehicles. The risk to passengers and crew members in this operating environment increases as passenger train speed increases.

FRA encourages passenger systems to operate over dedicated rights-of-way with no at-grade crossings. FRA believes such systems can potentially provide the safest means of high-speed passenger transportation. Should proposed vehicle crashworthiness standards be modified for such operations? If so, to what degree? Should consideration of equipment used exclusively on dedicated rights-of-way be undertaken as part of this proceeding or through a system safety approach in individual proceedings for rules of specific applicability?

Discussion of Operating Issues

Commuter Equipment and Operations

FRA is aware that unique features of some commuter equipment and the unique operating cycle of commuter railroads may require specific attention. Some commuter equipment is stored at outlying locations overnight to be in position for the first morning trip into the major city being served. Mechanical employees are generally not available at these outlying locations to do pre-departure safety inspections. At those outlying points where mechanical employees are not available, an abbreviated initial daily safety inspection is generally performed by train crew members.

During the middle of the day, the pace of commuter operations generally slows, and the equipment is brought to a central location for a more comprehensive inspection by mechanical personnel prior to being dispatched for the evening rush hour. This reality of the commuter operating cycle must be taken into account for any proposed rules governing pre-departure safety inspections of commuter equipment. However, where mechanical employees and facilities are available to perform the pre-departure inspection, it must be performed by mechanical employees. Equipment that receives an abbreviated inspection by the train crew at outlying points at the beginning of the day must receive a complete pre-departure inspection by mechanical employees at the earliest opportunity during the day.

Some of the MU equipment operated by commuter railroads is very different from intercity rail passenger equipment. FRA needs the help of the operators of such equipment to identify the differences that may require special regulatory treatment to avoid unintended impacts on commuter operations. Through participation of APTA on the Working Group, FRA anticipates that commuter railroads will make a special effort to point out unique operating or equipment features that should be taken into account to develop safety standards for commuter equipment.

Information available to FRA suggests that nationwide there are about 20 commuter railroads operating roughly 5,400 passenger cars, 400 cab cars, 2,000 multiple unit locomotive pairs, and 400 conventional locomotives. Are these estimates accurate? What size crews operate commuter trains? Approximately how many people stand on each train? As a result of implementing the proposed standards, would commuter operators realize different levels of safety benefits than intercity operators? Please explain.

Cab Car Forward and Risk

FRA is concerned regarding operation of passenger trains with cab cars or MU locomotives positioned at the head of the train at high speeds. Such operations place the train operator and the passengers in the lead vehicle at inherently greater risk than operating the trainset with a locomotive or power car leading. Current designs of cab cars and MU locomotives provide little structural protection to the operator and forward-most passengers in the event of a head-on or side-swipe collision. Cab car locomotives and passenger MU locomotives are structurally equivalent from a crashworthiness standpoint. (Amtrak has noted that not all cab car locomotives should be considered equivalent to MU locomotives when the cab cars are not equipped with stairway traps in the leading end, such as in the X2000 train).

Computer modeling of passenger train collisions at high speeds by the Volpe Center predicts a dramatic increase in casualties in head-on collisions of trainsets operated with a cab car forward when compared to the same collision with a power car or locomotive leading. This prediction is based on a limited number of hypothetical accident scenarios. The prediction is not based on accident statistics. The technical papers[5] documenting these predictions are part of the docket.

Recent accidents involving trains operating with cab cars in the forward position have heightened FRA's concern. On February 9, 1996, a near-head-on collision occurred between New Jersey Transit Rail Operations, Inc., (NJTR) trains 1254 and 1107 on the borderline of Secaucus and Jersey City, New Jersey. Two crewmembers and one passenger were fatally injured, and an additional 162 passengers reported minor injuries. The passenger fatality and most of the injuries occurred on train 1254, which was operating with the cab control car forward and the locomotive pushing. In addition, the engineer on train 1254 was fatally injured.

On February 16, 1996, a near-head-on collision occurred between Maryland Mass Transit Administration (MARC) train 286 and Amtrak train 29 on CSX Transportation, Inc., at Silver Spring, Maryland. The MARC train consisted of a cab control car in the lead, followed by two passenger coaches and a locomotive pushing the consist. The accident resulted in 11 fatalities, consisting of 3 crewmembers and 8 passengers who were located in the MARC cab car, and at least 13 non-fatal injuries to other passengers of the MARC train.

Following these accidents, FRA issued Emergency Order No. 20, Notice

[5] "Evaluation of Selected Crashworthiness Strategies for Passenger Trains"; "Train Crashworthiness Design for Occupant Survivability." See note 2.

No. 1, on February 20, 1996, requiring prompt action to immediately enhance passenger train operating rules and emergency egress, and to develop a more comprehensive interim system safety plan addressing cab car forward and MU operations that do not have either cab signal, automatic train stop, or automatic train control systems. 61 FR 6876, Feb. 22, 1996. FRA subsequently issued Notice No. 2 to Emergency Order No. 20 on February 29, 1996, to refine three aspects of the original order. 61 FR 8703, Mar. 5, 1996.

NTSB recommends that MU cars and control cab locomotives be equipped with corner posts to provide greater structural protection from a side-swipe collision. NTSB makes this recommendation based on the findings of the investigation of a passenger train collision that occurred on January 18, 1993, in which Northern Indiana Commuter Transportation District (NICTD) eastbound commuter train 7 and NICTD westbound commuter train 12 collided in a corner-to-corner impact in Gary, Indiana, resulting in 7 passenger fatalities and 95 injuries. The presence of a gauntlet bridge and absence of automatic train control contributed to the cause of this accident. The damage that both trains sustained after the initial impact resulted from the action of dynamic forces that caused the left front corner and sidewall of the passenger compartment of each car to experience a complete structural failure and intrude inward. Because little structure was available in the corner post areas to absorb the forces of the collision, the substantial car body intrusion into each car left no survivable space in the left front areas of either car. Consequently, NTSB issued Safety Recommendation R–93–24, which recommends that:

> In cooperation with the Federal Transit Administration and the American Public Transit Association, [FRA] study the feasibility of providing car body corner post structures on all self-propelled passenger cars and control cab locomotives to afford occupant protection during corner collisions.

The RSERA requires FRA to analyze the crashworthiness of locomotives. As part of this analysis, the Volpe Center tasked ADL to do computer modeling of collisions involving cab cars to predict the benefit of substantial corner posts. The docket contains copies of this report.[6] ADL used the following general approach to evaluate cab car crashworthiness: Finite element models for the major structural elements of a typical cab car were developed and utilized to compute the load versus deformation characteristic curves for major structural elements involved in collisions. These characteristics were used as input to the train collision dynamics model developed previously for freight locomotives. The collision dynamics model was modified as needed to represent a typical passenger train with a cab car at the head end and a locomotive at the rear pushing, instead of a freight train with locomotives at the head end. The modified models were then validated by comparison of predicted results with the actual damage in documented collisions.

This modeling predicts, for control cab/MU locomotives of current design, that when the underframe resists the forces of collision, a cab car will sustain substantial loss of survivable volume in both operator and passenger compartments in head-on collisions at closing speeds above 30 mph. The result of such crush would cause severe injury or fatality to some of the cab car occupants.

When the underframe is bypassed and collision or corner posts resist the forces of the collision, the cab car will sustain substantial loss of survivable volume at collision closing speeds in the 10 to 15 mph range. These predictions emphasize the importance of designs that increase the probability that the underframe will be fully involved in resisting the forces resulting from a collision.

ADL took the modeling one step further by repeating the calculations for a conceptual cab car with a 50 percent underframe strength increase and a 400 percent corner post strength increase over current cab car design practice. These structural changes increased the closing speed required to result in a significant loss of survivable space by approximately 10 mph. These results suggest that only a small improvement in protection is possible through structural changes for a cab car leading, train-to-train collision. However, these structural changes may provide a much more significant increase in protection for the less severe scenarios of a grade crossing collision, a collision with debris including lading that falls from freight trains, or a collision with an object overhanging the track.

Several system characteristics determine the degree of risk involved in cab-car-forward or MU equipment operations. These characteristics include operating speed, traffic density, signal system, grade crossings and grade crossing warning systems (including barriers to prevent entry onto the crossing), and right-of-way features. In addition, the operator of a cab car or MU equipment often has an opportunity to exit the control stand area and move through the passenger compartment toward the rear of the car when a collision is impending.

FRA seeks comment focusing on what is practical and what is economical to reduce the risk associated with operating cab cars in the forward position and operating MU equipment. FRA poses the following set of questions to operators and builders of cab car type equipment: What can be done to increase the protection provided to the operator and forwardmost passengers in a head-on collision with a cab car leading? Advanced versions of some European trains employ a concept where the operator's position is designed to be pushed to the rear relative to the rest of the cab to provide the operator additional protection during a collision. Could such a technique be employed to protect operators in future North American equipment? What design changes can be made to increase the probability that the underframe will be fully involved in resisting the collision forces? Recognizing that structural changes will have only limited benefit, should speed restrictions be placed on cab-forward operations? Should passengers be prohibited from occupying cab cars operating above a certain speed when in a leading position? What would be the impact of placing speed restrictions on cab car forward operations? What mitigating factors may exist that would alleviate FRA's concern for the increased risk associated with cab-car-forward operations as speeds increase? If speed restrictions are placed on cab car forward operations, what speed restrictions should be imposed?

What costs and benefits would be associated with alternatives for increasing crew and passenger protection in a head-on collision with a cab car leading?

Data indicate that at least 400 cab cars operate as lead units. Is this estimate accurate? Approximately how many trips are made each year with cab cars operating as lead units? At what maximum speeds do trains operate with the cab car forward?

FRA estimates that 2,000 MU locomotive pairs operate as lead units. Is this estimate accurate? Approximately how many trips per year involve multiple unit locomotive pairs?

Combined Passenger and Freight Trains

FRA recognizes that circumstances exist where freight trains haul passenger cars and where passenger trains haul freight cars. For example, freight trains on occasion include private or business

[6] "Cab Car Crashworthiness Study Final Report," April 1995, Reference 63065.

cars, Amtrak trains can include mail cars, and Amtrak has experimented with roadrailer-type equipment in passenger trains. Passenger safety standards should cover these special situations as well.

How frequent are such operations? Are any special safety considerations necessary for passenger cars hauled by freight trains or is normal passenger equipment safety practice adequate for this special situation? Are any special safety considerations necessary for freight-type equipment hauled by passenger trains or for passenger trains that haul freight-type equipment.

Station/Platform Boarding and Exiting Passenger Trains

FRA requests comment on the safety of persons in station areas, issues regarding boarding and exiting from trains, and other issues affecting the safety of passenger operations. The following specific issues have come to FRA's attention in recent years, and are illustrative of the concerns that may warrant examination in this proceeding:

Door Securement

The manner and extent to which end and side doors are secured varies among passenger operators. When doors may be opened with excessive ease, a risk exists that passengers will unwittingly fall from moving trains. Of particular concern is the need to secure passenger train end doors against casual operation.

However, full, interlocked securement may greatly complicate evacuation in emergency situations. In some situations when a train is departing, the train doors must be open as it leaves the station for the crew to observe the platform area. In some situations when a train is arriving, the train doors must also be open to allow trap doors to be raised to minimize dwell time in stations not equipped with floor-level platforms. A signal light that displays the status of the doors to the crew in the control cab may have value for departing trains. Many railroads currently employ such a display light. Should passenger car doors be secured while the train is in motion during normal operations? What provision should be made for operation of doors by passengers in emergency situations? To what extent does the railroad's operating environment (elevated structures, tunnels, etc.) bear on resolving this question?

Ground-Level Stations

Ground-level stations are economical responses to light-density boarding in both commuter and intercity service. However, particularly where multiple tracks are present, the environment presents the possibility that passengers may be struck by moving trains. Attention needs to be directed toward the design of the interface of the ground-level station to the train to ensure passengers can safely board and leave the train. What station-to-train interface design features are desirable to minimize the possibility of injuries resulting from boarding or departing the train? What warning is appropriate for the arrival of passenger trains? Should movement of freight trains through stations be announced? What measures are appropriate to safeguard passenger movements in stations? What alternatives have been implemented in the United States? Internationally? With what success? What costs are associated with alternative measures to safeguard passenger movements in ground level stations? When is construction of pedestrian overpasses and fencing warranted?

Floor-Level Platforms

Station platforms that are elevated to the level of the passenger car floor permit prompt boarding and can be arranged to provide better access for persons with disabilities. However, concern has been expressed with regard to movement of trains through stations on tracks that are adjacent to platforms. Attention needs to be directed toward the design of the interface of the floor-level platform to the train to ensure passengers can safely board and leave the train. What platform-to-train interface design features are desirable to minimize the possibility of injuries resulting from boarding or departing the train? What warning is appropriate for the arrival of trains?

High-Speed Movements through Stations

Express trains often move through passenger stations without stopping, sometimes on tracks immediately adjacent to areas where passengers are waiting to board local trains. Could movement of high-speed express trains through stations present an unreasonable risk? If so, how could that risk be mitigated? What measures are utilized by passenger railroads currently facing this situation? At what costs can alternative measures be implemented to mitigate risks of high-speed express trains through stations?

Additional Economic Impact Information

Information available to FRA suggests that there are about 8,200 passenger cars and 970 conventional locomotives dedicated to rail passenger service in the United States. Is this information accurate? What ridership levels are experienced through the year? Would meeting the new higher standards described in Appendix B result in higher fares? If so, how much higher? Would a decrease in ridership be anticipated? If so, to what extent? Please explain the method of estimation. To which alternative forms of travel would lost ridership be expected to switch? How has this conclusion been reached? What assumptions have been made? FRA is interested in obtaining copies of studies or other documentation addressing the issue of passenger diversion from rail to other modes of travel as a result of new rail safety standards. What factors have the greatest effect on ridership levels: price, seat availability, trip time, variability in trip time, etc.?

Appendix D lists the economic questions posed by this ANPRM.

Regulatory Impact

FRA will evaluate any proposed action and its potential impacts to determine whether it would be considered significant under Executive Order 12866 or DOT policies and procedures (44 FR 11034, Feb. 26, 1979). Due to the substantial impact this rulemaking may have on a major transportation safety problem, this rulemaking is expected to be classified as significant pursuant to DOT Order 2100.5. FRA will also examine any proposed action and its potential impacts to determine whether it will have a significant economic impact on a substantial number of small entities under the provisions of the Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*).

FRA will further evaluate any proposed rule pursuant to DOT regulations implementing the National Environmental Policy Act (42 U.S.C. 432 *et seq.*).

Any proposed action will be further evaluated to determine information collection burdens pursuant to the Paperwork Reduction Act. Any proposed action will be evaluated pursuant to Executive Order 12612 to determine whether it would have substantial effects on the states, on the relationship between the national government and the states, or on the distribution of power and responsibilities among the various levels of government.

The economic impact of any rule that may be proposed on the subject of passenger equipment safety standards cannot be accurately quantified with the information currently available to FRA. An analysis of the economic impact will be made after evaluating the data submitted in response to this ANPRM, and the findings of that analysis will be published as part of any further notices of rulemaking issued in this matter. In addition, without fully evaluating the comments solicited by this ANPRM, it is impossible to determine what action FRA will take with regard to the other areas addressed by this ANPRM, and thus it is impossible to determine the economic impact of those changes at this time. Furthermore, any action taken by FRA is expected to result in the prevention or mitigation of accidents, personal injuries and property damage. However, until FRA fully considers the comments requested by this ANPRM and determines what action it will take, these benefits cannot be quantified.

Comments and Hearing

FRA solicits the submission of written comments, which should be filed in triplicate with the Docket Clerk at the address provided above. Specific responses to the questions set forth in this notice would be appreciated. The comment period will close on July 9, 1996, so that all comments can be presented to the Working Group before its next scheduled meeting in July 1996. When responding, reference to the topic or question number in the ANPRM will ensure full consideration of the comments submitted.

FRA has not currently scheduled a public hearing in connection with this ANPRM. Any interested party desiring an opportunity for oral comment should submit a written request to the Docket Clerk before the end of the comment period.

Issued in Washington, DC on June 5, 1996.

Jolene M. Molitoris,

Administrator, Federal Railroad Administration.

Appendix A—Sample System Safety Plan Elements

The outline that follows describes the elements of a system safety plan for a safety program for the development of a new high-speed passenger trainset. Safety programs for less complex procurements of new equipment might be greatly simplified versions of this plan.

General Description

1. The system safety plan shall describe the system safety program to be conducted as part of the trainset design process to ensure all safety-critical issues and Federal safety requirements are identified and addressed.

2. The system safety program shall ensure safety issues are treated equal to cost and performance issues when design trade-offs are made. The basis for making safety-related design trade-offs shall be documented.

3. The system safety plan shall be the top level document—completed as one of the first design process deliverables—used as guidance for the development of the following lower level safety planning and design guidance documents:

a. Fire Protection Engineering Plan.

b. Software Safety Plan.

c. Inspection, Testing, and Maintenance Plan.

d. Training Plan.

e. Pre-Revenue Service Acceptance Test Plan

4. The system safety plan shall describe the approaches to be taken to accomplish the following tasks or objectives:

a. Identification of all safety requirements including Federal requirements governing the design of the trainset and its supporting systems.

b. Evaluation of the total system—including hardware, software, testing and support activities—to identify known or potential safety hazards over the entire life cycle of the equipment.

c. The process to be used to raise safety issues during design reviews.

d. The process to be used to eliminate or reduce the risk of the hazards identified.

e. The monitoring and tracking system to be used to track the progress made toward resolving safety issues, reducing hazards, and meeting safety requirements.

f. The development of the testing program to demonstrate that safety requirements have been met.

5. The system safety program shall include periodic safety reviews that result in safety action items being assigned and tracked.

6. The system safety program shall include adequate documentation to audit how the design meets safety requirements and to track how safety issues were raised and resolved.

7. The system safety plan shall address how operational limitations may be imposed if the design cannot meet certain safety requirements.

Fire Protection Engineering Plan

1. Develop a Fire Protection Engineering Plan to be used to design adequate fire safety into the trainset.

2. The Fire Protection Engineering Plan shall:

a. Require the system developer to complete a thorough analysis of the fire protection problem.

b. Require the system developer to use good fire protection engineering practice as part of the design of the trainset design process.

c. Describe and analyze the effectiveness of the steps to be taken to design the train to be sufficiently fire resistant to ensure the detection of a fire and the evacuation of the train before the fire, smoke or toxic fumes cause injury to the passengers or crew.

d. Identify, analyze and prioritize the fire hazards inherent in the design of the trainset.

e. Describe the design approach taken and justify the design trade-offs made to minimize the risk of each fire hazard.

f. Present an analysis and propose tests to demonstrate how the fire protection engineering approach taken will lead to a train which meets these fire protection standards.

g. Be a major subset of the overall System Safety Plan, and dovetail with the railroad's Emergency Preparedness Plan.

h. Present the analysis required to select materials which provide sufficient fire resistance to ensure adequate time to detect the fire and safely evacuate the train. The system developer shall also propose the tests to be conducted to demonstrate this analysis has basis in fact.

i. Present the analysis done to ensure the ventilation system does not contribute to the lethality of a fire.

j. Include the analysis performed to determine which train components require overheat protection. If overheat protection is not provided for a component at risk of being a source of fire, a solid rationale and justification for the decision shall be included in the plan.

k. Identify all unoccupied train compartments which contain equipment or material which poses a fire hazard, and analyze the benefit provided from including a fire or smoke detection system in each compartment identified. Fire or smoke detectors shall be installed in compartments where the analysis determines that they are necessary to ensure time for safe evacuation of the train. The analysis shall provide the reasoning why a fire or smoke detector is not necessary if the decision is made not to install one in any of the unoccupied compartments identified in the plan.

l. Include an analysis of the occupied and unoccupied spaces which require portable fire extinguishers. The analysis will include the proper type and size of fire extinguisher for each location.

m. Identify all unoccupied train compartments that contain equipment or material which poses a fire hazard risk. On a case-by-case basis, the plan shall analyze the benefit provided by including a fixed, automatic fire-suppression system in each compartment identified. The type and size of the automatic fire-suppression system for each necessary application shall be determined. A fixed, automatic fire suppression system shall be installed in compartments where the analysis determines they are necessary and practical to ensure time for safe evacuation of the train. The analysis shall provide the reasoning why a fixed, automatic fire suppression system is not necessary or practical if the decision is made not to install one in any of the unoccupied compartments identified in the plan.

n. Describe the procedures to be used for inspection, maintenance, and testing of all fire safety systems and equipment.

3. The system developer shall follow the design criteria, perform the tests, and follow the operating procedures called for in the plan.

Software Safety Plan

1. Trainset system software that controls or monitors safety functions shall be treated as safety-critical.

2. The system operator shall require the system developer to develop a software safety plan to guide the design, development, testing, integration and verification of computer programs used to control and/or monitor trainset functions.

3. The software safety plan shall include a description of how the following tasks will be accomplished or objectives achieved to ensure reliable, fail-safe system software:

a. Software design process used.

b. Software design documentation to be produced.

c. Software hazard analysis.

d. Software safety reviews.

e. Software hazard monitoring and tracking.

f. Software module level safety tests.

g. Safety tests of multiple modules combined to function as a software system.

h. Hardware/software integration safety tests.

i. Demonstration of overall software safety as part of the pre-revenue service tests of the trainset.

Inspection, Testing, and Maintenance Plan

1. The plan shall:

a. Provide adequate technical detail on the procedures to be followed by the system operator to ensure trainset safety does not deteriorate over time.

b. Be used as the basis for the trainset inspection, testing, and maintenance safety standards.

c. Contain the specific, detailed inspection, testing, and maintenance procedures and intervals required to ensure safe, reliable long-term operation of all train systems.

d. Focus on, and give priority to, those inspections, preventive maintenance procedures, and tests required to prevent any deterioration in train safety.

e. Include an inspection and maintenance program that ensures all systems and components of the train are free of general conditions that endanger the safety of the crew, passengers, or equipment. These conditions include but are not limited to:

i. Insecure attachment of components.

ii. Continuous accumulations of oil or grease.

iii. Improper functioning of components.

iv. Cracks, breaks, excessive wear, structural defects or weakness of components.

v. Leaks.

vi. Use of components or systems under conditions that exceed those for which the component or system is designed to operate.

2. The plan shall include a description of the process to be used to develop detailed information on the inspection, testing and maintenance procedures necessary for long-term safe operation of the trainset. This information shall include:

a. Safety Inspection Criteria and Procedures.

b. Testing Procedures/Intervals.

c. Predetermined corrective action to take upon failure of an inspection or test.

d. Scheduled Preventive Maintenance.

e. Maintenance Procedures.

f. Special Testing Equipment.

3. The plan shall set initial scheduled maintenance intervals conservatively. The intervals shall be extended only when thoroughly justified by accumulated operating data.

Training Plan

1. Develop a training plan to provide employees and contract personnel including supervisors with the knowledge and skills necessary to effectively implement the inspection, maintenance and testing program, and to safely do his/her job.

2. The training plan shall include the knowledge and skills necessary for electronic, computer software, and mechanical personnel.

3. The plan shall contain detailed descriptions of the training—crucial to the safe operation of the trainset— which will be required for each craft.

4. The plan shall contain the certification process to be used to be sure each employee in a safety sensitive position is fit and well qualified to do his/her job.

5. The training plan shall include the training necessary for supervisors to be able to adequately spot check the work of the inspection, maintenance and testing personnel that they supervise.

6. The training plan shall include:

a. Identification of all the knowledge and skills necessary to accomplish the tasks described in the inspection, testing, and maintenance plan.

b. Design of a training program including classroom instruction and hands-on experience to ensure that employees and supervisors are given the necessary knowledge and skills.

c. A means to measure that employees—including supervisors—have the necessary knowledge and skills.

d. Modules that specifically address technology used as part of the trainset that is new to the railroad industry.

e. A program of periodic refresher training to recertify employees and contract personnel.

f. A schedule to have the work force adequately trained prior to the start of revenue service.

Pre-Revenue Service Acceptance Testing Plan

1. Develop a pre-revenue service testing plan and fully execute the plan prior to introducing new equipment into revenue service.

2. The plan shall include:

a. Identification of any waivers of Federal safety regulations required for the tests or for revenue service operation of the trainset.

b. A clear statement of the test objectives. One of the major objectives shall be to demonstrate that the trainset meets safety design requirements when operated in the environment in which it is to be used.

c. A planned schedule for conducting the tests.

d. A description of the railroad property or facilities to be used to conduct the tests.

e. A detailed description of how the tests are to be conducted including:

i. Which components are to be tested;

ii. How they are to be tested;

iii. How frequently they are to be tested;

iv. What criteria are to be used to judge their performance; and

v. How the test results are to be reported.

f. A description of any special instrumentation to be used during the tests.

g. A description of the information or data to be obtained.

h. A description of how the information or data obtained is to be analyzed or used.

i. A clear description of any criteria to be used as safety limits during testing.

j. A description of the criteria to be used to measure or determine the success or failure of the tests. If acceptance is to be based on extrapolation of less than full level testing results, the analysis to be done to justify the validity of the extrapolation shall be described.

k. A description of any special safety precautions to be observed during the testing.

l. A written set of standard operating procedures to be used to ensure that the testing is done safely.

m. A verification of the inspection, maintenance, and testing procedures and criteria to be used for the revenue service operation of the trainset.

3. The system operator shall report the results of the pre-revenue service tests and correct any safety deficiencies in the design of the trainset or in the inspection, testing, and maintenance procedures.

4. If safety deficiencies cannot be corrected by design changes, operational limitations may be imposed on the revenue service operation of the trainset.

Standard Operating Procedures

1. Develop step-by-step standard operating procedures for performing all safety-critical or potentially hazardous trainset inspection, testing, maintenance or repair tasks.

2. Standard operating procedures shall:

a. Describe in detail each step required to safely perform the task;

b. Describe the qualifications necessary to safely perform the task;

c. Describe any precautions that must be taken to safely perform the task;

d. Describe the use of any safety equipment necessary to perform the task;

e. Be approved by the chief mechanical officer of the system operator;

f. Be approved by the responsible official for safety of the system operator;

g. Be read and understood by the employees and contractors performing the tasks;

h. Be enforced by supervisors with responsibility for accomplishing the tasks; and

i. Be updated and approved annually.

3. Knowledge of standard operating procedures shall be required to qualify an employee or contractor to perform a task.

Appendix B—Sample Design Standards Based on a Tiered Approach

Introduction

FRA offers this sample outline of tiered design requirements to help generate discussion on how to set safety standards for equipment. As discussed in the body of the ANPRM, it is not clear whether the distinction between various tiers would be based solely on operating speed, a risk analysis of the envisioned operating environment, or another method. For purposes of discussion, this appendix is based on two tiers determined solely by operating speed:

Tier I: Existing and future equipment designed for operation in an environment with known risk or proven safe operation, *e.g.*, existing passenger equipment operating at speeds of 110 mph or less or up to 125 mph under specific waiver conditions.

Tier II: Equipment that is envisioned to operate in higher risk operating environments, *e.g.*, Amtrak's planned operation at 150 mph in the Northeast Corridor, or perhaps cab car forward operations under some sets of higher risk operating conditions.

(APTA takes exception to the possibility of including cab car forward operations in the Tier II category.)

FRA recognizes the need to address special equipment outside this two-tiered system, such as that operated by tourist and excursion railroads and private passenger cars. FRA also recognizes the possible need to identify additional tiers in the future, whether it be for an intermediate tier between Tiers I and II described above or for equipment intended to operate at very high speeds, *i.e.*, in excess of 150 mph.

(Amtrak agrees with the logic behind the tiered safety standard based on speed. The logical breaks for Amtrak are 0 to 90 mph, 90 to 125 mph, and 125 mph and above, thus creating a three-tiered standard.)

It is important to emphasize that neither FRA nor the Working Group has endorsed the parameters provided, except to the extent that they mirror existing rail safety laws. FRA intends that the parameters suggested in this appendix serve only as the starting point for discussion to help determine the parameters to be included in a subsequent Notice of Proposed Rulemaking (NPRM).

A. Crash Energy Management System Design Requirements

Tier I: (Note: Existing equipment designs do not typically incorporate crash energy management principles in an effort to mitigate the consequences of a collision. However, *future* designs of Tier I equipment should embrace the following guidelines.)

(APTA believes crash energy management design requirements should be applied only to Tier II equipment.)

1. Both the power vehicle and the passenger vehicle shall be designed with a crash energy management system to dissipate kinetic energy during a collision. The crash energy management system shall cause a controlled deformation and collapse of designated sections within the unoccupied volumes to absorb collision energy and reduce the decelerations on passengers and crew resulting from dynamic forces transmitted to occupied volumes.

2. The design of the power vehicle and each unit of the passenger vehicle shall consist of an occupied volume located between two normally unoccupied volumes. Where practical, sections within the unoccupied volumes shall be designed to be structurally weaker than the occupied volume. During a collision or derailment, the designated sections within the unoccupied volumes shall start to deform and eventually collapse in a controlled fashion to dissipate energy before any structural damage occurs to the occupied volume. Alternately, a crash energy management strategy shall be implemented by trainset.

3. The crash energy management system shall keep the train in line and on the track long enough to maximize the energy absorbed by controlled crushing of designated sections within unoccupied volumes of the train. The train shall be designed for controlled collapse of the designated sections within unoccupied volumes of the train, starting from the ends of the train and working toward the center of the train as the energy to be dissipated increases.

4. The trainset shall be designed for a crush distance and crush force that result in survivable volumes in all occupied areas of the trainset under the conditions of the collision scenario. A collision scenario needs to be defined to serve as a basis for design analysis of Tier I equipment's crash energy management system and structure. What parameters should be used to define this collision scenario?

5. The locomotive or power car cab shall be designed to limit the secondary impact deceleration of crew members to a maximum of 24g and an average of 16g for 250 milliseconds after initial impact under the conditions of the collision scenario.

6. The trainset shall be designed to limit the secondary impact deceleration acting on passengers in the leading passenger compartment to a maximum of 6g and an average of 4g for 250 milliseconds after initial impact under the conditions of the collision scenario.

7. The occupied volume of the power vehicle and the occupied volumes of the passenger vehicle shall be designed and constructed in a manner to preclude telescoping of the crushed unoccupied volume structure into the occupied volume.

8. The unoccupied volume of the power vehicle shall have a static end yield strength of no less than 50 percent of the required static end strength of the power vehicle occupied volume. The unoccupied volume of each unit of the passenger vehicle shall have a static end yield strength of no less than 50 percent of the required static end strength yield of the passenger unit occupied volume. Any deviation form this requirement must be fully justified by analysis or test.

9. The crash energy management system shall start to function at a static end load of no less than 50 percent of the required static end strength of the occupied volume, but no more than 90 percent of the actual static end strength of the occupied volume.

10. An analysis based on the collision scenario shall be performed to verify that the trainset crash energy management system meets the requirements of this section. Assumptions made as part of the analysis to calculate how the kinetic energy of the colliding passenger train is dissipated shall be fully justified. The analysis must clearly show that the designated energy absorbing sections within the unoccupied volumes of the trainset crush before collapse of the occupied volumes start and that the deceleration of people in the occupied volumes is limited to the levels required by paragraphs 5 and 6 above. This analysis shall be made available to FRA upon request.

(APTA points out that crash energy management design concepts have not been validated by tests or analysis for equipment operating in the speed range envisioned for Tier I equipment. APTA points to the need for a major research and physical testing program to demonstrate and validate crash energy management design benefits.)

(Amtrak is in full agreement with the concept of crash energy management, but similarly feels that some form of full-scale testing may be required to validate the computer simulations. Further, Amtrak warns that this type of testing is expensive by nature, and an effort to identify a funding source needs to be initiated now in order not to delay the rulemaking process.)

Tier II: Same requirements as above for Tier I equipment.

B. Structural Design Requirements

1. Static End Strength

Tier I: The current U.S. practice is to require both locomotives and coaches to have a minimum static end strength of 800,000 pounds without deformation. If a crash energy management design approach is taken, this requirement applies only to the occupied volume of the equipment. Unoccupied volumes may have a lesser static end yield strength.

Tier II: The longitudinal static yield strength of the trainset occupied volumes shall be no less than 1,000,000 pounds ultimate strength.

(APTA suggests that the static end strength requirements for both Tier I and Tier II equipment should be the same. APTA believes the occupants of the weaker car may suffer unduly in a collision of cars of differing strength.)

2. Anticlimbing Mechanism

Tier I: The current U.S. practice is to require locomotives (power cars) to have an anticlimbing mechanism capable of resisting an upward or downward vertical force of 200,000 pounds. This requirement is given in Association of American Railroads (AAR) Specification S–580, that became effective in August, 1990. Passenger coaches and MU locomotives (49 CFR 229.141(a)(2)) are required to have an anticlimbing mechanism capable of resisting an upward or downward vertical force of 100,000 pounds. How should the anticlimber requirements for Tier I equipment be specified to ensure maximum advantage is taken of the strength of the underframe to resist collision forces?

Tier II: a. Anticlimber engagements of each end of each interior trainset unit shall be designed to keep the trainset in line and on the track until the energy-absorbing capability of the crash energy management system has been exceeded and the strength of occupied volumes of the train start to be overcome.

b. Anticlimber engagements shall be capable of resisting both vertical and lateral buckling forces between units due to an acceleration of 1g acting on the total loaded mass including trucks of the heavier of the two coupled units.

3. Link Between Coupling Mechanism and Carbody

Tier I: The mechanical link which attaches the front coupling mechanism to the car body shall be designed to resist a vertical downward thrust from the coupler shank of 100,000 pounds for any horizontal position of the coupler, without exceeding the yield points of the materials used.

Does this requirement provide protection to passengers and crew? If not, how should this parameter be specified?

Tier II: Same requirements as above for Tier I equipment.

4. Short Hood Structure (Non-MU Locomotives Only)

Tier I: The skin covering the short hood or forward-facing end of the locomotive shall be equivalent to a ½-inch steel plate with a 25,000 pounds-per-square-inch yield strength. Higher yield strength material may be used to decrease the thickness of the material as long as an equivalent strength is maintained. This skin shall be securely attached to the forward collision posts and shall be sealed to prevent the entry of flammable fluids into the occupied cab area. Does this requirement inhibit the application of crash energy management technology to Tier I equipment?

Tier II: Same requirements as above for Tier I equipment.

5. Collision Posts

Tier I: a. Locomotive Forward Collision Posts—Two collision posts are required, each capable of withstanding a shear load of 500,000 pounds at the joint of the collision post to the underframe without exceeding the ultimate strength of the joint. Each post must also be capable of withstanding, without exceeding the ultimate strength, a 200,000 pound shear force exerted 30 inches above the joint of the post to the underframe (AAR Specification S–580). This requirement is independent of train weight. Alternately, an equivalent end structure may be used in place of the two collision posts. The single end structure must withstand the sum of the forces required for each collision post.

b. MU Locomotive Rear Collision Posts—Two collision posts are required, each having an ultimate shear value of not less than 300,000 pounds at a point even with the top of the underframe member to which it is attached. If reinforcement is used to provide the shear value, the reinforcement shall have full value for a distance of 18 inches up from the underframe connection and then taper to a point approximately 30 inches above the underframe connection (49 CFR 229.141(a)(4)). FRA believes this requirement needs to be improved. The collision posts can easily be strengthened and lengthened (preferably full height to the roofline). An equivalent single end structure may be used in place of the two collision posts. The single end structure must be designed to withstand the sum of the forces required for the end posts. For analysis purposes, the required forces can be assumed to be evenly distributed at the end structure at the underframe joint.

c. Passenger Coach Collision Posts—Current U.S. practice is to require a pair of collision posts at each end of a passenger coach. If a passenger coach consists of articulated or otherwise permanently joined units, collision posts are required only at the ends of the permanently coupled assembly of units, not at the ends of each unit of the assembly. In other words, collision posts are required at ends of passenger equipment where coupling and uncoupling are expected. The requirements for passenger coach collision posts are identical to the requirements for locomotive rear collision posts. FRA believes this requirement needs to be improved. The collision posts can easily be strengthened and lengthened (preferably full height to the roofline). An equivalent end structure may be used in place of the two collision posts.

FRA believes a unified collision post requirement should apply to all Tier I passenger vehicles, to include coaches and power/cab cars. The collision posts should be stronger and preferably extend to the roofline. How should collision posts for Tier I passenger vehicles be specified?

Tier II: As discussed in the body of the ANPRM, FRA believes that a unitized type of end structure with integral collision and corner posts that extend to the roof line should be considered for a design standard for passenger equipment.

a. Strength of the Leading and Trailing Ends of a Trainset.

i. The leading and trailing ends of the trainset shall be equipped with an end structure capable of transmitting to the frame of the leading or trailing unit a horizontally applied longitudinal load of 1,000,000 pounds uniformly applied at floor level decreasing uniformly with height to no less than 400,000 pounds uniformly applied at the roof line without exceeding the ultimate strength of the end structure.

(APTA points out that the need for and basis of the high roofline strength requirement has not been established.)

ii. A leading/trailing end structure may be used to meet requirements for corner posts and collision posts.

b. Strength of Collision Posts or End Structures. (Ends of trainset other than leading or trailing ends.)

i. Each end of a trainset unit designed for automatic coupling that is not a leading or trailing end of the trainset shall be equipped with collision posts or an end structure capable of transmitting to the frame of that unit a horizontal, longitudinal load of 600,000 pounds applied at floor level decreasing uniformly with height to no less than 240,000 pounds applied at the roof line without exceeding the ultimate strength of the collision posts or end structure.

(APTA points out that the need for and basis of the high roofline strength requirement has not been established.)

ii. A unitized end structure may be used to meet requirements for corner posts and collision posts.

6. Corner Posts

Tier I: Corner posts shall be full height (extending from underframe structure to roof structure) and capable of resisting a horizontal load of 150,000 pounds at the point of attachment to the underframe and a load of 80,000 pounds at the point of attachment to the roof structure without failure. The orientation of the applied horizontal load shall range from longitudinal inward to transverse inward. The corner posts may be positioned to provide protection or structural strength to the occupied volume.

Tier II: As discussed in the body of the ANPRM, FRA believes that a unitized type of end structure with integral collision and corner posts that extend to the roof line should be considered for a design standard for passenger equipment.

a. Strength of Corner Posts at the Leading or Trailing End of a Trainset:

i. The leading and trailing ends of the trainset shall be equipped with a corner post at the intersection of the end with each side.

ii. Each corner post shall be capable of resisting—without failure or deformation—a horizontal load applied at any point in a 90 degree arc from lateral to longitudinal of 333,000 pounds applied at floor level decreasing uniformly to no less than 133,000 pounds at the roof line.

iii. The corner posts may be part of the end structure.

b. Strength of Corner Posts Not at the Leading or Trailing End of a Trainset:

i. Each end of a trainset unit that is not a leading or trailing end of the trainset and that is equipped with automatic couplers shall be equipped with a corner post at the intersection of the end with each side.

ii. Each corner post shall be capable of resisting—without failure or deformation—a horizontal load applied at any point in a 90-degree arc from lateral to longitudinal of 200,000 pounds applied at floor level decreasing uniformly to no less than 80,000 pounds at the roof line.

iii. The corner posts may be part of the end structure.

(APTA does not believe that the corner post requirements proposed by FRA are realistic. APTA believes these proposed corner post requirements should be replaced with a requirement that the post be able to resist a load of 65,000 pounds applied at a point 30″ above the floor without permanent deformation.)

7. Crash Refuge

Tier I: (Note: Existing equipment designs do not typically incorporate crash energy management principles in an effort to mitigate the consequences of a collision. However, future designs of Tier I equipment should embrace the following guidelines.)

(APTA does not believe that crash refuge requirements should be applied to future designs of Tier I equipment.)

a. A refuge or survivable area to which the crew can retreat in the event of an impending collision shall be provided. This refuge or survivable area shall take maximum advantage of the structural strength of the power vehicle or control cab and include shock-mitigating material.

b. This refuge shall have the structural integrity and shock mitigation necessary to allow the crew to survive the accelerations and forces resulting from the collision scenario described as part of the recommended crash energy management system requirements.

c. The crash refuge shall be readily accessible for quick entry by the crew.

Tier II: Same requirements as above for Tier I equipment.

8. Rollover Strength

Tier I: There are no current industry or Federal specifications for rollover protection in locomotives or passenger equipment. The following are proposed examples of such requirements to protect crew and passengers in the event of a rollover scenario:

a. Locomotives should be able to withstand a uniformly applied load equal to 2g acting on the mass of the locomotive without failure of the cab side structure or the cab roof structure. (Local deformation of the side sheathing or roof sheathing in the cab area is permitted as long as a survivable volume is preserved in the crew compartment.)

(APTA believes that this specific requirement should be replaced with a more general requirement stating that locomotives shall be designed to provide a survivable volume in the crew compartment in the event of a rollover.)

b. Passenger coach and MU locomotive sides and roofs shall have sufficient structural strength to withstand the dynamic rollover force exerted by an acceleration of 2g acting on the mass of an individual vehicle or unit without collapse of the occupied volume. The occupied volume may deform to the extent that no more than 10 percent of initial volume is lost due to crush caused by the rollover. FRA believes existing North American designs will likely meet this requirement.

Tier II: Same requirements as above for Tier I equipment.

9. Side Impact Strength

Tier I:

a. A side impact design requirement would, among other things, protect passengers and crew from side collisions by heavy highway vehicles at grade crossings. Such a requirement may be particularly important for equipment with a floor height less than 36 inches above the top of the rail. A concept for the requirement is an ability to withstand the load applied by a loaded tractor trailer travelling at a selected speed colliding with the side of the car over an area and at a height typical of tractor trailer bumpers with a limited deformation of the car body structure. What specific parameters should be used to implement this concept or what alternate concepts can be proposed for a side impact strength design requirement?

b. If the highway vehicle is likely to override the trainset unit floor structure, the trainset unit side structures shall be designed to resist the resulting forces without penetration of the highway vehicle into the occupied volume of the trainset unit.

Tier II: Same requirements as above for Tier I equipment.

(APTA believes the advanced bus design side penetration requirements should be considered as an option to the requirements proposed by FRA.)

10. Truck-to-Car-Body Attachment

Tier I: The intent of the requirement in 49 CFR 229.141(a)(5) and (b)(5) is to keep the truck attached to the car body in the event of a derailment or rollover. In place of this requirement, new designs might be required to resist without failure a minimum force applied in any horizontal direction for the link which attaches the truck to the car body. The requirement under consideration is as follows:

a. For all trainset units, ultimate strength of the truck-to-car-body attachment shall be sufficient to resist without failure a force of 250,000 pounds or the force due to an acceleration of 4g acting in any direction on the mass of the truck, whichever is greater.

b. The mass of the truck includes axles, wheels, bearings, truck-mounted brake system, suspension system components, and any other components attached to the truck.

Tier II: Same requirements as above for Tier I equipment.

11. Strength of Attachment of Interior Fittings

a. Seat Strength:

Tier I:

i. All seat components shall be designed to withstand loads due to the impact of passengers at a relative speed of 25 mph.

ii. The seat back shall include shock-absorbent material to cushion the impact of passengers with the seat ahead of them.

Tier II: Same requirements as above for Tier I equipment.

b. Seat Attachment Strength:

Tier I:

i. Passenger and crew seats shall be securely fastened to the car structure in a manner so as to withstand an acceleration of 4g acting in the vertical direction on the deadweight of the seat or seats, if a tandem unit.

ii. The ultimate strength of a seat attachment must be such that the seat attachment is able to resist the longitudinal inertial force of 8g acting on the mass of the seat plus the impact force of the mass of the passenger(s) being decelerated from a relative speed of 25 mph.

Tier II: Same requirements as above for Tier I equipment.

(APTA questions the basis for the seat strength and seat attachment strength requirements. APTA also believes the requirements should apply only to passenger seats, not to crew seats.)

c. Other Interior Fittings:

Tier I: Other interior fittings shall be attached to the car body with sufficient strength to withstand accelerations of 8g/4g/4g acting longitudinally/laterally/vertically on the mass of the fitting.

Tier II: In addition to the Tier I requirement provided above, the following is required:

The ultimate strength of a locomotive cab interior fitting and equipment attachment shall be sufficient to resist without failure loads due to accelerations of 12g/4g/4g longitudinally/laterally/vertically acting on the mass of the fitting or equipment.

(APTA recommends a 3g/3g/3g requirement for the strength of attachment of interior fittings for both Tier I and Tier II equipment.)

d. Luggage Stowage Compartment Strength:

Tier I:

i. Luggage stowage compartments shall be of enclosed aircraft type.

ii. Ultimate strength shall be sufficient to resist loads due to accelerations acting longitudinally/laterally/vertically of 8g/4g/4g on the mass of the luggage stowed.

(APTA recommends the following requirement for Tier I equipment: Passenger luggage stowage racks shall provide longitudinal restraint for stowed articles.)

Tier II: Same requirements as above for Tier I equipment.

(APTA recommends 3g/3g/3g for Tier II equipment luggage stowage compartments)

e. Interior Surface Fittings:

Tier I:

i. To the extent possible, interior fittings shall be recessed or flush-mounted.

ii. Corners and sharp edges shall be avoided.

iii. Energy-absorbent material shall be used to pad surfaces likely to be impacted by passengers or crew members during collisions or derailments. (APTA recommends deleting this requirement.)

Tier II: Same requirements as above for Tier I equipment.

C. Glazing

Tier I: As addressed in the body of the ANPRM, FRA believes that portions of the current glazing requirements in 49 CFR Part 223 may need to be revised to adequately protect crew members and passengers. In this proceeding or a separate future proceeding, FRA may ask for consideration of modifications to 49 CFR Part 223 to address the concerns listed below:

1. The witness plate used for testing is too thick, allowing spalling of pieces of glass large enough to cause injury;

2. The impact test using a 24-pound cinder block is not repeatable;

3. Vendors or materials should be periodically recertified by an independent testing laboratory;

4. The strength of the framing arrangement securing the glazing is neither specified nor tested; and

5. Interior glass breakage in the event of a collision poses a significant hazard to passengers.

Tier II: FRA believes that the following requirements address the concerns listed above, and also address additional issues necessary to provide adequate protection to crew and passengers in the higher risk environments in which Tier II equipment will be operating.

1. Anti-Spalling Performance—.001 aluminum witness plate, 12 inches from glazing surface, no marks in witness plate after any test.

2. Bullet Impact Performance—Able to stop without spall or bullet penetration a single impact of a 9-mm, 147-grain bullet traveling at an impact velocity of 900 feet/second with no bullet penetration or spall.

3. Large Object Impact Performance.

a. End Facing—Impact of a 12-pound solid steel sphere at the maximum speed at which the vehicle will operate, at an angle equal to the angle between the glazing surface as installed and the direction of travel, with no penetration or spall.

b. Side Facing—Impact of a 12-pound solid steel sphere at 15 mph, at an angle of 90 degrees to the surface of the glazing, with no penetration.

4. Small Object Impact Performance.

a. Side Facing—Impact of a granite ballast stone with major and minor axes of no greater than 10 percent difference in length, weighing a minimum of 0.5 pounds, travelling at 75 mph, impacting at a 90-degree angle to the glazing surface, with no penetration or spall.

5. Frame Strength—Frame holds glazing in place against all forces that do not cause glazing penetration.

6. Passing Trains—Glazing and frame shall resist the forces due to air pressure differences caused by trains passing with the minimum separation for two adjacent tracks while traveling in opposite directions, each traveling at maximum speed.

7. Interior Glazing—Interior trainset glazing shall meet the minimum requirements of AS1 type laminated glass as defined in American National Standard ''Safety Code for Glazing Materials for Glazing Motor Vehicles Operating on Land Highways,'' ASA Standard Z26.1–1966.

D. Emergency Systems—Each Unit and Each Level of Bi-Level Units

Tier I:

1. *Emergency Lighting.*

a. Illumination level shall be a minimum of 5 foot-candles at floor level for all potential trainset evacuation routes.

b. A back-up power system capable of operating all emergency lighting for a period of at least two hours shall be provided.

c. The back-up power system shall be capable of operation in all trainset unit orientations. (APTA recommends adding ''within 45 degrees of vertical'' to the end of this requirement.)

d. The back-up power system shall be capable of operation after the initial shock of a collision or derailment. (APTA proposes a 3g shock load.)

2. *Emergency Communication.*

a. Both interior and exterior locations of emergency communications equipment shall be specified. Exterior locations must be compatible with communication equipment normally carried by emergency response personnel. Interior locations must be provided at both ends of every level of passenger units, for passengers to communicate emergency conditions to the trainset operator.

b. Back-up power—Emergency communication system back-up power shall be provided for a minimum time period of two hours.

c. Clear, concise instructions for emergency use shall be posted at all potential evacuation locations.

(APTA recommends that these requirements be deferred to the Passenger Train Emergency Preparedness Working Group.)

3. *Emergency Equipment.*

a. Locations of emergency equipment shall be clearly marked.

b. Clear, concise instructions for use of emergency equipment shall be posted at each location.

(APTA recommends that these requirements be deferred to the Passenger Train Emergency Preparedness Working Group.)

4. *Emergency Exits.*

a. Locations of emergency exits shall be clearly marked and lighted.

(APTA recommends eliminating lighted)

b. Clear, concise instructions for use of the emergency exits shall be posted at each location.

c. Number of exits required:

i. Four windows—one located at each end of each side—of a passenger coach shall operate as emergency exits.

ii. If the coach is bi-level, four windows—one located at each end of each side—on each level shall operate as emergency exits.

iii. For special design cars, such as sleepers, each compartment shall have at least one emergency exit.

d. Size—Passenger coach sealed window emergency exits shall have a minimum free opening of 30 inches wide by 30 inches high. (APTA recommends 18 inches wide by 24 inches high.)

e. Each locomotive or power cab shall have a minimum of one roof hatch emergency exit with either a minimum opening of 18 inches by 24 inches or a clearly marked structural weak point in the roof to provide quick access for properly equipped emergency personnel. (APTA recommends eliminating this requirement.)

f. Each passenger coach or passenger service car shall be equipped with either a minimum of two roof hatch emergency exits with a minimum opening of 18 inches by 24 inches (APTA recommends eliminating the size requirement) or a clearly marked structural weak point in the roof to provide quick access for properly equipped emergency personnel.

g. Each emergency exit shall be easily operable by passengers and crew members without requiring the use of any special tools.

Tier II: Same requirements as above for Tier I equipment.

E. Doors (APTA recommends this section apply only to exterior powered side doors.)

Tier I:

1. The status of exterior doors shall be displayed to the crew. If door interlocks are used, the sensors used to detect train motion shall be accurate to within ±2 mph.

2. Doors shall be powered by the emergency back-up power system.

3. Doors shall be equipped with a manual override that can be used to open doors without power both from outside and inside the trainset. Instructions for manual override shall be clearly posted in the car interior at door locations.

4. Doors shall be easily operable by passengers and crew members following a derailment or collision without requiring the use of any special tools to accomplish the manual override in the event of head-end power loss.

5. Doors shall open outward to facilitate timely egress in the event of a collision or derailment.

Tier II: Same requirements as above for Tier I equipment.

F. Fuel Tanks

Tier I:

1. *External Fuel Tanks.*

a. Height off rail—With all locomotive wheels resting on the ties beside the rail, the lowest point of the fuel tank shall clear an 8.5-inch combined tie plate/rail height by a minimum of 1.5 inches. This requirement results in a minimum 10-inch vertical distance from the lowest point on the wheel tread to the lowest point on the fuel tank.

b. Bulkhead and skin—material, thickness, and strength.

i. Bulkheads—1-inch steel plate with 25,000 psi yield strength. Higher yield-strength steel may be used to decrease the thickness required as long as equivalent strength is maintained.

ii. Skin—1/2-inch steel plate with 25,000 psi yield strength or equivalent. Higher yield-strength steel may be used to decrease the thickness required as long as equivalent strength is maintained.

iii. The material used for construction of fuel tank exterior surfaces shall not exhibit a decrease in yield strength or penetration resistance in the temperature range of 0 to 160 °F.

c. Compartmentalization—The interior of fuel tanks shall be divided into a minimum of four separate compartments designed so that a penetration in the exterior skin of any one compartment shall result in loss of fuel only from that compartment.

d. Vent system spill protection—Fuel tank vent systems shall be designed to prevent them from becoming a path of fuel loss in the event the tank is placed in any orientation due to a locomotive overturning.

e. The bottom surface of the fuel tank shall be equipped with skid surfaces to prevent sliding contact with the rail or the ground from easily wearing through the tank.

f. Structural Strength—The structural strength of the tank shall be adequate to support 1.5 times the dead weight of the locomotive without deformation of the tank.

2. *Internal Fuel Tanks.*

a. ''Internal fuel tank'' is defined as a tank whose lowest point is at least 18 inches above the lowest point on the locomotive wheel tread and that is enclosed by, or is part of, the locomotive structure.

b. Compartmentalization—The interior of fuel tanks shall be divided into a minimum of four separate compartments designed so that a penetration in the exterior skin of any one compartment shall result in loss of fuel only from that compartment.

c. Vent system spill protection—Fuel tank vent systems shall be designed to prevent them from becoming a path of fuel loss in the event the tank is placed in any orientation due to a locomotive overturning.

d. Internal fuel tank bulkheads and skin shall be 3/8-inch steel plate with 25,000-lb yield strength or material with equivalent strength. Skid plates are not required.

Tier II: Same requirements as above for Tier I equipment.

G. Cab Controls, Interior and Safety Features

Tier I:

1. *Slip/Slide Alarms* (49 CFR 229.115).

a. Each power vehicle/control cab shall be equipped with an adhesion control system designed to automatically detect a loss of adhesion during power application and then reduce power to limit wheel slip. (APTA recommends eliminating this requirement.)

b. The adhesion control system shall also automatically adjust the braking force on each wheel to prevent sliding during braking. In the event of a failure of this system to prevent wheel slip/slide within preset parameters, a visual and/or audible wheel slip/slide alarm shall alert the train operator. The slip/slide alarm shall alert the operator in the cab of the controlling power vehicle/ control car to slip/slide conditions on any powered axle of the train. (APTA recommends eliminating this requirement.)

c. Each powered axle shall be monitored for slip/slide. (APTA recommends moving this requirement to passenger equipment power brake rules.)

2. Operator controls in the power vehicle/ control cab shall be arranged to be comfortably within view and within easy reach when the operator is seated in the normal train control position.

3. The control panels shall be laid out to minimize the chance of human error.

4. Control panel buttons, switches, levers, knobs, etc., shall be distinguishable by sight and by touch.

5. An alerter shall be provided. The alerter may allow the operator freedom of movement in the control cab but shall not allow the operator to move outside the area in which control of the train is exercised while the train is in motion.

6. *Cab Information Displays.*

a. Simplicity and standardization shall be the driving criteria for design of formats for the display of information in the cab.

b. Essential, safety-critical information shall be displayed as a default condition.

c. Operator selection shall be required to display other than default information.

d. Cab/train control signals shall be available as a display option for the operator.

e. Displays shall be easy to read from the operator's normal position under all lighting conditions.

7. *Pilots, Snowplows, Endplates.*

a. The power vehicle/control cab car shall be equipped with a structurally substantial endplate, pilot or snowplow which extends across both rails of the track.

b. The height of the endplate, pilot, or snowplow shall be greater than 3 inches and less than 6 inches off the rails.

8. *Headlights* (49 CFR 229.125)

a. The power vehicle/control cab shall be equipped with more than one headlight producing no less than 200,000 candela.

b. The headlights shall be focused to illuminate a person standing between the rails at 800 feet (1000 feet for Tier II) under clear weather conditions.

9. *Crew's Field of View.*

a. The cab layout shall be arranged so the crew has an effective field of view in the forward direction and to the right and left of the direction of travel.

b. Field-of-view obstructions due to required structural members shall be minimized.

c. The crew's position in the cab shall be located to permit the crew to be able to directly observe traffic approaching the train from either side of the train. (APTA recommends this requirement be revised to be measurable or be eliminated.)

10. *Seat Placement/Features.*

Seats provided for crew members shall:

a. Be equipped with quick-release lap belts and shoulder harnesses.

b. Be secured to the car body with an attachment having an ultimate strength capable of withstanding the loads due to accelerations of 12g/4g/4g acting longitudinally/laterally/vertically on the mass of the seat and the crew member occupying it. (APTA recommends a 3g/3g/3g requirement that applies only to the mass of the seat.)

c. Be designed so all adjustments have the range necessary to accommodate a 5th-percentile female to a 95th-percentile male.

d. Be equipped with lumbar support that is adjustable from the seated position.

e. Be equipped with force-assisted, vertical-height adjustment, operated from the seated position.

f. Have manually reclining seat backs, adjustable from the seated position.

g. Have adjustable headrests.

h. Have folding, padded armrests.

(APTA recommends that these requirements only apply to floor mounted seats.)

11. *Impact Mitigation.*

a. Sharp edges and corners shall be eliminated from the interior of the cab.

b. Interior surfaces of the cab likely to be impacted by crew members during a collision or derailment shall be padded with shock-absorbent material.

Tier II: Same requirements as above for Tier I equipment.

H. Fire Safety

Tier I:

1. A Fire Protection Engineering Plan shall be developed as part of the system planning process.

a. The fire protection engineering plan shall identify and evaluate the major sources of fire risk. (APTA recommends that this requirement be deleted.)

b. The plan shall describe the design steps taken to delay the onset of lethal conditions until the fire can be detected, the train stopped and all personnel safely evacuated. (APTA recommends that this requirement be deleted.)

2. The trainset ventilation system shall be designed so as not to contribute to the spread of flames or products of combustion.

3. Trainset roof design shall prevent high-voltage arcs from overhead catenaries from penetrating the skin or shell of the occupied spaces in the trainset. The roof shall not be susceptible to ignition due to high-voltage arcing. (APTA recommends that this requirement be deleted.)

4. Where possible, components that are potential sources of fire ignition shall be located outside occupied volumes and shall be separated from occupied volumes by a structural fire-resistant barrier. (APTA recommends that this requirement be deleted.)

5. Portions of the trainset structure separating major sources of ignition, of energy storage, or of fuel loading from the occupied volumes of the trainset shall have sufficient resistance to fire, smoke and fume penetration to allow time for fire detection and safe evacuation of the trainset. (APTA recommends that this requirement be deleted.)

6. All materials and finishes used or installed in the construction of the trainset shall have sufficient resistance to fire, smoke and fume production to allow sufficient time for fire detection, for the trainset to stop, and for safe evacuation of passengers before lethal conditions develop. (APTA recommends that this requirement be deleted.)

7. At a minimum, the materials used for the construction of cab interiors including but not limited to walls, floors, ceilings, seats, doors, windows, electrical conduits, air ducts and any other internal equipment shall meet FRA guidelines published in the Federal Register on January 17, 1989. (See 54 FR 1837, ''Rail Passenger Equipment; Reissuance of Guidelines for Selecting Materials to Improve Their Fire Safety Characteristics''; see also the latest National Fire Protection Association ''NFPA 130, Standard for Fixed Guideway Transit Systems.'')

8. *Detection and Suppression.*

a. Fire extinguishers shall be placed in each unit.

b. All trainset components with a potential to overheat in the event of a malfunction to the extent they could be the source of an on-board fire shall be equipped with overheat warning devices. These components shall include, but not be limited to:

i. Diesel Engines;

ii. Traction Motors;

iii. Dynamic Brake Energy Dissipation System Components;

iv. Transformers;

v. Inverters; and

vi. Head-End Power Generation Systems.

(APTA recommends that the system safety plan determine how to handle components that could overheat rather than requiring detection devices.)

Tier II: Same requirements as above for Tier I equipment.

I. Electrical System Design

No one specific, industry electrical standard adequately addresses all of the electrical safety issues relating to the operation of a trainset. As safe operation of trains becomes more dependent on electronic technology, reliable electrical and electronic systems become crucial. The industry standard most appropriate for each major component of the trainset electrical system needs to be carefully selected.

The requirements provided below are intended for Tier I and Tier II equipment, as applicable.

1. Conductor Sizes—Conductor sizes shall be selected on the basis of current-carrying capacity, mechanical strength, temperature, flexibility requirements and maximum allowable voltage drop. Current-carrying capacity shall be derated for grouping and for operating temperature in accordance with nationally recognized standards.

2. Circuit Protection.

a. The main propulsion power line shall be protected with a lightning arrestor, automatic circuit breaker and overload relay. The lightning arrestor shall be run by the most direct path possible to ground with a connection to ground of not less than No. 6 AWG. These overload protection devices shall be housed in an enclosure designed specifically for that purpose with arc chute vented directly to outside air.

b. Head end power including trainline power distribution shall be provided with both overload and ground fault protection.

c. Circuits used for purposes other than propelling the trainset shall be connected to their power source through correctly sized circuit breakers or circuit breaking contactors.

d. Each auxiliary circuit shall be provided with a circuit breaker located as near as practical to the point of connection to the source of power for that circuit. Such protection may be omitted from circuits controlling crucial safety devices.

3. Battery System.

a. The battery compartment shall be isolated from the cab by a non-combustible barrier.

b. Battery chargers shall be designed to protect against overcharging.

c. Battery circuits shall include an emergency battery cut-off switch to completely disconnect the energy stored in the batteries from the load.

d. If batteries are of the type to potentially vent explosive gases, the battery compartment shall be adequately ventilated to prevent accumulation of explosive concentrations of these gases.

4. Power Dissipation Resistors.

a. Power dissipating resistors shall be adequately ventilated to prevent overheating under worst-case operating conditions.

b. Power dissipation grids shall be designed and installed with adequate air space between resistor elements and combustible material.

c. Power dissipation resistor circuits shall incorporate warning or protective devices for low ventilation air flow, over-temperature and short circuit failures.

d. Resistor elements shall be electrically insulated from resistor frames, and the frames shall be electrically insulated from the supports that hold them.

e. The current value used to determine the size of resistor leads shall not be less than 120 percent of the RMS load current under the most severe operating conditions.

5. Electromagnetic Interference/ Compatibility.

a. No trainset system shall produce electrical noise that interferes with trainline control and communications or with wayside signaling systems.

b. To contain electromagnetic interference emissions, suppression of transients shall be at the source wherever possible.

c. Trainset electrical/electronic systems shall be capable of operation in the presence of external electromagnetic noise sources.

d. All electronic equipment shall be self-protected from damage and/or improper operation due to high voltage transients and long-term over-voltage or under-voltage conditions.

J. Inspection, Testing, and Maintenance

Tier I: The operating railroad shall provide detailed information on the inspection, testing, and maintenance procedures necessary for long-term safe operation of the trainset. This information should include:

1. Testing Procedures/Intervals;
2. Scheduled Preventive Maintenance;
3. Maintenance Procedures;
4. Special Testing Equipment; and
5. Training of Mechanical Forces.

Tier II: Same requirements as above for Tier I equipment.

K. Brake System

Existing brake system equipment must meet the applicable requirements of 49 CFR Parts 229, 231, and 232, and 49 U.S.C. Chapters 203 and 207 as they relate to the specific equipment and operation.

FRA has recognized that the current regulations fail to adequately delineate between requirements for conventional freight braking systems and the more diverse systems for various categories of passenger service. FRA also recognizes that the regulations should be updated to recognize the contemporary electronic systems that are used to control elements of power brake systems.

In response to the above concerns, FRA published a NPRM for power brake regulations in September 1994. Four public hearings were held to discuss particular issues regarding the proposed rules, and FRA is in the process of reviewing comments received for inclusion in a revision to the original proposed rule.

Proposed brake system design requirements for Tier I and II equipment will be determined by the Passenger Equipment Safety Standards Working Group using the information on passenger equipment brakes accumulated in docket PB–9 in response to the NPRM on power brakes.

L. Automated Monitoring and Diagnostics

As train speed increases, the human decision and reaction time necessary to avoid potential calamity decreases. Automatic control techniques that briefly take the operator out of the control loop are a means to eliminate the delays associated with human decision and reaction in situations where taking quick and positive action can be crucial. (APTA recommends that this paragraph be deleted.)

Tier I: There are no current requirements for Tier I equipment to incorporate automatic monitoring and control measures as described above. Specific functions are identified below for Tier II equipment, as increased train speeds and higher risk operating environments make reactions to these functions more time-sensitive with respect to safety. If the functions identified below can be shown to be practically and economically feasible in Tier I equipment, implementation should be considered. (APTA recommends no such requirements for Tier I equipment.)

Tier II:

1. The trainset shall be equipped with a system that monitors the performance of the following safety-critical items:

a. Reception of Cab Signals/Train Control Signals;
b. Truck Hunting;
c. Dynamic Brake Status;
d. Friction Brake Status;
e. Fire Detection Systems;
f. Head End Power Status;
g. Alerter;
h. Horn and Bell;
i. Wheel Slip/Slide; and
j. Tilt System, if so equipped.

2. The monitoring system shall alert the operator when any of the monitored parameters are out of predetermined limits. In situations where the system safety analysis indicates that operator reaction time is crucial to safety, the monitoring system shall take immediate, automatic corrective action such as limiting the speed of the train.

3. The self-monitoring system shall be designed with an automatic self-test feature that notifies the operator that the system is functioning correctly.

M. Trainset System Software

The requirements provided below are intended for Tier I and Tier II equipment, as applicable.

1. Software used to monitor and control trainset safety features or functions shall be treated as safety-critical.

2. A formal system software safety program shall be used to develop the system software. This program shall include a software hazard analysis and thorough software design walk-through and verification tests to ensure software is reliable and designed to be fail-safe.

(APTA recommends that Section M be eliminated.)

N. Trainset Hardware/Software Integration

The requirement provided below is intended for Tier I and Tier II equipment, as applicable.

1. A comprehensive hardware/software integration program shall be planned and conducted to demonstrate that the software functions as intended when installed in a hardware system identical to that to be used in service.

O. Suspension System Design Requirements

Tier I: FRA does not currently address suspension system requirements for passenger equipment.

Tier II:

1. The suspension system shall be designed so no single wheel lateral to vertical force (L/V) ratio is greater than 0.8 for a duration required to travel 3 feet at any operating speed or over any class of track used by the trainset unless the axle sum ratio is less than 1.0. The L/V should be measured with an instrument with a band pass of 0 to 25 Hz.

2. Net axle lateral force may not exceed 0.5 times the static vertical axle load.

3. The minimum vertical wheel/rail force shall be a minimum of 10 percent of the static vertical wheel load.

4. The maximum truck side L/V ratio shall not exceed 0.5.

5. When positioned on track with a uniform 6-inch superelevation, trainsets shall have no wheel unload to a value less than 60 percent of its static value on perfectly level track.

6. When the equipment is positioned on level, tangent track, and any one wheel is raised by three inches, no other wheel of the equipment shall unload to a value of less than 0.65 times the weight of the unit divided by the number of wheels supporting the unit. (Builders of passenger equipment take exception to this proposed requirement as too stringent. They prefer a more flexible requirement allowing individual railroads to

define wheel unloading requirements for safe operation under worst case track conditions for the intended use of the equipment. Compliance with this requirement must be demonstrated as part of the vehicle qualification tests.)

7. All Tier II equipment shall be equipped with lateral accelerometers mounted above an axle of each truck. The accelerometer output signals shall be accurately calibrated and shall be passed through signal conditioning circuitry designed to determine if hunting oscillations of the truck are occurring. Hunting oscillations are defined as six or more consecutive oscillations having a peak acceleration in excess of 0.8g peak-to-peak at a frequency of between 1 and 10 Hz. If hunting oscillations are detected, the train monitoring system shall provide an alarm to the operator and automatically slow the train to a speed where hunting oscillations no longer occur before returning total control of the trainset to the operator.

8. Ride Vibration (Quality)—While traveling at the maximum operating speed over the intended route, the train suspension system shall be designed to:

a. Limit the vertical acceleration as measured by a vertical accelerometer mounted over the leading truck of each trainset unit to no greater than 0.55g single event, peak-to-peak.

b. Limit the lateral acceleration as measured by a lateral accelerometer mounted over the leading truck of each trainset unit to no greater than 0.3g single event, peak-to-peak.

c. Limit the combination of lateral and vertical events occurring within any time period of 2 consecutive seconds to the square root of (V^2+L^2) to no greater than 0.604—where L may not exceed 0.3g and V may not exceed 0.55g.

9. If hunting oscillations are detected on any equipment in the train, the maximum speed of that train shall be limited to 10 mph less than the speed at which hunting stops as the train speed is decreased from the initial hunting speed.

10. If the ride quality limitations of paragraph 8 of this section are exceeded, the operating speed shall be restricted to that which would result in a peak-to-peak lateral acceleration no greater than 0.25g and a peak-to- peak vertical acceleration no greater than 0.5g.

11. Passenger cars of a non-tilting design shall not operate under conditions resulting in a cant deficiency of greater than 6 inches or that corresponds to a steady-state lateral acceleration of 0.1g, whichever is less.

12. Trainsets of a tilting design shall not operate under conditions resulting in a cant deficiency greater than 9 inches or that corresponds to a steady-state lateral acceleration of 0.1g (measured parallel to the car floor), which ever is less.

13. All wheels shall be heat treated, curved-plate type or a design with equivalent resistance to thermal abuse.

14. Bearing overheat sensors are required. These are not required to be on board, and may be placed at reasonable wayside intervals. Periodic bearing inspection required at 50 percent of the L10 life at a load factor of 2.

P. General Locomotive/Power Car Design Requirements

Tier I: 1. All moving parts, high voltage equipment, electrical conductors and switches, and pipes carrying hot fluids or gases shall be installed in non-exposed locations or shall be appropriately equipped with interlocks or guards to minimize the chance of personal injury. (APTA recommends eliminating this requirement for Tier I equipment.)

Tier II: Same requirement as above for Tier I equipment.

Q. Power Vehicle/Control Cab Health and Comfort Design Features

Issues under this heading may be added to this proceeding following submission of FRA's Report to Congress on Locomotive Crashworthiness and Working Conditions.

R. Coupler/Draft System Performance (Only Leading and Trailing Couplers of Integral Trainsets)

Note: This requirement is applicable only for use in integral trainsets, envisioned to be prevalent in the higher speed operating environments of Tier II equipment. Otherwise, guidance regarding coupler/draft system performance requirements remain as specified.

Tier II: 1. Leading and trailing automatic couplers of the trainset shall be compatible with standard AAR couplers with no special adapters used. These couplers shall include automatic uncoupling devices that comply with the Safety Appliance Standards (49 CFR Part 231) and 49 U.S.C. 20302(a)(1)(A).

2. The leading and trailing trainset unit's coupler/draft system design shall include an anti-climbing feature capable of resisting without failure a minimum vertical force between the coupled units in either the up or the down direction resulting from an acceleration of 1g acting on the total mass including trucks of the leading or trailing unit of the trainset. The coupler/draft system itself may fail (shear back type coupler) to allow the anti-climbing feature to engage.

S. Safety Appliance Design Requirements

Tier I: Current safety appliance requirements are found at 49 CFR Parts 229, 231 and 232, and 49 U.S.C. Chapters 203 and 207. (Existing requirements which are statutorily based cannot be changed by this rulemaking.)

Tier II: 1. The leading and the trailing ends of the trainset shall be equipped with automatic couplers that:

a. Couple on impact and allow uncoupling without necessitating a person going between cars; and

b. Shall be activated either by a traditional uncoupling lever or some other means of automatic uncoupling mechanism that does not require a person to go between equipment units.

2. Leading and trailing end automatic couplers and uncoupling devices may be stored within a shrouded housing, but shall be easily removed when required for emergency use.

3. If the units of the trainset are semi-permanently coupled, with uncoupling done only at maintenance facilities, the trainset units need not be equipped with sill steps, end or side handholds.

4. If the units of the trainset are coupled with automatic couplers, the units shall be equipped with sill steps, end handholds and side handholds that meet the requirements of 49 CFR 231.14.

5. Passenger handrails or handholds shall be provided on both sides of steps used to board or depart the train.

6. Power vehicle and control cab exits shall be equipped with handholds and sill steps.

7. *Safety appliance mechanical strength.*

a. All handrails and sill steps shall be made of 1-inch diameter steel pipe or ⅝-inch thickness steel or a material of equal or greater mechanical strength.

b. All safety appliances shall be securely fastened to the carbody structure with mechanical fasteners that have mechanical strength greater than or equal to that of a ½-inch diameter SAE steel bolt mechanical fastener.

8. *Handrails.*

a. Throughout their entire length, handrails shall be a contrasting color to the surrounding vehicle body.

b. Vertical handrails shall be installed so as:

i. The maximum distance above the top of the rail to the bottom of the handrail shall be 51 inches and the minimum distance shall be 21 inches.

ii. To continue to a point at least equal to the height of the top edge of the control cab door.

iii. Minimum hand clearance distance between the handrail and the vehicle body shall be 2½ inches for the entire length.

iv. All vertical handrails shall be securely fastened to the vehicle body.

v. If the length of the handrail exceeds 60 inches, it shall be securely fastened to the power vehicle body with two fasteners at each end.

9. *Sill steps.*

a. Each power vehicle or control cab shall be equipped with sill steps below each door.

b. Power vehicle or control cab sill steps shall be a minimum cross-sectional area ½ by 3 inches, of steel or a material of equal or greater strength and fatigue resistance.

c. Sill steps shall be designed and installed so:

i. The minimum tread length of the sill step shall be 10 inches.

ii. The minimum clear depth shall be 8 inches.

iii. The outside edge of the tread of the sill step shall be flush with the side of the power vehicle or cab car body structure.

iv. Sill steps shall not have a vertical rise between treads exceeding 18 inches. The lowest sill step tread shall be not more than 20 inches above the top of the track rail.

v. The sill step shall be a color which contrasts with the surrounding power vehicle body color.

vi. All sill steps shall be securely fastened.

vii. As a minimum, 50 percent of the tread surface area shall be open space.

viii. The portion of the tread surface area which is not open space and is normally contacted by the foot shall be treated with an anti-skid material.

10. *Safety appliance mechanical fasteners.*

a. Safety appliance mechanical fasteners shall have mechanical strength and fatigue resistance equal to or greater than a ½-inch diameter SAE steel bolt.

b. Fasteners shall be installed with a positive means to prevent unauthorized removal.

c. Fasteners shall be installed to facilitate inspection.

11. Safety appliances installed at the option of the system operator shall be firmly attached with mechanical fasteners and shall meet the design and installation requirements given herein.

12. If two trainsets are coupled to form a single train by an automatic coupler, the coupled ends must be equipped with end handholds, side handholds and sill steps. If the trainsets are semi-permanently coupled, these safety appliances are not required.

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Appendix C.—AMTRAK Passenger Train Safety Inspection Criteria (Serves as a Sample Only)

LOCOMOTIVE QUICK REFERENCE CARD

INITIAL TERMINAL PRE-DEPARTURE INSPECTION

A LOCOMOTIVE IS TO BE IN COMPLIANCE WITH FOLLOWING OR WILL NOT BE ALLOWED TO CONTINUE IN SERVICE.

BLUE SIGNAL PROTECTION MUST BE PUT INTO EFFECT PER 49-CFR PART 218: PROVIDED FOR "WORKMEN, VENDORS OR CONTRACT PERSONNEL"

1. MAP COMPLETED FOR DAILY INSPECTION IN COMPLIANCE WITH 49-CFR PART 229/231/232/236
2. DEFECTS RECORDED ON MAP 9 ARE CORRECTED IN ACCORDANCE WITH 49-CFR 229.21 (a).
3. MAP 100 COMPLETE AND COPY IN CAB.
4. INSPECTION DATES CURRENT ON FRA FORM F 6180-49A IN CAB.
5. ALERTOR & SPEEDOMETER OVERSPEED FUNCTIONAL & PROPERLY SEALED.
6. ENSURE ALL REQUIRED SEALS, AS STATED ON MAP 100, ARE PROPERLY APPLIED AND SEALED
7. EVENT RECORDERS WORKING.
8. HEADLIGHTS, BELL, WINDSHIELD WIPERS & SANDERS ARE WORKING PROPERLY.
9. ALL HOSES ARE PROPERLY CONNECTED.
10. ALL WARNING ALARMS WORKING PROPERLY.
11. FUNCTIONAL HAND BRAKE OR PARK BRAKE.
12. LEAD LOCOMOTIVE MUST HAVE PROPERLY OPERATING RADIO.
13. TRAIN LINE COMPLETE RELAY SHALL NOT BE BY PASSED.
14. ALL CIRCUIT BREAKERS FUNCTIONING PROPERLY.

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LOCOMOTIVE QUICK REFERENCE CARD

INITIAL TERMINAL PRE-DEPARTURE INSPECTION

A LOCOMOTIVE IS TO BE IN COMPLIANCE WITH FOLLOWING OR WILL NOT BE ALLOWED TO CONTINUE IN SERVICE.

BLUE SIGNAL PROTECTION MUST BE PUT INTO EFFECT PER 49-CFR PART 218: PROVIDED FOR "WORKMEN, VENDORS OR CONTRACT PERSONNEL"

ELECTRIC LOCOMOTIVES

15. NO CONDEMNABLE DISC CRACKS.
    a. CRACK MUST NOT BE ENTIRELY THROUGH EITHER A THREADED OR COUNTERSUNK BOLT HOLE.
    b. NO MORE THAN ONE CRACK ENTIRELY THROUGH DISC BETWEEN EITHER TWO COUNTERSUNK OR TWO THREADED BOLT HOLES.
    c. NO MORE THAN 3 CRACKS, ENTIRELY THROUGH DISC, ON EACH SIDE OF WHEEL UNLESS CONDEMNABLE BY ITEM A OR B ABOVE.

16. ENSURE TRACTION AND REACTION ROD BOLTS, NUTS, KEEPERS AND SAFETY HANGER/PINS ARE PROPERLY SECURE.

17. ENSURE PANTOGRAPH STRUCTURE HAS NO CRACKS, MISSINGS PINS, MISSING OR LOOSE SHUNTS, CRACKED SHOE CARBONS, BADLY CHIPPED CARBONS OR CARBONS WORN BELOW 1/4 IN.

18. ENSURE INSULATORS ARE FREE OF CRACKS WHICH WILL COLLECT DIRT PARTICLES AND PROVIDE CONDUCTIVE PATH FOR ELECTRIC CURRENT.

19. ENSURE PANTOGRAPH POLE IS IN PLACE.

NOTE: SUPERVISORS ARE REQUIRED TO MONITOR PERSONNEL TO ENSURE COMPLIANCE WITH THESE STANDARDS.

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LOCOMOTIVE QUICK REFERENCE CARD

INITIAL TERMINAL PRE-DEPARTURE INSPECTION

A LOCOMOTIVE THAT HAS ONE OF THE FOLLOWING DEFECTS WILL NOT BE ALLOWED TO CONTINUE IN SERVICE.

BLUE SIGNAL PROTECTION MUST BE PUT INTO EFFECT PER 49-CFR PART 218: PROVIDED FOR "WORKMEN, VENDORS OR CONTRACT PERSONNEL"

1. WHEEL DEFECTS.
   a. Flange thickness 1 in. or less at a point 3/8 in. above wheel tread.
   b. Flat spots 1 1/2 in. or more in length.
   c. Shelling/spalling 1 1/2 in. or more in length.
   d. Flange height 1 3/8 in. or more.
   e. Rim thickness 1 1/8 in. or less.
   f. Gouge or chip in flange more than 1 3/8 in. in length and 3/8 in. in width.
   g. Tread worn hollow more than 1/4 in.
   h. Crack or break in flange, tread, rim, plate or hub.
   i. Loose wheels.

2. DEFECTIVE TRUCKS.
   a. Pins not properly secured in place.
   b. Brake shoe keys missing.
   c. Brake shoes not aligned properly on the disc/tread of the wheel.
   d. Safety hangers loose, cracked, broken or missing.
   e. Outer coil spring broken or fully compressed .
   f. Shock absorbers leaking clearly formed droplets of fluid. (means a <u>fresh</u> accumulation of oil, grease which continually or slowly forms into beads.)
   g. Missing/broken shock absorber or mounting.
   h. Loose tie bars.
   i. Broken or cracked center castings, motor suspension lugs or frames.
   j. Maximum side bearing clearance NOT to exceeed 1/4 in. on each side or a total of 1/2 in. on both sides.
   k. Friction side bearings may not be run in contact unless designed to do so.

3. SAFETY APPLIANCE - DEFECTS
   a. Handrails, hand holds loose, cracked, broken or missing.
   b. Handrails, hand holds with less than 2 in. clearance.
   c. Missing, unsafely bent, cracked, loose, broken ladder steps or step treads.

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LOCOMOTIVE QUICK REFERENCE CARD

INITIAL TERMINAL PRE-DEPERTURE INSPECTION

A LOCOMOTIVE THAT HAS ONE OF THE FOLLOWING DEFECTS WILL NOT BE ALLOWED TO CONTINUE IN SERVICE.

BLUE SIGNAL PROTECTION MUST BE PUT INTO EFFECT PER 49-CFR PART 218: PROVIDED FOR "WORKMEN, VENDORS OR CONTRACT PERSONNEL"

4. PILOTS, SNOW PLOWS, END SHEETS - CONDEMNING CLEARANCE
   a. Clearance above top of rail less than 3 in. or more than 6 in.

5. CAB SEATS - SAFETY DEFECTS
   a. Not securely mounted .
   b. Improper or unsecured latching device.
   c. Cracked or broken frame, mounting device or brace.

6. AIR BRAKE
   a. Piston travel must be properly adjusted.
      - F-40 - 2 1/2 in. to 3 1/2 in.
      - E-60 - 3/4 in. to 1 in.
      - FL9 - 5 in. to 7 in.
      - CF7 & GP9 - 2 1/2 in. to 3 1/2 in.
      - P32BH (DASH 8) 2 1/2 in. to 2 3/4 in.
   b. All shoes/pads shall have a minimun of 3/8 in. or more wear material and must be firmly seated against wheel/disc when brakes are applied.
   c. All shoes/pads must be free and clear of wheel/disc when brakes are released. (You may have to shake to assure release.)
   d. Brake cylinder pressure must not be less than 30 PSI.

NOTE: SUPERVISORS ARE REQUIRED TO MONITOR INSPECTION PERSONNEL TO ENSURE COMPLIANCE WITH THESE STANDARDS.

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CAR FLEET QUICK REFERENCE CARD

INITIAL TERMINAL

PRE-DEPARTURE INSPECTION

A CAR THAT HAS ONE OF THE FOLLOWING DEFECTS WILL NOT BE ALLOWED TO CONTINUE IN SERVICE.

BLUE SIGNAL PROTECTION MUST BE PUT INTO EFFECT PER 49-CFR PART 218: PROVIDED FOR "WORKMEN, VENDORS OR CONTRACT PERSONNEL"

1. WHEEL DEFECTS.
   a. Flange thickness 1 in. or less at a point 3/8 in. above wheel tread.
   b. Flat spots 1 1/2 in. or more in length.
   c. Shelling/spalling 1 1/2 in. or more in length.
   d. Flange height 1 3/8 in. or more.
   e. Rim thickness 1 1/8 in. or less.
   f. Any crack or break in the flange, plate or edge of tread or crack exceeding 1/2 in. in wheel tread see AAR RULE 41 sec A. (Not to be confused with Heat Checks. see AAR RULE 41 sec.E-21 Fig. A)
   g. A chip or gouge in the flange that is 1 1/2 in. in length and 1/2 in. or more in width.
   h. Axle that is cracked or broken.
   i. Axle that has a gouge between wheels that is 1/8 in. or more in depth.
2. ROLLER BEARINGS
   a. Roller bearing leaking lubricant in clearly formed droplets. (means a **fresh** accumulation of oil, grease which continually or slowly forms into beads.)
   b. Roller bearing end plate with loose or missing cap screw.
   c. Roller bearing end plate with broken, missing, or improperly applied cap screw lock.
3. DEFECTIVE TRUCKS
   a. Shoes/pads loose, key missing, improper alignment or worn to thickness of 3/8 in. or less.
   b. Levers, rods, brake beam & hangers worn more than 30% of cross sectional area.
   c. Any component not secured properly.
   d. Equalizer rubbing.
   e. Pedestal liner broken or missing.
   f. Shock absorber leaking clearly defined droplets (means a **fresh** accumulation of oil, grease which continually or slowly forms beads.)
   g. Leaf guider properly secured and not bent, broken or cracked (Superliners).
4. COUPLERS
   a. Uncoupling device without sufficient clearance (vertical and lateral) to prevent unintentional uncoupling or fouling on curves.

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CAR FLEET QUICK REFERENCE CARD

INITIAL TERMINAL

PRE-DEPARTURE INSPECTION

A CAR IS TO BE IN COMPLIANCE WITH THE FOLLOWING OR WILL NOT BE ALLOWED TO CONTINUE IN SERVICE.

BLUE SIGNAL PROTECTION MUST BE PUT INTO EFFECT PER 49-CFR PART 218: PROVIDED FOR "WORKMEN, VENDORS OR CONTRACT PERSONNEL"

1. ELECTRICAL
   a. At maintenance yards the "short looping" of a train's 480 volt system is prohibited.
   b. Whenever loss of trainline occurs at the station or enroute "short looping" is permissible.
   c. When a mechanical department employee short loops a train the Conductor & Engineer must be notified in writing.
   d. After a train is short looped, it will proceed to it's final destination for inspection and repairs and AMTRAK National Ops shall be notified- ATS 728-2307/2308 BELL 215-349-2307/2308.
2. Emergency lights functioning properly.
3. Rear car marker lights functioning properly. If necessary, an approved portable marker light can be used.
4. On-Board surveillance system operating properly. (If equipped.)
5. EMERGENCY WINDOW.
   -Properly identified with operating handles properly installed.
6. Handbrake functioning properly.
7. All safety appliances comply with 49-CFR sections, 231.13 or 231.14. (all handhold clearances minimum 2 in.)
8. Train consist air brake leakage not to exceed 5 PSI per minute per AMT-3.
9. All brakes must apply and release.
   a. Actuators (disc and tread if equipped) must function properly.
   b. All shoes/pads must be firmly seated against wheel/disc in proper alignment when brakes applied.
   c. All shoes/pads must be free and clear of wheel/disc when brakes are released. ** (You may have to shake to assure release.)
   d. No cracks extending entirely through one of the wheel disc surfaces.
   e. Piston travel must not be more than 80% of the total possible piston travel.
10. All safety equipment in place and operational.
    (Fire extinguishers, wrecking bars, etc.)

NOTE: SUPERVISORS ARE REQUIRED TO MONITOR INSPECTION PERSONNEL TO ENSURE COMPLIANCE WITH THESE STANDARDS.

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CAR FLEET
QUICK REFERENCE CARD
INSPECTION CRITERIA

INTERIOR

1. Check OMS (DMH) for Defects/Trends.
2. Check MAP 21A for Defects.
2. Inspect Breakers, Wiring, Panels/Electric Locker.
3. Inspect Onboard Hot Bearing System.
4. Inspect Carpeting/Curtains/Upholstery.
5. Check for Infestation.
6. Inspect Windows.
7. Inspect All Signage.
8. Inspect Seats/Food Trays.
9. Inspect Foot Rests/Leg Rests/Seat Locks.
10. Inspect Cushions/Cushion Attachment..
11. Ensure Proper Interior Temp.
12. Check Emergency Tools/First Aid Kits.
13. Inspect Fire Extinguisher/Inspection Date.
14. Inspect Sleeping Accommodations.
15. Ensure Proper Refrigerator Temp, 33°F to 40°F.
16. Ensure Freezer Temp - 0°F and Below.
    Amfleet I - 10°F and Below.
17. Inspect Door Gaskets/Gauges.
18. Inspect Hot Water Heater.
19. Inspect Dishwasher -
    Wash Cycle Temp 140°F to 160°F.
    Rinse Cycle Temp 160°F at Plate Surface.
20. Inspect All Food Service Equipment.
21. Inspect Restraining Devices.
22. Inspect Lighting System Emerg./OH/Reading.
23. Inspect Toilet Operation.
24. Inspect Sinks/Faucets.
25. Inspect All Piping/Hoses (Water System).
26. Inspect Hand Brake.
27. Inspect Diaphragm Curtain.
28. Inspect PA System.
29. Inspect Side/Trap Doors/Seals.
30. Inspect Collision Doors.
31. Inspect Body End Doors/Seals.

CAR FLEET
QUICK REFERENCE CARD
INSPECTION CRITERIA

EXTERIOR

31. Inspect for Exterior Carbody Damage.
32. Inspect Safety Appliances.
33. Inspect Hoses/Hangers (Brake System).
34. Inspect Diaphragms.
35. Inspect Couplers/Uncoupler Levers.
36. Inspect Entire Truck.
37. Ensure All Truck To Carbody Clearances.
38. Check Brake Pads.
39. Check Wheels for Condemning Limits.
40. Leaf Guider Properly Secured and Not Bent, Broken or Cracked.
41. Inspect Under Car for Damage.
42. Inspect 480V Cable System.
43. Inspect Wheel Slide System.
44. Inspect Battery Charger System.
45. Inspect Batteries.
46. Ensure Proper Freon Levels.
47. Inspect Freeze Protection Circuitry.

* Items in Red Must be in Full Compliance or the Car Cannot Leave.

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1000 MILE INSPECTION

BLUE SIGNAL PROTECTION MUST BE PUT INTO EFFECT PER 49-CFR PART 218:

"WHEN A TRAIN IS ON A MAIN TRACK A BLUE SIGNAL MUST BE DISPLAYED ON EACH END OF THE ROLLING EQUIPMENT AND ON THE CONTROLLING LOCOMOTIVE AT A LOCATION READILY VISIBLE TO THE ENGINEMAN/OPERATOR"

1. AIR BRAKES

a. Inspect all brake hoses for condition and proper securement.
b. All angle cocks and cut-out cocks are properly positioned.
c. Brake pipe trainline must be charged with minimum 110 PSI air pressure.
d. All brake rigging and brake pads must be properly secured.
e. All brake shoes/pads have 5/16 in. or more wear material to complete the trip.
f. All brake rigging must be free of binding or fouling.
g. Trainline brake pipe leakage must not exceed 5 PSI per minute for entire consist.
h. After 20 lb brake pipe reduction is made from locomotive perform the following:
- Each brake cylinder must be operational and inspected to ensure each brake shoe/pad is properly aligned and in contact with braking surface.
- Piston travel is not to exceed 90% of total possible piston travel (ex.- If total piston stroke is 9 in. then piston travel cannot exceed 8 in.) Upon release of brakes ensure all disc pads and all tread shoes are completely released.

2. WHEELS

If one or more of the Following Condition(s) Exist, a Car <u>Can Not Continue in Service.</u>

a. Flange thickness 15/16 in. or less at a point 3/8 in. above wheel tread.
b. Flat spots 1 3/4 in. or more in length .
c. Shelling/spalling 1 3/4 in. or more in length or width.
d. Flange height 1 7/16 in. or more.
e. Rim thickness 1 in. or less.
f. Any crack or break in the flange, plate or edge of tread, or crack exceeding 1/2 in. in wheel tread per AAR RULE 41 sec. A (Not to be confused with heat checks. see sec. E-21 Fig. A.)

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1000 MILE INSPECTION

BLUE SIGNAL PROTECTION MUST BE PUT INTO EFFECT PER 49-CFR PART 218:

"WHEN A TRAIN IS ON A MAIN TRACK A BLUE SIGNAL MUST BE DISPLAYED ON EACH END OF THE ROLLING EQUIPMENT AND ON THE CONTROLLING LOCOMOTIVE AT A LOCATION READILY VISIBLE TO THE ENGINEMAN/OPERATOR"

3. IF REQUIRED

a. Perform daily inspection of diesel locomotives on train in compliance with 49-CFR Part 229/231/232/236.

b. Inspect and test locomotive cab signals or automatic train stop on all units, when units will operate in cab signal/ATS territory.

c. Vendors must maintain hours of service log as required by the FRA.

NOTE: SUPERVISORS ARE REQUIRED TO MONITOR INSPECTION PERSONNEL TO ENSURE COMPLIANCE WITH THESE STANDARDS.

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Appendix D—Economic Questions for Passenger Equipment Safety Standards

Economic questions which appear in the body of this document are posed to help FRA gain a clear understanding of what costs the industry would incur to meet possible passenger equipment safety standards. To estimate the total costs that the industry would incur as a result of complying with possible passenger equipment safety standards, we need to understand how performance of existing structures, equipment, programs, and procedures compare with what would be required to meet the standards. FRA also needs to gain a better understanding of both the qualitative and quantitative benefits associated with the requirements under consideration.

FRA would appreciate receiving economic information from all concerned parties including individual passenger service operators and equipment manufacturers. Information regarding only one particular sector or operator is useful. Use of this information will result in a more accurate analysis of costs and benefits.

1. Questions on System Safety Plans

Are any system safety plans or similar plans currently in use? How much would it cost (in terms of time and effort) to update existing or develop new system safety plans? On average, approximately how often would system safety plans have to be updated?

How would system safety plans improve safety? Specifically, what areas of safety would be improved, by how much, and why? Please provide copies of any studies, data, or arguments which support your answer.

2. Questions on Pre-Departure or Daily Safety Inspections

In terms of labor, materials, etc., what additional resources would each operator need to perform a pre departure inspection equivalent to Amtrak's? How many pre-departure or daily inspections are performed annually by each operator?

What potential safety benefits would result from performing inspections equivalent to Amtrak's? Please explain/document estimates. For those currently performing inspections, what additional benefits could be realized by modifying those inspection procedures to meet Amtrak's? Please explain/document. What additional costs would result from performing inspections equivalent to Amtrak's, or for those operators currently performing inspections, what additional costs would be incurred by modifying inspection procedures to be equivalent to Amtrak's? Please explain/document.

3. Questions on Periodic Testing and Maintenance

Currently, what equipment is tested and maintained periodically? How often (in terms of miles or time) is this equipment tested and maintained? What do periodic tests and maintenance currently entail—labor, materials, etc.? What benefit(s)/costs would be associated with a periodic testing and maintenance requirement? Please explain.

4. Questions on Personnel Qualifications

Currently, how many employees/contractors are involved in inspecting, testing, and maintaining a passenger car or locomotive? How many of these people are mechanical personnel? Are there established minimum training and qualification requirements for employees and contractors performing inspections, testing, and maintenance? Approximately how many labor hours does each passenger service operator spend each year on these activities?

What are the potential benefits of increased training in periodic testing and maintenance? To what extent are expenditures on such training cost effective? Historically, does this type of training produce identifiable safety benefits? Please explain.

5. Questions on Tourist and Excursion Railroads

Information available to FRA indicates that there are approximately 100 excursion railroads operating about 250 locomotives and 1,000 passenger cars. Is this information correct? What size crews operate excursion and tourist trains? What is the average annual passenger car mileage for tourist and excursion railroads?

What potential safety benefits are available from possible passenger equipment standards for tourist and excursion railroads? To what extent can these safety benefits be realized, and what will they cost? Please explain.

6. Questions on Private Passenger Cars

How many private passenger cars are in operation? On average, how many miles do private passenger cars travel annually?

What potential safety benefits are available from possible passenger equipment standards for private passenger car operators? To what extent can these safety benefits be realized, and what will they cost? Please explain.

7. Questions on Commuter Equipment and Operations

Information available to FRA suggests that there are about 20 commuter railroads nationwide operating roughly 5,400 passenger cars, 400 cab cars, 2,000 multiple unit locomotive pairs, and 400 conventional locomotives. Are these estimates accurate? What size crews operate commuter trains? Approximately how many people stand on each train?

As a result of implementing possible passenger equipment standards, would commuter operators realize different safety benefits and costs than intercity operators? Please explain.

8. Questions on Operations With Cab Car Forward and MUs

What costs and benefits would be associated with alternatives for increasing crew and passenger protection in a head-on collision with a cab car leading?

Data indicate that at least 400 cab cars operate as lead units. Is this estimate accurate? Approximately, how many trips are made each year with cab cars operating as lead units? At what maximum speeds do trains operate cab car forward?

Information available to FRA suggests approximately 2,000 multiple unit locomotive pairs operate as lead units. Is this estimate accurate? Approximately how many trips per year involve multiple unit locomotive pairs?

9. Questions on Operating Practices and Procedures

a. What costs and potential benefits are associated with alternative measures to safeguard passenger movements in ground level stations?

b. At what costs can alternative measures to mitigate risks of high-speed express trains through stations be implemented?

10. Questions on Equipment Design Standards

a. What would be the likely costs associated with different alternatives available for ensuring that anticlimbers are loaded vertically during collisions?

b. What costs would be associated with specifying a more effective anticlimber, stronger and full height collision posts, and full height corner posts on conventional passenger locomotives?

c. How much would it cost to equip conventional passenger service locomotives with the type of strengthened fuel tanks discussed in Appendix B? What levels of safety benefits can be realized from strengthened/ruggedized fuel tanks?

d. How many units have backup power systems currently in place? What would it cost to install a backup power system? What levels of safety benefits would result from backup power systems?

How many coach units have backup emergency lighting? What would it cost to install a backup emergency lighting system? What rationale is used to determine whether a unit will have backup emergency lighting? To what extent would potential safety benefits be realized? Please explain.

What would it cost to install roof hatches on cars?

What options exist for enclosing existing luggage compartments? At what cost? To what extent would potential safety benefits from enclosing luggage compartments be realized? Please explain.

e. What levels of benefits would be realized from modifying 49 CFR Part 223 as suggested? At what cost would these benefits be realized?

11. Questions on Design Standards for High-Speed Equipment

a. What costs would be associated with alternative approaches designed to prevent crushing or penetration of the occupied volume in power and coach cars? Please be specific in defining the alternative approach and its cost elements.

b. How much would installation of alternative buckling delay systems cost in terms of labor hours and materials?

c. What seat configurations do passenger cars operating at speeds greater than 80 mph have? If configurations vary, please explain the differences and why they vary. How many seats does the average passenger car have? If there is no such thing as an average passenger car, how many seats do the different types of passenger cars have? How many cars are there of each different type?

What costs would be involved with installation of lap belts, shoulder harnesses, and other safety restraints on passenger cars? To what extent would safety benefits be realized from installing safety restraints? Please explain.

d. In terms of time, materials, and labor, what would installation of crash refuges (protected areas for the crew when a collision is unavoidable) in locomotives cost?

12. Question Regarding Size of Fleet Affected

Information available to FRA suggests that there are about 8,200 passenger cars and 970 conventional locomotives dedicated to rail passenger service in the United States. Is this information accurate?

13. Questions Regarding Ridership and Ticket Prices

What ridership levels are experienced through the year? Would meeting the new higher standards described in Appendix B result in higher fares? If so, how much higher? Would a decrease in ridership be expected? If so, to what extent? Please explain the method of estimation. To which alternative forms of travel would any lost ridership be expected to switch? How has this conclusion been reached? What assumptions are made? FRA is interested in obtaining copies of studies or other documentation addressing the issue of passenger diversion from rail to other modes of travel as a result of new rail safety standards. What factors have the greatest effect on ridership levels: price, seat availability, trip time, variability in trip time, etc.?

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