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of Transportation
**Federal Railroad
Administration**

RECOMMENDED EMERGENCY PREPAREDNESS GUIDELINES FOR PASSENGER TRAINS

Office of Research
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U.S. Department of Transportation
Research and Special Programs Administration
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PREFACE

The Federal Railroad Administration (FRA) has recognized the need for intercity and commuter passenger train system operators to engage in careful advance planning to respond effectively to emergencies. This advance planning should address emergency response procedures, training of system operating and other emergency response organization personnel, and provision and use of emergency equipment.

The overall safety record of conventional intercity and commuter passenger train operations has been very good. However, it is essential to plan ahead to minimize the consequences of emergencies that could occur. Moreover, many minor incidents could easily develop into life-threatening events if they are not addressed in a timely and effective manner. In addition, new intercity high-speed guided ground transportation technologies being considered for U.S. operations possess unique characteristics which may affect the safety of passengers and personnel during emergencies. Regardless of the type of technology, size of the system, and type of service provided, passenger train system operators must develop and implement emergency preparedness programs that are appropriate for their train equipment, right-of-way structures and wayside facilities, and local operating conditions.

The recommendations contained in this document are intended to assist passenger train system operating and emergency response organization management in evaluating and modifying or supplementing their emergency response plans. The recommendations address guidelines relating to emergency plans, procedures, and training. Guidelines for passenger train and facility features which are intended to shorten emergency response time, improve the effectiveness of evacuating passengers, and minimize the effects of an emergency are also presented.

Depending on the local operating environment, certain recommendations contained in this report may not be appropriate for a particular passenger train system operator.



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In addition, the author wishes to acknowledge the following EG&G Dynatrend, Inc. employees: Robert B. Park, who provided graphics coordination, Marilyn Gross, who obtained NTSB documents, Robert L. Gaumer, who provided valuable editorial review of this document, and Arthur H. Rubin, who prepared the document for publication.

METRIC/ENGLISH CONVERSION FACTORS

ENGLISH TO METRIC

LENGTH (APPROXIMATE)

- 1 inch (in) = 2.5 centimeters (cm)
- 1 foot (ft) = 30 centimeters (cm)
- 1 yard (yd) = 0.9 meter (m)
- 1 mile (mi) = 1.6 kilometers (km)

AREA (APPROXIMATE)

- 1 square inch (sq in, in²) = 6.5 square centimeters (cm²)
- 1 square foot (sq ft, ft²) = 0.09 square meter (m²)
- 1 square yard (sq yd, yd²) = 0.8 square meter (m²)
- 1 square mile (sq mi, mi²) = 2.6 square kilometers (km²)
- 1 acre = 0.4 hectares (he) = 4,000 square meters (m²)

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- 1 pound (lb) = .45 kilogram (kg)
- 1 short ton = 2,000 pounds (lb) = 0.9 tonne (t)

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- 1 teaspoon (tsp) = 5 milliliters (ml)
- 1 tablespoon (tbsp) = 15 milliliters (ml)
- 1 fluid ounce (fl oz) = 30 milliliters (ml)
- 1 cup (c) = 0.24 liter (l)
- 1 pint (pt) = 0.47 liter (l)
- 1 quart (qt) = 0.96 liter (l)
- 1 gallon (gal) = 3.8 liters (l)
- 1 cubic foot (cu ft, ft³) = 0.03 cubic meter (m³)
- 1 cubic yard (cu yd, yd³) = 0.76 cubic meter (m³)

TEMPERATURE (EXACT)

$$[(x-32)(5/9)] \text{ } ^\circ\text{F} = y \text{ } ^\circ\text{C}$$

METRIC TO ENGLISH

LENGTH (APPROXIMATE)

- 1 millimeter (mm) = 0.04 inch (in)
- 1 centimeter (cm) = 0.4 inch (in)
- 1 meter (m) = 3.3 feet (ft)
- 1 meter (m) = 1.1 yards (yd)
- 1 kilometer (km) = 0.6 mile (mi)

AREA (APPROXIMATE)

- 1 square centimeter (cm²) = 0.16 square inch (sq in, in²)
- 1 square meter (m²) = 1.2 square yards (sq yd, yd²)
- 1 square kilometer (km²) = 0.4 square mile (sq mi, mi²)
- 1 hectare (he) = 10,000 square meters (m²) = 2.5 acres

MASS - WEIGHT (APPROXIMATE)

- 1 gram (gr) = 0.036 ounce (oz)
- 1 kilogram (kg) = 2.2 pounds (lb)
- 1 tonne (t) = 1,000 kilograms (kg) = 1.1 short tons

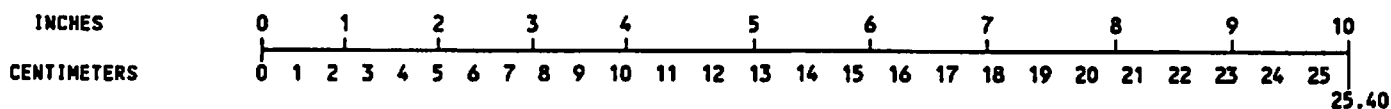
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- 1 liter (l) = 2.1 pints (pt)
- 1 liter (l) = 1.06 quarts (qt)
- 1 liter (l) = 0.26 gallon (gal)
- 1 cubic meter (m³) = 36 cubic feet (cu ft, ft³)
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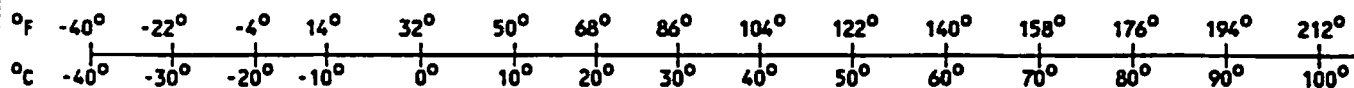
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1. INTRODUCTION

The overall safety record of conventional intercity and commuter U.S. passenger train operations has been very good. However, it is essential to plan ahead to minimize the consequences of emergencies that could occur. Moreover, many minor incidents could easily develop into life-threatening events if they are not addressed in a timely and effective manner. In addition, new intercity high-speed passenger train technologies being considered for U.S. operations possess unique characteristics which may require new approaches to emergency response to maintain the safety of passengers and personnel during emergencies. Regardless of the type of technology, size of the system, and type of service provided, passenger train system operators must develop and implement emergency preparedness programs that are appropriate for their train equipment, right-of-way structures and wayside facilities, and local operating conditions.

The Federal Railroad Administration (FRA) has sponsored the development of recommended emergency preparedness guidelines to assist organizations which operate conventional intercity and commuter passenger trains and/or plan to use new high-speed passenger train technologies. The guidelines in this document address emergency planning, training, and passenger trains and related facilities.

1.1 EMERGENCY PREPAREDNESS CONCEPT

An emergency is defined as any situation which is life-threatening or which causes major injury to persons and/or damage to or in any train or related facility.

Safety planning is composed of two basic phases: preventive and reactive. The preventive phase is directed at preventing the occurrence of an incident, accident, or emergency. The reactive phase is directed at the response once an incident, accident, or emergency has occurred to minimize its effect.

Emergency preparedness focuses on the ability of the passenger train system operator to respond effectively to emergencies and coordinate its efforts with emergency response organizations in a manner which protects the traveling public, personnel, and system equipment and facilities. The level of system preparedness will directly influence the severity of casualties and/or system damage in an emergency.

To respond effectively to emergencies, passenger train system operators must address carefully planned emergency response procedures, proper training of operating system organization and emergency response personnel, and provision of necessary emergency equipment.

1.2 PURPOSE

With certain exceptions, the FRA regulations contained in the Code of Federal Regulations, Title 49 (49 CFR) [1], and the FRA guidelines relating to fire safety [2], do not directly address emergency preparedness procedures or equipment. For example, 49 CFR, Part 223.15 (c) requires that passenger cars be equipped with emergency window exits; Part 220.47 requires that certain radio transmission procedures be followed in an emergency. The FRA fire safety guidelines are intended to maximize the time available for passenger evacuation in the event of a fire.

These recommended guidelines are intended to assist organizations that operate various types of passenger train service to assess, develop, document, and improve their emergency response capabilities and to coordinate efforts with emergency response organizations in a manner that best protects the traveling public and system passenger trains, right-of-way structures and wayside facilities.

The guidelines provide a framework for passenger train system operators to evaluate and, if necessary, modify or supplement their emergency response plans, procedures, training, and equipment.

1.3 SCOPE

The guidelines address conventional intercity and commuter passenger train systems; the guidelines are also relevant to high-speed steel-wheel-on-steel-rail systems and systems which propose the use of magnetic levitation (maglev) technology.

As used in this document, the terms "passenger train system operator" and "passenger train system operating organization" refer to the organizational entities which operate (or plan to operate) U.S. conventional intercity and commuter passenger trains and new proposed high-speed passenger train technologies. (The passenger train system operators of steam and other railroad special excursion trips may also find the information in the guidelines helpful.) In many cases, right-of-way structures and wayside facilities (e.g., tunnels, bridges, signal system, and other wayside facilities, such as stations) are owned by entities other than the passenger train system operator. For the purposes of this document, the term "passenger train system operator" refers to the passenger car and motive power unit owner, train system operator, right-of-way structure/wayside facility owner, railroad carrier, and subcontractor organization, any or all of which may be responsible for the actual operation and movement of intercity or commuter trains. The term "train crew" refers to on-board operating personnel including conductor, assistant conductors, engineer, and assistant engineer. Some systems use the term "train operator" or "attendant" to refer to the on-board operational train crew. "On-board service employees" refers to non-operational passenger service personnel, e.g., food service employees, coach attendants, and passenger service supervisory staff. "Train Dispatcher/Control Center" refers to the organizational entity which controls the movement of trains and wayside motive power supply. "Emergency response" is a generic term used to refer to fire departments and other public safety organizations which may respond to passenger train emergencies.

The operations of each individual passenger train system service must be considered in the development and implementation of an effective emergency preparedness program. Factors which should be considered include system size and route location, type of passenger cars and motive power units, type of right-of-way structures and wayside facilities, and type and number of passengers carried, as well as train operating system organization and outside emergency response organization resources. Chapter 2 of this document describes the considerations which could influence the type of emergency response actions that may be necessary and which could influence the decision to evacuate passengers during an emergency. Specific aspects of the considerations described may not be appropriate for particular passenger train system routes or operations.

Chapters 3 and 4 include guidelines which should be considered by passenger train system operators to enhance their particular emergency plans, protocols and procedures, as well as training, for their individual operations. In addition, these chapters address coordination with emergency response organizations which could be called upon to respond to passenger train emergencies. Recommendations may not be appropriate for particular passenger train system routes or operations.

Chapters 5 and 6 present guidelines for passenger train and right-of-way structures and wayside facility features which are intended to shorten emergency response time, improve the effectiveness of evacuating passengers, and minimize the effects of an emergency. The recommendations in these chapters should be considered during the procurement, overhaul, and rehabilitation of passenger trains and right-of-way structures and wayside facilities, including system extensions. Recommendations may not be appropriate for particular passenger train system routes and operations.

1.4 ADDITIONAL SUPPORTING DOCUMENTATION

A number of references containing emergency preparedness-related information were reviewed during the development of the guidelines presented in this document. Accordingly, the recommended guidelines reflect existing "best practices" and are intended to provide a reasonable basis for planning improvements. The most significant resources are described in the remainder of this section.

The Amtrak accident which occurred near Mobile, Alabama on September 22, 1993 generated newspaper articles which included interviews with passengers, train crew, and emergency response personnel, as well as preliminary theories about causes of the accident [3].

A 1990 FRA study reviewed the safety of passenger railroad tunnels in terms of emergency response and evacuation [4]. In addition, a detailed fire and life safety audit was performed under contract to the National Railroad Passenger Corporation (Amtrak) for the railroad tunnels and Pennsylvania Station in New York City; actions to be taken by supervisory personnel for a variety of emergency scenarios were also included [5]. As a result of the audit recommendations, a number of facility improvements have been undertaken. In addition, an extensive compilation of papers was published as a result of an international conference on road and rail tunnels held in 1992 [6]. Subjects included safe tunnel rail operation, response to incidents, and design standards and guidelines.

In 1990, the FRA completed safety investigations of the Metro North Commuter Railroad and the Long Island Railroad; specific emergency preparedness-related aspects of these systems were reviewed [7 and 8]. As part of that investigation, the Federal Transit Administration (FTA) identified conditions of concern relating to emergency preparedness for portions of these commuter train operations not under the jurisdiction of the FRA [9].

Two earlier studies completed by the FRA [10 and 11] discuss issues relating to overall emergency preparedness for conventional intercity passenger train systems. More recently, emergency preparedness aspects of maglev and other new high-speed passenger train technologies proposed for U.S. operations have been studied [12-19]. Another recently completed report performed for the FRA [20] discusses issues pertaining to train features designed to minimize the severity of injury and to permit passengers to evacuate the train in an emergency.

The emergency procedures and equipment described in Amtrak rulebooks, manuals, and training programs [21-29] and in commuter train system documents provide valuable insight into the unique operational environment of these types of trains. Amtrak has also issued procurement design specifications for its passenger equipment [30-36], parts of which relate to emergency preparedness.

Federal regulations and guidelines contain transportation access requirements which implement the provisions of the Americans with Disabilities Act (ADA) of 1990 [37-40]. These requirements contain items which govern passenger train access for mobility-impaired persons; they thus have direct implications as they could affect the evacuation of these persons in an emergency. A report recently completed for the Office of Transportation Access, of the Massachusetts Bay Transportation Authority, extensively discusses emergency egress from rapid rail transit vehicles and facilities for persons with disabilities [41]. Many concepts in this report are transferable to passenger train system operations.

The National Transportation Safety Board (NTSB) is an independent Federal agency with the statutory responsibility "to promote transportation safety by conducting independent safety investigations and formulating safety improvement recommendations" (Public Law 93-633). The NTSB issues these recommendations to the FRA, passenger train system operators, and other related entities, as appropriate. Recommendations have also been issued for certain incidents, although detailed accident reports were not prepared.

These recommendations address a number of emergency preparedness-related concerns. NTSB has also published special studies and investigation reports which include additional analysis of emergency preparedness-related issues. NTSB documents reviewed during the preparation of the guidelines in this document are listed in Chapter 7.

In response to a Congressional inquiry, the Resources, Community, and Economic Development Division of the U.S. General Accounting Office recently prepared a report which discusses passenger car safety standards [42]; this report references emergency equipment.

France [43 and 44], Germany [45 and 46], Great Britain [47], and the International Union of Railways (UIC) [48-54] have published a number of documents relating to passenger train emergency preparedness aspects.

The FTA has published emergency preparedness guidelines for rail transit and urban, rural, and specialized transit systems [55-57]. (Those documents provided the preliminary organizational framework used for the development of these guidelines. However, the guidelines in this document have been tailored to consider the unique characteristics and operational environment of intercity passenger and commuter trains.)

The National Fire Protection Association (NFPA) has issued NFPA 130, Standard for Fixed Guideway Transit Systems [58]. This standard contains minimum fire protection and life safety requirements for underground, surface, and elevated fixed guideway systems. Although conventional railroad passenger systems are specifically excluded from the standard, many of the items described could be appropriate for these systems. NFPA 101, Life Safety Code [59] contains additional information which may pertain to passenger train facilities, such as stations.

On November 17, 1987, a fire occurred in the King's Cross Underground Station in London, England. The independent investigation report prepared as a result of this fire provides valuable insights relating to emergency preparedness for train stations [60].

Under contract to the FRA, the National Institute of Standards and Technology (NIST) is reviewing the approach of U.S. and foreign fire safety protection requirements. A report documenting the results of the NIST work is expected in December 1993 [61].

Other important sources of information reviewed during the development of these guidelines include the NFPA standard for fire service incident management [62], the Federal Aviation Administration (FAA) Advisory Circular for emergency plans [63], the FAA airworthiness standards for transport category aircraft [64], a background paper relating to research and technologies for aircraft evacuation testing [65], the NFPA manual for airport/community emergency planning, [66].

Other references include documents published by the Association of American Railroads (AAR) [67] and the American Railway Engineering Association (AREA) [68].

The bibliography in Appendix G includes these references and provides an extensive listing of other additional references relating to emergency preparedness.

2. EMERGENCY RESPONSE CONSIDERATIONS

It is essential that the personnel of the passenger train system operating organization, as well as the personnel of emergency response organizations, share a common advance awareness and understanding in order to respond to emergencies in a timely and effective manner. This chapter provides an overview of the issues that the management of these organizations must consider in order to develop, implement, and improve their capability to respond to passenger train emergencies. Certain aspects of the considerations described in this chapter may not be appropriate for particular train system routes or operations.

The majority of passenger train operational problems are handled effectively and do not become emergencies. Current emergency preparedness policies de-emphasize immediate evacuation from trains located between stations unless passengers and crews are in immediate danger, e.g., fire. In many instances, the train crew can immediately take action to resolve the problem and the potential emergency without evacuating the train. Accordingly, in the majority of situations, after notifying the Train Dispatcher/Control Center that a problem exists and receiving permission, the train crew will attempt to move the train to the nearest station or safe location (e.g., outside a tunnel) before taking any other action. If the train crew cannot resolve the situation or move the train or if the train cannot proceed because of hazardous conditions, passenger train system organization and/or emergency response organization personnel may be sent to the emergency scene to provide mechanical aid, alternate transportation (e.g., rescue train and/or buses, depending on location of the emergency), or medical assistance, as necessary.

The effectiveness of the overall response to various emergencies will be greatly influenced by any of the following:

- Type of emergency - e.g., injury/illness, stalled train, sudden stop of train, suicide/accidental collision with a person, derailment/collision, fire/smoke, severe weather conditions/natural disasters, security situations, and other emergencies;

- Characteristics and type of train involved - number and type of motive power units and passenger cars, number of passengers; number, size, and identification of access/egress points; on-board emergency equipment; etc.;
- Functional status of electrical and mechanical systems - including lighting, ventilation/heating/cooling, and public address systems on board the train and in the right-of-way structure/wayside facility;
- Operational environment - train location (e.g., in tunnel, on bridge, at station), type of right-of-way structure/wayside facility and terrain, time of day, and weather;
- Passenger characteristics - personal, special needs, and injuries;
- Availability and performance of passenger train system organization personnel (including train crew, on-board service personnel, and Train Dispatcher/Control Center); and
- Availability and performance of emergency response organization personnel and "Good Samaritans."

2.1 TYPES OF EMERGENCIES

An understanding of the types of emergencies which could occur and their related hazards is necessary for effective emergency preparedness planning and specific protocol and procedure development. Typical emergency scenarios include illness or injury, stalled train, sudden stop of train, suicide/other collision with a person, collision/derailment, fire, collision/derailment and fire, collision/derailment with water immersion, severe weather conditions/natural disasters, and security situations (e.g., bombings, bomb threats, hijackings, civil disorders, and other acts of terrorism). It is quite possible that an emergency could involve a combination of these scenarios.

These emergency scenarios are listed in Table 2-1, which includes an indication of the likelihood of injury and whether evacuation is likely to be required. A brief description of each scenario and the specific concerns associated with passenger assistance and evacuation are reviewed in the following subsections.

TABLE 2-1. POTENTIAL EMERGENCY SCENARIOS AND LIKELY CONSEQUENCES

POTENTIAL EMERGENCY SCENARIO	IS INJURY LIKELY TO OCCUR?	IS EVACUATION LIKELY TO BE REQUIRED?
Illness or injury	Yes	Not necessarily*
Stalled train (on elevated structure, at-grade, or in tunnel, presence of exhaust gases)	No*	Not necessarily**
Sudden stop of train	Yes	Not necessarily*
Suicide/other collision with person	Yes	Yes***
Derailment/collision	Yes	Yes
Fire or smoke	Yes	Yes
Derailment/collision and fire or smoke	Yes	Yes
Derailment/collision with water immersion and fire or smoke	Yes	Yes
Severe weather conditions/natural disasters	No****	Yes****
Security situations (e.g., Bomb: threat and actual)	Not necessarily*	Yes

* Depends on severity of injury or duration of event.

** Depends on location, whether electrical/mechanical systems are functioning, and other external factors.

*** passengers will probably not be evacuated from a train or station.

**** Depends on severity and duration of event.

During any of these situations, it is important that train crew and on-board service personnel keep passengers informed to the extent possible and provide clear guidance regarding evacuation, etc.

It is recognized that due to their knowledge, experience, and special training, emergency response personnel are the individuals most qualified to perform medical and rescue activities. However, if no emergency response organization personnel are on the scene during a life-threatening situation, if their arrival time is unknown or delayed and if the train is located in a remote area, it may be necessary for the train crew, on-board service or other operating organization personnel, or "Good Samaritans" to take some type of life-support or other emergency action.

2.1.1 Illness or Injury

For the purposes of this document, personal illness or injury which occurs inside or while entering/exiting a passenger train or related facility is considered to be an emergency and should be addressed as such. Individuals with respiratory and heart conditions are more susceptible to illness. Stress, exhaustion, heat, humidity, altitude, and sickness could aggravate these conditions and cause a person to become ill or sustain an injury. A visually or mobility impaired passenger could trip or be unable to maintain balance and fall when moving about, entering, or exiting the train. An individual could collapse or fall during an emergency. Falling can cause bodily injury or may aggravate existing medical conditions. If a person sustains an injury or becomes ill, the degree of risk is related to the severity and location of the event. For example, if a person faints from heat but the fall is braced and the individual recovers within a few minutes, there is probably little or no risk. However, because a blow to the head can cause internal injury, medical treatment is required if a person hits his/her head and is rendered unconscious. Moreover, the severity of such an injury may not be immediately apparent, particularly if the individual recovers consciousness within a few minutes.

Because it is not possible for unqualified individuals to diagnose the medical cause or consequence of an illness or injury, it is unlikely that they will know what appropriate corrective action to take. Moreover, movement of an ill or injured person by untrained persons could cause additional harm. In addition, many individuals take special medication(s). Persons may wear medical alert tags or bracelets and carry dosages of their medication; however, someone who becomes extremely ill or unconscious would probably not be able to volunteer information.

Train crew and/or on-board service personnel may not be familiar with first aid procedures, may be unavailable because of other duties, or may be otherwise unable to provide assistance. The generally accepted procedure is for the train crew (or station personnel, if the incident occurs before the train has departed the station) to notify the Train Dispatcher/Control Center who calls for an emergency medical service (EMS), or other appropriate response agency, to remove the ill or injured person(s) from the train or facility.

2.1.2 Stalled Train

Train operations may be temporarily halted between stations due to a mechanical or electrical failure/malfunction. Depending on the length of time the train is stopped and its location, passengers will generally be evacuated only if there is immediate danger if they remain on the train, no prospect of swift equipment repair, or severe weather poses a threat to the train. For example, under certain weather conditions, it is more sensible for passengers and train crew to remain inside the train to avoid getting lost or suffering injuries related to heat or cold.

Poor ventilation, noxious fumes (e.g., generation of locomotive exhaust gases in a tunnel), extreme heat or cold, inability to communicate adequately (orally and visually), medical conditions, confusion, fear, disorientation, isolation (real or perceived), loss of contact with the train crew (and on-board service

employees) or emergency response personnel, and lack of mobility could contribute to the hazards associated with a stalled train.

Because of special needs or disabilities, some persons may have difficulty coping with delays caused by equipment breakdowns and may require medical aid. In addition, passengers may be visually impaired, may have limited mobility (e.g., wheelchair users), or may be restricted by a cast or brace, all of which require special assistance during emergency response and evacuation. Section 2.4 discusses these considerations in more detail.

If evacuation becomes necessary, passengers with mobility problems (including vision or other impairment) or passengers who have difficulty in maintaining balance, because of footwear or clothing, may be unable to walk along the right-of-way or on a walkway (benchwall), platform, or bridge. They may have to be carried or may require other special assistance. The location of the train in a tunnel, on an elevated segment, on an embankment, on a narrow bridge, or on an unstable surface requires that special actions be performed to ensure the safe evacuation of passengers. Families with infants and small children, and passengers who may tire easily or need medical assistance present special evacuation difficulties.

2.1.3 Sudden Stop of Train

A sudden stop is usually caused by something external to the normal operation of the train, such as an object on the track or guideway. (Collisions are covered in subsection 2.1.4.) Another cause could be activation of the train emergency brake by a member of the train crew, or in some cases, a passenger. (Most fully automated high-speed train technologies are designed so that sudden deceleration cannot occur; however, it could occur in an emergency or under manual train operation.)

Passengers are not normally prepared for the sudden stop of a train; sudden deceleration forces generated by an emergency stop at

high or even slow speed may cause passengers to be thrown from their seats or off their feet resulting in physical injury.

Unless reassured by the train crew and on-board service personnel, passengers may believe that there has been a collision or derailment and begin to panic. Elderly and disabled persons could be at somewhat greater risk because of their potential special needs and limitations. Passengers using wheelchairs, walkers, canes, or other personal assistive devices may be separated from them by a sudden stop or may be unable to brace themselves. The surprise and stress of the stop may also aggravate certain health conditions.

As in the illness/injury scenario, the priority is to notify the Train/Dispatcher/Control Center staff who requests local emergency response personnel to go to the emergency site. Immediate passenger evacuation is secondary unless staying on the train is itself life-threatening; some type of first aid action may also be necessary.

2.1.4 Suicide/Other Collision with Person

Passenger train operations will likely be delayed when a person is hit by a train. However, depending on the circumstances, injuries may or may not occur, and passenger evacuation from the train or facility may or may not be required. If evacuation is necessary, the considerations described for the illness and injury and sudden stop of train scenarios can be applied.

2.1.5 Derailment/Collision

Many serious injuries and damage to train equipment may occur as a result of a train derailment and/or collision. Persons may be injured from impact forces or being trapped by mangled or twisted car body or interior components. The priority for the train crew, if a derailment/collision occurs which does not involve fire or other immediate danger, is to notify the Train Dispatcher/Control

Center personnel who will inform the appropriate emergency response organization(s). Stabilization of train equipment to reduce hazards may also be necessary. Removing electrical power from downed or damaged power lines and the third rail must be arranged. If a person suffers a life-threatening injury, first aid from the train crew or fellow passengers may help. Rapid evacuation is generally secondary to immediate treatment by emergency response organization personnel, unless staying on the train is itself life-threatening. Once injured passengers are medically stabilized, they will be removed and transported to a medical facility.

Although the priority is to ensure that injured passengers receive medical treatment, other uninjured or less seriously injured passengers may panic and/or attempt to evacuate the train, without waiting for or ignoring instructions. The surprise and stress of a derailment/collision may also aggravate certain medical or other conditions of some passengers. Unless there is a hazard which requires immediate attention, it is important that the train crew and on-board service employees check the condition of all passengers and provide reassurance and clear directions. Train crew and on-board service personnel, preferably under the direction of the conductor, can play a key role in reducing panic by calmly giving clear, assertive instructions and directing passenger evacuation from a particular car or the train to a point of safety.

Weather conditions and the location of the emergency (see Sections 2.1.9 and 2.3) are also important considerations. Other related hazards include downed power lines and fuel oil spills from either the locomotive (if diesel) or a motor vehicle (if a grade crossing collision is involved).

It is essential that the train crew, on-board service employees, and emergency response personnel realize that wheelchair users may be unaware of their own injuries. For example, wheelchair passengers with paralyzed limbs may suffer broken bones, burns, or vascular damage and bleeding without being aware of the injury.

Additional discussion of passenger car crashworthiness, interior arrangement, and seating is contained in Chapter 5.

2.1.6 Fire/Smoke

The occurrence of a train or facility fire/smoke situation is a potentially life-threatening event which may require rapid evacuation of all individuals from the affected cars or area to avoid casualties resulting from burns, or toxic gas inhalation. Fire often causes panic and confusion; smoke may decrease visibility, making it difficult for passengers, train crew, and other passenger train system operating organization and emergency response personnel to find emergency exits (and access points). Oxygen is reduced, making breathing difficult and decreasing stamina. Even if the fire is contained, toxic fumes may be present inside the train or facility; those with respiratory conditions may be quickly overcome. The persons in greatest danger are those who cannot walk at all or who can only move at a slow pace.

Evacuation of wheelchair users is a particular concern in this scenario. In many cases, these persons must be evacuated without their chairs, depending on the location and intensity of the fire and on the weight of the individual and chair.

2.1.7 Derailment/Collision with Fire/Smoke

A train derailment/collision that involves fire or smoke is one of the most serious emergency scenarios which could occur. Spilled or leaking fuel can ignite. The hazards of the fire/smoke scenario, i.e., burns and toxic gas inhalation, are aggravated by the possibility that the train crew and many passengers may sustain injury during a collision or derailment and may require immediate medical treatment. This combination of events makes evacuation more difficult than for either condition separately, yet evacuation is even more imperative. Immediate evacuation of injured passengers takes precedence over medical treatment.

2.1.8 Derailment/Collision with Water Immersion

A derailment/collision that results in passenger cars and/or motive power units being immersed in water is another situation in which evacuation is critical. Passengers and crew may drown, whether injured or not in the initial accident, unless other crew or passengers aid them until emergency response personnel arrive. Fire caused by ignited fuel oil which has spread onto the water surface is an added hazard. As in the previous scenario, immediate evacuation of injured persons takes precedence over treatment.

2.1.9 Severe Weather Conditions/Natural Disasters

Hurricanes and tornados, snow and ice storms, heavy rains, and earthquakes can adversely affect the operation of passenger trains. During certain conditions, many systems suspend or reduce the level of service provided, e.g., reduce speed, detour on alternate routes, or arrange alternative transportation. The paradox is that during snow and ice storms, the preferred mode for many people is train travel.

Severe weather conditions could delay the arrival of passenger train system operating organization and emergency response personnel, as well as vehicles and equipment. Extreme heat or cold could aggravate physical or medical conditions of individuals. Ice and snow could aggravate mobility limitations, causing any person, particularly those who are elderly or mobility-impaired to slip or fall, even if assisted. Rain, snow, sleet, ice, and high winds can make emergency response operations hazardous, particularly in isolated areas. Personnel carrying or assisting passengers are more likely to lose their footing and slip or slide. Downed power lines or fallen trees may obstruct roads and force detouring of the normal response route. Entering or exiting the train or right-of-way structure could be precarious, increasing the risk of falling and sustaining serious injury. Fog, snow, or rain and darkness can also reduce visibility or obscure lighting. Finally, severe weather conditions could impair the ability of emergency response

personnel to transport emergency equipment to an emergency scene or to gain access to passengers, making evacuation very difficult.

2.1.10 Security Situations

As a result of bombings (or bomb threats), civil disorders, hijackings, or other acts of terrorism, passengers, train crew, and other passenger train operating organization personnel may be injured or be detained as hostages. In the case of an actual bombing, the same type of considerations as discussed in the train collision/derailment with fire scenario are applicable.

In the event of security situations which could involve confrontations, taking of hostages, or other life-threatening conditions, the actions of the train crew and other passenger train system operating organization personnel must be calm and serve to minimize potential of injury to all persons. The specific actions that should be performed depend on the particular circumstances of the security situation. It is essential that the Train Dispatcher/Control Center be notified so that appropriate local emergency response personnel (including police) can be summoned. In the case of a bomb threat, pre-determined limits as to who can receive and who can transmit radio communication should be followed. The preferred alternative is for passengers to leave the train or area presenting the threat of harm; however, the same sort of factors (e.g., location of train, location of individuals on board the train, availability of emergency response personnel) may make it advisable to stay on the train or in the facility until the situation is resolved.

2.2 TRAIN CHARACTERISTICS

Various types of equipment are used to provide passenger train service. This section provides a brief overview of various types of train consists. Chapter 5 further describes specific train characteristics which could affect safety during emergencies and identifies specific recommendations to address those concerns.

2.2.1 Conventional Intercity Passenger Trains

Depending on the type and number of cars, route, and time of day or year, an intercity passenger train could carry more than 700 passengers. Passenger capacity of the cars varies, depending on length of car and interior configuration. Both single and multi-level cars are used for intercity and commuter service. Figures 2-1 and 2-2 illustrate the interior and exterior of a typical single-level intercity coach car. Side doors are normally used for boarding and leaving the train; car design allows safe passage through end doors between cars. Multi-level cars also have stairways which allow passengers to move from one level to another. Depending on the type of car, interior arrangement, and layout, toilet rooms are provided at various locations.

Intercity day coaches may carry up to 84 passengers. Single-level coach cars used in overnight service may carry up to 44 passengers; multi-level intercity coach cars may carry up to 72 passengers.



Figure 2-1. Interior of Typical Single-Level Intercity Coach Car



Figure 2-2. Exterior of Typical Single-Level Intercity Coach Car

Single-level sleeping cars consist of double and/or single private rooms with day seating and sleeping berths (accommodating up to 19 persons); "slumbercoaches" are a higher capacity version of the standard sleeping car (39-person capacity). Multi-level sleeping cars have private rooms on both levels (accommodating up to 48 persons). Certain sleeping car rooms are designed to accommodate families and persons who require special assistance.

Food service cars include single- and multi-level lounge and cafe cars (which permit passengers to purchase sandwiches, snacks, and drinks) and full-service dining cars (which offer freshly prepared meals). The seating capacity in these cars varies.

Within the Northeast Corridor (NEC), the majority of trains use electric locomotives with motive power supplied by an overhead catenary transmission system (Figure 2-3). These trains are equipped with coach and cafe cars; baggage, "parlor" (first class seating) and sleeping cars are also operated on certain routes.



Figure 2-3. Electric Locomotive Used in Northeast Corridor

On a few NEC trains and on all other routes outside the NEC, train motive power is provided by head-end diesel-electric locomotives (Figure 2-4). On certain medium- and some long-distance routes, single-level passenger coaches and cafe, "club," lounge, dining, sleeping, and baggage cars are used; multi-level passenger cars (coach, baggage, dormitory, lounge, dining, and sleeping cars) are used on primarily western, longer distance routes, and other selected routes, where clearance permit their operation. Turbo trains operated by Amtrak in New York State include two motive power units located at each end of the train which also include passenger sections which provide "club" and coach space; other passenger cars provide coach and cafe space. All Turbo motive power units and coaches are semi-permanently coupled train sets that are not altered between trips (motive power is provided by third-rail pickup within New York City).



Figure 2-4. Diesel-Electric Locomotive

Certain intercity passenger cars are equipped with a control cab which permits "push-pull" operation by the train engineer or other train crew to operate the train from either end (if operated from the control cab, the locomotive or other "power car" is pushing instead of pulling); this eliminates the need to turn the train at either terminal.

2.2.2 Commuter Trains

Commuter trains use high-capacity single- and bi-level cars; the seating capacity ranges from 66 for single-level cars to 162 for bi-level cars. Figures 2-5 and 2-6 illustrate the interior and exterior of typical bi-level commuter cars. Trains may be powered by diesel-electric or electric locomotives. Some systems use push-pull operations with control cab cars which have been previously described. Multiple units (MU) are self-propelled cars, using either diesel or electric power; one or more units may make up a consist. Some MU cars employ third-rail power pickup; others use



Figure 2-5. Interior of Typical Bi-Level Commuter Train



**Figure 2-6. Exterior of Typical Bi-Level Commuter Train
Showing Push-Pull Control Cab**

a pantograph to pick up power from an overhead catenary. The average trip length is 35 km (22 miles); typical distance between stations is about 5 km (3 miles).

2.2.3 High-Speed Train Technologies

Passenger trains being considered for U.S. high-speed rail operation include: the Swedish X2000 tilt-train, the German Intercity Express (ICE), the Italian ETR460 and ETR500, the Spanish Talgo, and the French Train à Grand Vitesse (TGV) Atlantique steel-wheel-on-steel rail technologies and the German Transrapid TR07 magnetic levitation (maglev) technology.

The X2000 and ICE have operated on the NEC in Amtrak demonstration service and are equipped with coaches and food service cars. Both the ICE and X2000 are lightweight, fixed consists which are electrically powered from an overhead catenary; highly automated command, control, and communications systems are a feature. Through the use of tilt-body technology, the X2000 operated on the existing NEC rail infrastructure at higher speeds through curves.

The TGV Atlantique train is also a fixed consist with a power car at each end and eight passenger cars in the middle; baggage compartments and food service capability are provided. TGV equipment has been proposed for U.S. operation at speeds up to 320 km/h (200 mph) along a high-speed rail route linking San Antonio, Dallas, and Houston, Texas. The entire right-of-way would be fenced and grade separated to increase security and prevent at-grade crossing conflicts with other traffic.

The Transrapid TR07 electromagnetic (EMS) "attractive-type" maglev technology has been proposed for operations at speeds up to 400 km/h (250 mph), over a 22.5 km (14 mi) route from the Orlando, Florida airport with a station near Disney World. The Transrapid TR07 maglev system uses an EMS "attractive" type of suspension to "levitate" the train above a flat surface guideway. A fixed consist includes control cabs and passenger sections. Maglev

systems proposed for U.S. operation utilize elevated guideway sections instead of rails and roadbed. The Transrapid guideway configuration utilizes vehicles that wrap around the guideway. Other proposed maglev technologies utilize different guideway and vehicle configurations.

The TGV and Transrapid high-speed train technologies would operate in the U.S. along dedicated right-of-ways, with grade separation.

2.3 OPERATIONAL ENVIRONMENT

Compared with motor vehicles which operate on streets, roads, and highways, passenger trains represent a more restricted transportation environment; operations are confined along a fixed physical right-of-way track or guideway structure.

Depending on the location of the passenger train emergency, unclear jurisdictional authority, traffic congestion, lack of access, lack of emergency equipment, and/or unavailability of knowledgeable and skilled personnel could prevent police, emergency medical personnel, or other emergency response personnel from making a timely response and hamper evacuation.

The following environmental factors directly affect the success of emergency response efforts:

- Notification capability;
- Location of the train in relation to the station;
- Type of cars in the consist, and their condition and position at the emergency scene;
- Right-of-way construction and train location in relation to the right-of-way structure and wayside structure;
- Specific hazards:
 - Train movements and power supply,
 - Air quality (altitude, ventilation), and
 - Visibility and weather;

- Access of passenger train system operator and/or emergency response personnel with equipment to the right-of-way structure/wayside facility, or station.

Intercity and commuter trains operate through densely and sparsely populated areas and through the jurisdictions of several emergency response organizations. Train frequency of service and routes can also change on an hourly or daily basis to meet peak and off-peak service demands.

The majority of passenger train motive power units are equipped with a radio (the train conductor normally uses a hand-held radio). If uninjured, the train crew should be able to contact the passenger train system Train Dispatcher/Control Center. (As indicated in Chapter 1, the term "passenger train system operator" includes the passenger car and motive power unit owner, system operator, right-of-way/wayside facility owner, railroad carrier, and subcontractor organization, or other entity, any or all of which may be responsible for the actual operation and movement of intercity or commuter trains.) However, train location, the time of day, day of week, season of year, and weather could affect the ability of the appropriate emergency response organization to take action or gain access to the site of the emergency. Personnel may also be unavailable or may be unable to respond immediately because they do not possess sufficient information or must perform other duties (e.g., all personnel could be responding to another emergency).

In addition, it is possible that knowledgeable and skilled personnel may be unavailable or unable to transport critical equipment to the scene. Unclear jurisdictional authority could also hamper response to an emergency. These issues can be addressed by emergency dispatch protocols, and mutual aid coordination arrangements as established by the emergency response organizations. These protocols and arrangements should cover primary and back-up response. Chapter 3 discusses these elements in more detail.

Stations are the preferred location for passenger train evacuation since passengers can simply leave the train using the normal side doors. Many metropolitan area stations have high level platforms which do not require going up or down steps. Although certain stations are located underground (e.g., New York City), the majority are located above ground. At most intercity and commuter rail stations, train boarding areas are not enclosed. If the train is unable to reach a station during an emergency, passenger evacuation and response personnel access will be more difficult.

Negotiating a passenger car aisle, ballasted track, roadway, shoulder, or embankment and operating the handle (or control) for an emergency exit may require a degree of balance, strength, agility, and steadiness which some persons may not possess. High steps, vertical discontinuities, and horizontal gaps or voids could cause problems for many passengers, particularly those with visual or mobility impairments.

Typical passenger cars and motive power units have been previously described. If the train has been involved in a derailment or collision, structural damage or deformation may occur and cars may be overturned or unstable. Passenger evacuation can be difficult if doors or emergency exits are jammed or inoperable, or if exit paths are blocked. If the cars are on their sides, movement by the train crew, on-board service employees, and passengers to the end and side doors will be hindered; the height from the ground and angle of doors and emergency window exits could make it difficult for persons to reach and use them to enter or leave the train. Particular problems in an overturned car are moving over seats which are suddenly at right angles and inability to reach emergency exits which may now be overhead and too high or far away.

Medical, physical, or other conditions may also hamper passengers from accomplishing their own evacuation without assistance (see Section 2.5).

Chapter 5 contains additional discussion relating to the interior environment/arrangement of passenger cars.

The right-of-way structure may vary in construction. The track roadbed may consist of ballast or concrete slab. On bridges, the track may be laid over open trusses consisting of steel or wooden beams. Maglev guideways vary in shape according to their design; those that have been proposed are to be built of a concrete and/or steel structure.

The right-of-way structure may be located at-grade, in open cuts, on filled land, in tunnels, in valleys or ravines, or on elevated structures and bridges. In many areas, the right-of-way is elevated to eliminate grade crossing conflicts. Moreover, right-of-way structures could be located at high altitudes. In many instances, the right-of-way is owned by entities (e.g., freight railroads) other than the organization which owns and operates the passenger cars and motive power units; train movements and electrical power to the catenary or third rail power supply are controlled by the right-of-way owner.

The location of the passenger train relative to the distance from a main street or road, a hospital, or other emergency response organization and the type of right-of-way structure or wayside facility could affect both the ability of response personnel and the time required to reach an emergency site. Unlike many commuter train systems, intercity passenger train systems provide medium- and long-distance service through rural, less heavily populated areas and thus tend to operate in a more isolated environment. Figures 2-7 through 2-9 illustrate examples of rights-of-way located in isolated areas which could present access problems.

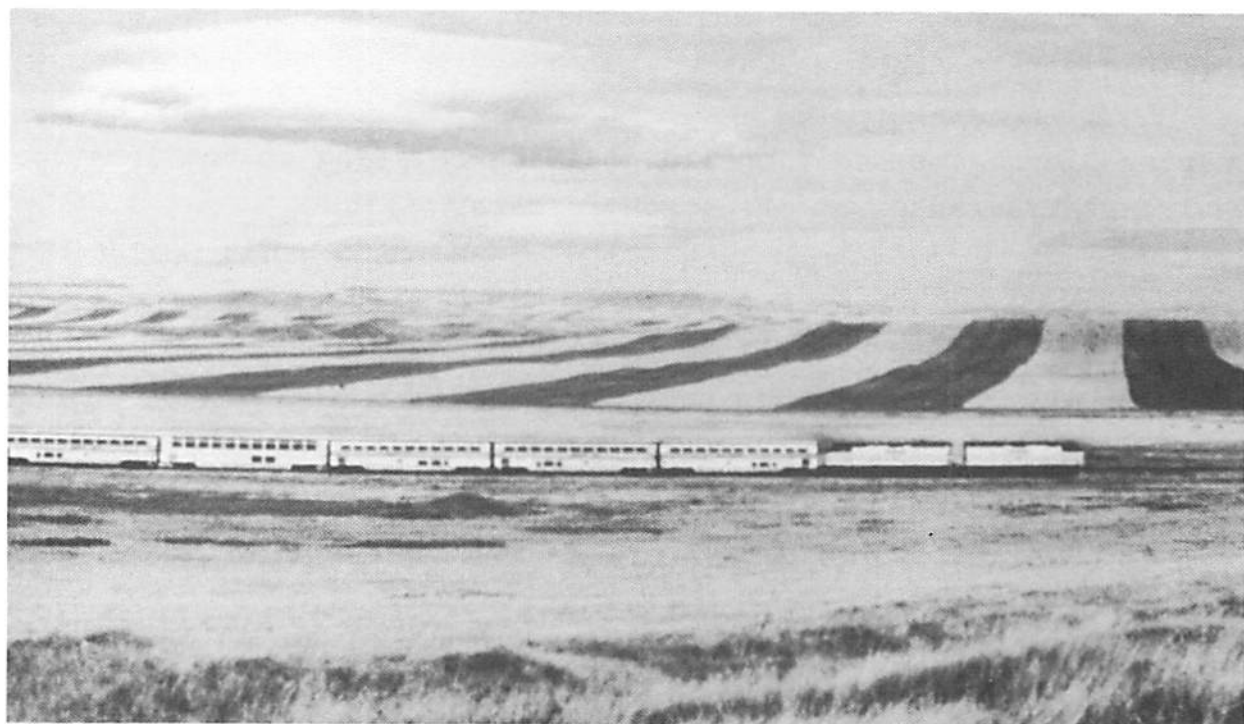


Figure 2-7. Intercity Passenger Train Operating Through Farmland



Figure 2-8. Intercity Passenger Train Operating Over a Trestle



Figure 2-9. Intercity Passenger Train Operating Over a Bridge

Response time to an emergency site may be longer in such locations than in urban areas due to greater distances, longer average trip lengths, lack of roads, remote areas with limited access, such as steep embankments, causeways, and large surrounding water and wetland areas.

Access roads may not be located next to or near the right-of-way and grade crossings. Where they exist, roads may be narrow or otherwise provide limited passage and could be difficult for emergency response organization vehicles to negotiate.

Tunnels may lack emergency exits or other emergency equipment, or locations may not be marked. Bridges that cross over wetlands, lakes, rivers, or other bodies of water or over ravines (particularly those in isolated areas with no nearby roads) pose particular access problems. Helicopters or boats often provide the only approach to these locations.

The inability of emergency response personnel to gain access or to transport emergency equipment to the passenger train emergency scene can impede evacuation, even if the emergency itself causes no physical injuries. In addition, evacuation to a point of safety, especially where passenger trains operate in open areas or on bridges or elevated structures, which are exposed to weather or located long distances from roads, may be difficult.

The possibility of contact with other trains, the catenary, third rail, or other high-voltage power source exists during emergencies. The Train Dispatcher/Control Center is responsible for issuing instructions and operating equipment to control the movement of trains, and isolating electrical wayside motive power. (In some cases, a "Power Director" is responsible for the power control function.) The Occupational Safety and Health Administration (OSHA) mandates very specific high tension wire and cable rules and lock-out/tag-out procedures; right-of-way owners also delineate specific power isolation procedures. **THE PRUDENT APPROACH FOR ALL PERSONS IS TO ASSUME THAT THE ELECTRICAL POWER IS ALWAYS ON.** This topic is discussed further in Section 3.5.4.

Lack of ventilation or presence of toxic gases in disabled trains located in tunnels can reduce oxygen levels and air quality. Passengers with respiratory conditions, such as asthma or emphysema, can be particularly affected by lack of oxygen or poor air quality caused by limited ventilation (see Section 2.5.3).

Darkness and severe weather conditions, such as extreme heat or cold, combined with train mechanical problems may create hazards for passengers, especially for those who are young, elderly, or disabled. In addition, darkness in tunnels or at night can reduce visibility for train crew and on-board service personnel, passengers, and response personnel. Lack of lighting will hinder efforts to evacuate passengers to a point of safety and will impede emergency response access and efforts. Inclement weather can also reduce visibility, obscure lighting, or reduce the effectiveness of emergency equipment. Section 2.1.9 covers weather in more detail.

2.4 PASSENGER TRAIN SYSTEM ORGANIZATION PERSONNEL

Intercity and commuter trains are operated with various combinations of crews. The majority of intercity trains are typically operated by an engineer, or engineer and assistant engineer; commuter train systems may use the term "train operator." Other operational train crew include conductors, assistant conductors ("trainmen"), and ticket takers. Depending on the route and type of train service, passenger train on-board service personnel may include supervisors/stewards, food service employees, and coach and sleeping car attendants. (It should be noted that operations personnel may be employed by directly by the passenger train owner, or by a system operator, the right-of-way/wayside facility owner, railroad carrier, subcontractor organization, or other entity. This document considers the terms "passenger train system operator" and "passenger train system operating organization personnel" to encompass the personnel of each of these entities.)

2.5 PASSENGER CHARACTERISTICS

Intercity and commuter passenger train systems provide transportation to a wide cross-section of the general public. Train passengers are demographically diverse and include elderly persons, young children, and persons who have various types of disabilities, e.g., mobility limitations, visual impairments, medical, and other conditions.

During a train emergency, it is important to provide confident, clear, informative leadership to passengers during an emergency. Depending on the circumstances, the general public may also need special medical care or physical assistance to evacuate the emergency scene. Passengers may be:

- Able to walk without assistance,
- Able to walk with a cane, a walker, or crutches, or the assistance of another person,
- Carrying babies or small children,

- Wheelchair users,
- Visually impaired or blind,
- Hearing impaired or deaf,
- Speech impaired,
- Mentally impaired, and/or
- Some combination thereof.

A major consideration for emergency preparedness planning, particularly in isolated service environments, is how to evacuate passengers who are injured or who possess mobility, communication, and other impairments when the train is located in a geographically remote area.

Children and elderly or disabled persons, even if uninjured, may have limited mobility, difficulty in communicating, and/or other conditions unrelated to the emergency, and are thus more likely to require special attention. Although there may be no immediate danger (e.g., a stopped train), persons with medical conditions may experience stress and require special care. While many passengers may have little difficulty moving about and entering/exiting the train under normal circumstances, difficulty in performing any of the following functions may prevent a passenger from moving with the speed, agility, and sureness needed to evacuate trains and/or right-of-way structures safely and quickly during emergencies:

- Going up or down steps, or an incline,
- Stooping, kneeling, or crouching,
- Walking long distances, even at a very slow pace,
- Crawling,
- Waiting or standing,
- Sitting down or getting up,
- Reaching for, handling, or grasping objects,
- Moving dynamically (i.e., running, jumping, or reacting instantly),

- Moving through narrow areas, within confined spaces, or through certain emergency exits,
- Moving in crowds,
- Establishing accurate depth perception, or
- Communicating (i.e., understanding instructions and making their needs understood).

Thus, many emergency procedures applicable to the general public may not be practical for all individuals. Specific aspects of these potential limitations associated with mobility, communications, and medical, physical, and other impairments are discussed below. It should be recognized that the limitations reviewed in the following sections are not shared by all persons. Moreover, these limitations may exist in a variety of different combinations and levels of severity.

2.5.1 Mobility

As mentioned previously, uninjured adults are the easiest to evacuate. However, other persons may require special assistance to leave the train (or right-of-way structure/wayside facility), as well as medical care. Both the ability of these individuals to move under their own power and the ability of the passenger train crew, other system operating organization employees, and emergency response personnel to adapt to their needs and limitations directly affect evacuation operations.

The train crew, other passenger train system operating organization personnel, and emergency response personnel must decide when and how to evacuate persons. Although individual weight and size are not usually considered to be mobility problems, the ability of passengers to exit through train emergency windows could be affected. During an emergency, the general public and/or mobility-impaired persons could find it difficult to do any of the following:

- Move through the aisle of the passenger car to an exit (Persons who use wheelchairs, walkers, canes, crutches, prostheses, or other personal assistive devices may find such movement especially difficult; in fact, such individuals may become trapped by these devices.);
- Exit a passenger car (or right-of-way structure/wayside facility) without assistance if required to use steps or a ladder, climb through a window, or move through a car that is severely tilted or overturned; or
- Travel long distances quickly without resting repeatedly (ANSI estimates that elderly or disabled persons would average only 200 feet in 2 minutes on level surfaces [69].).

Thus, persons with limited mobility or other impairments may impede an evacuation effort.

2.5.2 Communications

The ability of persons to hear, read, and understand instructions, or make themselves heard and understood during emergencies will affect response operations. For example, the inability of an individual to understand an instruction because of age, learning disability, cultural or language differences, or hearing or visual impairment could make it difficult to move that person to safety. Such an impairment may also make it difficult for these persons to remain calm and confident because of an "isolated" feeling that they are trapped or will not receive help.

The key point in communication is whether individuals are able to understand oral and/or written instructions and are then able to follow directions. During a passenger train emergency, persons may not be able to:

- Understand that there is an emergency, requiring special actions, e.g., evacuation from the train,
- Read and understand signs or instructions, or
- Hear and understand instructions.

2.5.3 Medical, Physical, and/or Other Conditions

Many medical, physical and other conditions may not significantly limit functional capabilities; others may pose only temporary limitations, or may not be perceptible to an outside observer. Medical conditions which may not be continuously disabling include epilepsy, diabetes, respiratory ailments, arthritis, and heart disease. Physical conditions include back or spinal conditions, degenerative muscle or bone conditions, cerebral palsy, nervous disorders, and missing or paralyzed limbs. Other conditions include learning disabilities, memory loss, senility, retardation, and various degrees of psychological, psychiatric, and emotional disorders. Persons could also have multiple medical, physical, emotional, or mental conditions.

Under normal circumstances, individuals who have medical conditions such as epilepsy and diabetes or who have cardiovascular, respiratory, or other impairments do not usually require special assistance. However, a stroke or heart attack, an asthmatic episode, fainting, an epileptic episode, or a fall could require medical assistance and evacuation of individuals. Because some limitations are not readily apparent, the train crew or other system operating organization personnel, emergency response personnel, or other passengers may not recognize the immediate or potential need for special assistance. Moreover, the lack of medication due to time delays and lack of medical assistance from those knowledgeable of a given condition or disability may cause or aggravate conditions. Individuals who have certain respiratory conditions can be particularly impaired by lack of oxygen or poor air quality caused by limited ventilation. Individuals carrying young children or those who are elderly or are disabled may be more prone to falls.

Persons with learning disabilities, or psychological or emotional conditions, may be unable to understand instructions or may be more susceptible to confusion or panic.

In summary, persons with medical, physical, and other conditions may be unable to do any of the following:

- Prevent the onset of adverse health conditions such as heart attacks, angina, shortness of breath, and palpitations under the stress of the situation;
- Function independently if medical conditions that require special treatment are aggravated, particularly if appropriate operating organization or emergency response personnel are unable to provide the appropriate assistance, or if those in need are not carrying the necessary medication; or
- Actively contribute to evacuation efforts.

2.6 RESPONSE PERSONNEL PERFORMANCE

In an emergency, the passenger train crew and on-board service employees are obviously persons who, if necessary, can take immediate, appropriate action at the scene, after the Train Dispatcher/Control Center is notified. It is important to keep passengers informed of reasons for delays, and other conditions and provide them with clear directions for necessary actions, such as evacuation. The train PA system should be used for announcements to request the services of persons with medical expertise who may be travelling on-board the train and avoid panic under dark conditions such as at night or in a tunnel. While this communication may sometimes be difficult to accomplish because of conflicting train crew priorities in an emergency, it is required to avoid panic and misinformation which may lead to inappropriate action by passengers. Even during circumstances which are under control from the point of view of the train crew, on-board service employees, and emergency response personnel, passengers may panic if they feel trapped, if communication is cut off, or if the train crew or emergency response personnel are having difficulty reaching them. If required due to a life-threatening condition, individuals can begin evacuating passengers under the direction of the train conductor; they can also provide valuable information to emergency response personnel, reducing hazards to all parties.

As noted earlier, the terms "passenger train system operator" and "passenger train system operating organization personnel" refers to the passenger car and motive power unit owner, train system operator, carrier, right-of-way/wayside facility owner, and subcontractor organization, any or all of which may be responsible for the actual operation and movement of intercity or commuter trains. Coordination of response plans, pro-tocols, and procedures among these various entities is required for effective response to emergencies, i.e., notification of outside agencies, movement of disabled trains, and passenger evacuation.

To be able to respond effectively to a passenger train emergency, train crews, on-board service employees and other passenger train operating system personnel, and emergency response personnel must possess appropriate knowledge and skills. However, persons who are knowledgeable and skilled in emergency response may be unavailable, may be unable to reach the emergency scene due to distance or traffic congestion, unable to transport critical equipment to the scene, or unfamiliar with proper passenger assistance techniques, train interiors, emergency evacuation procedures, and/or proper use of emergency equipment. The inability of emergency response personnel to reach the emergency scene and gain access to the train can make the evacuation of passengers very difficult, even if the emergency itself caused no physical injuries.

While these factors may impede the evacuation of many individuals, they are a particular problem when evacuating elderly, or disabled persons or families with small children. Proper emergency preparedness training to address these factors is critical to the success of the emergency response effort.

Proper emergency response training is also important because inadequate knowledge of the characteristics of individuals (particularly elderly and disabled persons) and the inability to adequately respond to any special needs during an emergency may cause injury; aggravate medical, physical, or other conditions; or delay the evacuation.

For example, many emergency response personnel are not familiar with the characteristics of passenger trains. Moreover, many rural areas depend on volunteers for response to emergencies. As a result, responding individuals may attempt techniques used for automobile accidents which may be inappropriate and could cause injury or delay evacuation of train passengers.

In addition, it may be necessary for the passenger train crew or on-board service employees (if they possess appropriate training) and emergency response personnel to assist certain passengers before the evacuation effort, by repositioning them to permit proper breathing, or to relieve pressure which may not cause injury but may create excruciating pain.

Chapter 3 discusses these various considerations in terms of preparing emergency plans, protocols, and procedures. Chapter 4 contains an extensive discussion of training programs, including emergency drills/exercises, and as well as recommendations for training program scope and content. Chapters 5 and 6 present recommendations for passenger trains and right-of-way structures and wayside facilities.

3. EMERGENCY PLAN DEVELOPMENT

To respond effectively to an emergency in a timely manner, passenger train system operators and emergency response organizations must develop emergency plans which describe the appropriate protocols and procedures to be carried out for emergencies that may occur. (As noted in Chapter 1, the term "passenger train system operator" refers to the passenger car and motive power unit owner, train system operator, right-of-way structure/wayside facility owner, railroad carrier, subcontractor organization, and other entity, any or all of which may be responsible for the actual operation and movement of intercity or commuter trains. All such entities should be included in the emergency planning process.) This advance planning will help minimize the consequences of emergencies and prevent minor incidents from developing into life-threatening situations. In addition, the impact of unique characteristics of new passenger train technologies should be considered when developing an emergency plan. This chapter discusses various aspects of emergency plans, protocols, and procedures. Certain aspects of the recommendations described in this chapter may not be appropriate for particular train system routes or operations.

For various types of passenger train routes and services, it is important to determine specific primary and back-up jurisdictional boundaries and responsibilities, well-defined emergency procedures, and a clear incident command, control, and communications system to be followed by emergency response organizations along service routes, in order to enhance the ability of individuals or organizations to respond effectively to an emergency. Thus, a formal process for the development, review, revision, and reissuance of planning and procedural protocols, as well as supporting documents, in whole or in part, should be established by all entities which may be called upon to respond to emergencies.

Emergency response plan protocols and supporting documents must consider the current and planned future operations of each type of train service which address routes, train consist length, type and size of cars and motive power units, and type and number of passengers carried. The personnel and equipment which the passenger train system operating organization, as well as various outside emergency response organizations will be able to provide to emergency sites, must be defined and evaluated. This type of advance planning is critical to ensure that knowledgeable and skilled personnel and the proper type of response equipment will be available when necessary.

The three objectives of an emergency preparedness program are:

- To plan the response by a passenger train system operating organization and the appropriate outside emergency response organizations,
- To mobilize the actual response to emergencies, and
- To recover from emergencies and restore normal operations.

To meet these objectives, an emergency plan should document the following elements: policy, scope, functions and responsibilities of the passenger train system operating organization, protocols with emergency response organizations, procedural guidelines for specific types of emergencies and activities to resolve them, supporting documentation, and general response capability criteria.

3.1 POLICY

The emergency plan statement of policy should define the goals and objectives to be addressed by the passenger train operating organization management in developing its own emergency response capability and coordinating it with the management of outside organizations and emergency response organizations, e.g., emergency medical service (EMS), police and fire departments. The policy statement should include an explicit commitment to safety by top-level passenger train system operating organization management.

3.2 SCOPE

The emergency plan should define the conditions which constitute an emergency and describe responsibilities for each of the following actions:

- Reporting an emergency to the train crew and Train Dispatcher/Control Center,
- Evaluating and establishing the parameters of an emergency,
- Notifying passenger train system operating organization personnel,
- Notifying emergency response personnel,
- Dispatching passenger train system operating organization and emergency response personnel and equipment to the emergency scene,
- Establishing how coordination of activities is established and who is in charge, i.e., command, control, and communication, of all response personnel. (Civil authorities may very likely supersede the passenger train system operating organization personnel in many cases.)
- Protecting passengers, personnel, and equipment at the emergency scene,
- Keeping passengers (and their families), passenger train operating system organization and emergency response personnel, and other relevant agencies informed, and
- Evacuating passengers,
- Arranging alternate transportation and other passenger follow-up services.
- Restoring normal operations.

Protocols and procedures should be based on mutual understanding between the passenger train system operating organization and the emergency response organizations.

3.3 PASSENGER TRAIN SYSTEM OPERATING ORGANIZATION FUNCTIONS AND RESPONSIBILITIES

The emergency plan should establish a chain of command which assigns functions and responsibilities to appropriate passenger train system operating organization personnel, while recognizing the authority and responsibilities of emergency response organization personnel. Coordination is crucial to the ability of all parties to effectively respond to an emergency, regardless of its size and location. Documentation, including applicable portions of the emergency plan, protocols and procedures within rulebooks, manuals, standard operating procedures (SOPs) and guidelines for Train Dispatchers/Control Center personnel, train crew, and on-board service employees, provides the basic framework for coordination between all "internal" responding parties. This internal system documentation, as well as its counterpart for response organization interfacing documents should include the following elements:

- Definition of functions and responsibilities during emergencies for passenger train system operating organization personnel at supervisory centers, including operations, maintenance, and security, as appropriate. These should include the functions of Train Dispatchers/Control Center personnel and maintenance supervisors.
- List of telephone numbers of responsible passenger train system operating organization and outside emergency response personnel, as appropriate, to be notified (covering 24 hours).
- Specification of criteria for deciding whether an emergency exists and requires assistance from outside emergency response organizations and the "Inter-Organizational Emergency Protocol" is therefore applicable.
- Procedures for determining the specific type, location, and severity of the emergency and thus which protocol and procedure is applicable.
- Protocols and procedures for notifying appropriate participating emergency response organizations.

- Protocols, procedures, and decision-making criteria for establishing alternatives for the local emergency "command post" of the passenger train system operating organization, if an outside emergency response organization is not involved.
- Protocols, procedures, and decision-making criteria for the orderly transfer of incident responsibility between the passenger train system operator personnel and participating response organization personnel.
- Procedures and for deciding when the emergency has ended and the "Inter-Organizational Emergency Protocol" is no longer applicable.

3.4 INTER-ORGANIZATIONAL COORDINATION

Many emergencies require response from outside response organizations, in addition to the passenger train system operator. Proper coordination of roles between all the organizations that may respond to an emergency is essential to ensure timely and effective response since the number of passengers carried and the train operating environment may be quite different according to the type of service and operating routes. Because of the great number of jurisdictions that intercity train routes operate through, it has not been simple for passenger train system operators to provide train familiarization to every outside emergency response organization within all individual communities along each route. (However, for distribution to public safety organizations, Amtrak has developed a booklet [24] and a videotape [28], both of which illustrate equipment and describe entry and evacuation procedures for its trains and certain right-of-way facilities. Commuter train systems have developed similar information for distribution to local response organizations. It is recognized that local, state, and regional governments and agencies have developed "community disaster plans," which outline response protocols (including mutual aid) and procedures for various types of fires and other major emergencies, including train accidents. In large metropolitan areas, passenger train system operators have worked with outside emergency response organizations to develop mutual understandings which are documented in formal planning and procedural protocols.

These protocols, as well as information sharing with various outside organizations (see Appendix A for examples), will assist in ensuring timely and effective response to emergencies.

The inter-organizational emergency protocols could be written documents that serve as the formal basis of mutual acknowledgement of the resources that each organization will provide. Each protocol should include an outline of the type, quality, and response time of emergency-related services that could be made available to the passenger train system operating organization. Protocols should include detailed command, control, and communication procedures and responsibilities, as they relate to passenger train emergencies. NFPA 1561, Standard on Fire Department Incident Management System [62], provides further general guidance for emergency management from the fire department perspective.

As a minimum, inter-organizational emergency protocols should contain:

- A list of participating emergency response organizations, including their names, signatures of approving officials, addresses, telephone numbers, radio frequencies, and call numbers or codes, as applicable, for all times of the day;
- A statement of how the protocols were developed, reviewed, and approved for use by the participating organizations;
- A definition of jurisdictional boundaries for primary responding organizations, and protocols for increasing the number of responding units beyond primary assistance when the magnitude of the emergency dictates;
- An outline of the type and availability of emergency response personnel and equipment to be provided (and financial responsibilities, when appropriate);
- A definition of the chain of command, control, and communication to be followed at the emergency scene;
- An outline for developing detailed communications and evacuation procedures;

- A statement of how proposed changes to protocols will be reviewed, approved, and implemented as formal revisions by the participating organizations;
- A description of and instructions for operation of specialized emergency equipment (including communications) on board the train or located within the right-of-way structure/wayside facilities;
- Description of passenger train system operating organization personnel and their duties (These personnel can provide specific critical information about passenger car configuration, number and condition of passengers, hazards, etc.);
- A "definition" section for special terms peculiar to the document, terminology of the passenger train system operator, and terminology of the other participating organizations; and
- A section identifying training responsibilities.

With the aid of these protocols, coordination of activities during actual emergencies should simply consist of following pre-established procedures. Any additional coordination needed because of the uniqueness of a specific emergency should be accomplished within the framework of (1) the previously established chain of command, control, and communication contained in the protocol, and (2) general precedent as documented in existing protocols and procedures, contained in other documentation, etc.

3.5 EMERGENCY PROCEDURES

To develop emergency response procedures that address the needs of train passengers (including those with limited mobility or other impairments), the management of the passenger train system operator, and emergency response organization(s) must understand the typical kinds of emergencies which could occur and their associated hazards (see Section 2.1). Moreover, personnel must understand the general emergency response activities to be taken and the proper sequence in which to take them. Such understanding is particularly important in many rural areas where passenger train service is provided across many jurisdictions, and response personnel may be delayed in reaching the scene due to long

distances. Many procedures are applicable regardless of the scenario, although each scenario has its unique characteristics. The procedures should specify the necessary tasks to be performed within a time or event sequence by the train crew, on-board service personnel, other passenger train system operating organization personnel and emergency response personnel. The procedures should be tailored to meet the specific needs of passengers, available response personnel, and the particular type of emergency and its location. As a minimum, these procedures should address the emergency scenarios described in Chapter 2:

- Illness or injury,
- Stalled train,
- Sudden stop of train,
- Suicide/other collision with person,
- Derailment/collision,
- Fire and smoke,
- Derailment/collision and fire,
- Derailment/collision with water immersion,
- Severe weather conditions/natural disasters, and
- Security situations.

Specific procedures for the following systematic sequence of passenger train system-related activities [adapted from References 70 and 71] should be developed for each type of emergency:

- Pre-incident planning (Preparation)
- Response,
- Assessment,
- Hazard control,
- Support operations,
- Train/right-of-way structure/wayside facility access,

- Emergency care,
- Extrication,
- Evacuation (removal) and transfer, and
- Debriefing.

Each of these emergency planning activities is described more extensively in the following subsections. The overview of the activities presented is intended to provide a perspective and shared understanding of the overall type and sequence of actions which should be addressed by the management of the passenger train system operator and emergency response organizations in developing their plans, protocols, and procedures. The text presented here is informational in nature and presented solely to assist the various entities which may be involved to prepare for a range of potential contingencies. Not all activities by any or all parties will be necessary for every type of emergency. Specific emergency plans, protocols, and procedures for the responsibilities for and the performance of these activities will reflect the mutual understandings developed by the particular passenger train system operator and the appropriate responding parties. Chapters 1 through 4 and 7 of Reference 72, as well as materials produced by Amtrak [21-24 and 26-27] and commuter rail systems, contain more extensive material relating to the activities necessary to develop and implement effective emergency plans, protocols, and procedures.

Guidelines for training programs that will enable personnel to implement the emergency plan and protocols and carry out specific types of procedures are described in Chapter 4 of this report.

3.5.1 Pre-Incident Planning (Preparation)

To be effective, the emergency plan requires development of appropriate emergency protocols and procedures and the procurement of emergency equipment, associated training, and advance provision of other emergency-related information. Adequate, periodic training and reference materials must be provided to ensure that

respective responsibilities are carried out. To be most effective, training should include on-site inspection of the train consists operated, as well as hands-on familiarization with the various types of passenger cars, motive power units, emergency equipment, and right-of-way structures and wayside facilities that may be encountered by personnel in their communities, counties, regions, states, or other jurisdictional entities.

Before an emergency occurs, emergency response organizations should obtain the following minimum information for passenger trains which operate along routes located in their jurisdiction, as well in adjacent jurisdictions:

- Name and address of passenger train system operator,
- Name, title, and work and home telephone number of a duty officer or other designated official of the passenger train system operating organization to be notified in case of emergency,
- Names, titles, and work and home telephone numbers of back-up officials for the duty officer or other designated official,
- Description of passenger train system operating organization personnel and their duties. These personnel can provide specific critical information about passenger car configuration, number and condition of passengers, hazards, etc.,
- Description of the passenger cars and motive power units usually used on specific routes (and in the fleet), including type, construction, and passenger capacity, evacuation procedures,
- Characteristics and usual number of persons generally carried, and
- Description of and instructions for the operation of communications equipment, and emergency exits and other specialized communications equipment) on board the train or located within the right-of-way structure and/or related facilities,
- Any other information that might be useful.

3.5.2 Initial Response

The passenger train crew must always be alert to situations which could become emergencies requiring outside response assistance. For example, after a sudden stop, the train crew should check with passengers to see if injuries have occurred.

If outside assistance is necessary, the initial response, in terms of number of personnel and equipment dispatched to the scene, will vary with the type of emergency, location, and number of persons involved. The passenger train system operator should establish specific criteria for the train crew to use in determining when to contact the Train Dispatcher/Control Center and in requesting medical or other assistance.

If a passenger is injured or becomes ill and outside assistance is required, the proper procedure is for the train crew to use the motive power unit radio, or individual hand-held radios to immediately notify the passenger train system operator Train Dispatcher/Control Center. (However, many intercity and commuter train crew are furnished with cellular telephones; these telephones may not always work, depending on the terrain or train location, e.g., in a tunnel.) The Train Dispatcher/Control Center personnel should then notify the police, fire department, and/or other appropriate response organization dispatcher so that they can arrange with appropriate action, e.g., have an ambulance meet the passenger train at a specified station or other accessible location. However, if the train crew cannot contact the Train Dispatcher/Control Center because of injury or a communications failure, the emergency response organizations may be notified by the first person who can reach a telephone.

Due to the magnitude of the emergency or its isolated location, it may be difficult to notify the Train Dispatcher/Control Center. Moreover, due to the lack of (or delay in) emergency response organization notification or due to the location of the emergency, emergency response organization personnel may not immediately reach

the emergency site. The train crew should assess the situation and, if uninjured, provide the necessary initial response until emergency personnel arrive, particularly if a life-threatening situation makes it necessary to evacuate passengers. This response should include making PA announcements by one of the train crew or on-board service employees, under the direction of the conductor, to keep passengers informed and provide directions. All individuals travelling on-board the passenger train should be accounted for (particularly in sleeping car compartments) so as to expedite evacuation, if necessary, and to avoid needless efforts to search for "missing" persons.

All persons able to reply should be asked about any pre-existing disabilities or conditions, their new injuries, and the characteristics of other individuals who may be incapacitated. Because many passengers regularly use commuter train service, they may be a good source of information about the other persons with whom they frequently ride. If a large number of children or elderly or disabled persons are on board a train, a larger-than-usual team of EMS, ambulance company, and/or police and fire department personnel may be necessary. (Chapter 2 describes personal characteristics of individuals which may affect the level of response required.)

In addition, persons should be identified who may require medical treatment due to conditions that are not directly related to the emergency. The most obvious source of personal medical information is medical alert tags. An apparently severely distorted limb or apparent dismemberment may only be an artificial limb or other prosthesis. It may be difficult to communicate with persons who have visual, hearing, and speech impairments (Appendix C and References 73 and 74 provide additional information) or do not understand or speak another language.

If properly trained, the train crew or on-board service employees should provide basic first aid until EMS personnel arrive.

3.5.3 Assessment/Response by Emergency Response Personnel

Passenger train system operating organization personnel should support the activities of the emergency response personnel to the extent that their skills, training, background, and physical ability allow.

When arriving at the emergency scene, emergency response personnel must assess the situation and determine what actions to take. Due to their knowledge and experience with train operations, the train crew and on-board service employees can provide valuable information and assistance to the "incident" officer-in-charge during an emergency. The train crew (and if necessary, on-board service employees) should convey the exact number and location of passengers on board the train to the incident officer-in-charge. (In the case of reserved intercity trains, this information may be available from another "division" of the passenger train system operating organization.) This information will assist response personnel in deciding whether evacuation is necessary and what type and level of additional resources are required.

Once the incident officer-in-charge has completed the assessment and has requested the necessary further assistance, that person should appoint certain individuals to control hazards, other individuals to maintain support operations, and others to locate victims. As mentioned previously, all individuals should be accounted for (particularly in sleeping car compartments) in order to expedite evacuation and to avoid efforts to search for "missing" persons. Some passengers may have already been removed from the train and/or right-of-way/wayside facility by passersby or may have wandered from the scene.

3.5.4 Hazard Control

"Hazard control" simply means preventing death or injury from train right-of-way structure/wayside facility-related hazards, such as

other trains, unstable car sections, debris, downed wires, fire/smoke, diesel or exhaust fumes, and damaged hazardous cargo.

If the train has been involved in a derailment or collision, passenger cars and/or motive power units, (or other vehicles) which are resting at a precarious position or angle on top of or below the train or right-of-way structures must be stabilized by emergency response personnel. **ALL PERSONNEL SHOULD BE WARY OF ENTERING ANY VEHICLE OR STRUCTURE THAT COULD BE UNSTABLE.**

The possibility of contact with other trains, the catenary, third rail, or other high-voltage power source exists during train emergencies. The generally accepted procedure is for the train crew to notify the Train Dispatcher/Control Center to ensure that other passenger trains or freight trains do not enter the emergency area and electrical power is removed from the emergency site. In certain cases, it may not be desirable to remove electrical power during an emergency, i.e., when a rescue train is dispatched to the emergency site to bring in response personnel and to evacuate passengers.

Specific electrical power removal procedures must be used with strict accountability and authorization prior to power restoration. However, because of human error or equipment inflexibility or malfunction, power may not be removed, or it may be inadvertently restored before evacuation operations are completed. Poor visibility and lack of coverboard protection could also make the third rail extremely hazardous. **THE PRUDENT APPROACH FOR ALL PERSONS IS TO ASSUME THAT THE ELECTRICAL POWER IS ALWAYS ON.** References 75 and 76 contain more information relating to train system wayside power systems.

A fire which involves passenger cars, motive power units, or right-of-way structures/wayside facilities must be extinguished as soon as possible to prevent injuries to passengers and passenger train operator personnel and allow time to evacuate all persons from the train, right-of-way structure or wayside facility.

Other hazards present at or during an emergency must be addressed on a site-specific basis.

3.5.5 Support Operations

The passenger train system operator may provide technical assistance to emergency response personnel and may also furnish alternative means of transportation for uninjured persons to continue their trips. Follow-up services for train passengers and other individuals may be necessary as discussed in Reference 77.

Additional emergency response personnel and equipment may be required for any of the following reasons:

- Triage and special medical equipment may be necessary.
- A fire may start or a previously "extinguished" fire may re-ignite.
- Passenger cars or motive power units must be removed from a hazardous area or condition.
- Reduced visibility or location of emergency may hinder emergency response operations and delay emergency medical treatment.
- Heavy equipment may be required for shoring and/or extrication.
- Food and shelter for passengers and other persons may be necessary,
- Evidence and personal property must be protected.
- Communications equipment may be needed for media liaison.
- Crowds may be difficult to control.
- Any other relevant reasons.

3.5.6 Train Access

Because locomotives and conventional rail passenger cars are designed to withstand extreme structural (critical) forces, forcible entry is very difficult. (The types of cars and motive

power units operated in various train consists are described in Chapter 2.) The emergency response crew should first attempt to use exit doors and emergency exit windows, where provided and operable, since they are quicker to use and can prevent further injury.

If the train has been involved in a derailment or collision, structural deformation, abnormal position (e.g., overturned) or instability (at an angle, overhanging) of passenger cars may occur, making access difficult for emergency response personnel, even if exits are not damaged or jammed.

If metal saws or cutting torches are used, caution should be exercised to avoid weakening the overall vehicle structural components, which could collapse and cause further injury.

Training for gaining access to the various types of passenger cars and motive power units is necessary for an effective emergency response. Instructions describing how to gain access to each type should be included in this training. (See Chapter 4 for guidelines related to training programs and materials.)

3.5.7 Right-of-Way Structure/Wayside Facility Access

Emergency response organization personnel should develop a plan for gaining access to all potential emergency sites located within their jurisdictional boundaries. (Points within neighboring locales and jurisdictions should also be considered under mutual aid protocols.) Specific appropriate strategies and equipment should be considered for the various types and locations of right-of-way and associated wayside facilities.

Access points may or may not be located next to or near the right-of-way structure, grade crossings, and other wayside facilities. Adjacent roads, where they exist, may be narrow or otherwise provide limited passage and thus could be difficult for emergency response organization vehicles to negotiate.

Tunnels may or may not have emergency exits or other emergency equipment; if provided, the locations may not be marked.

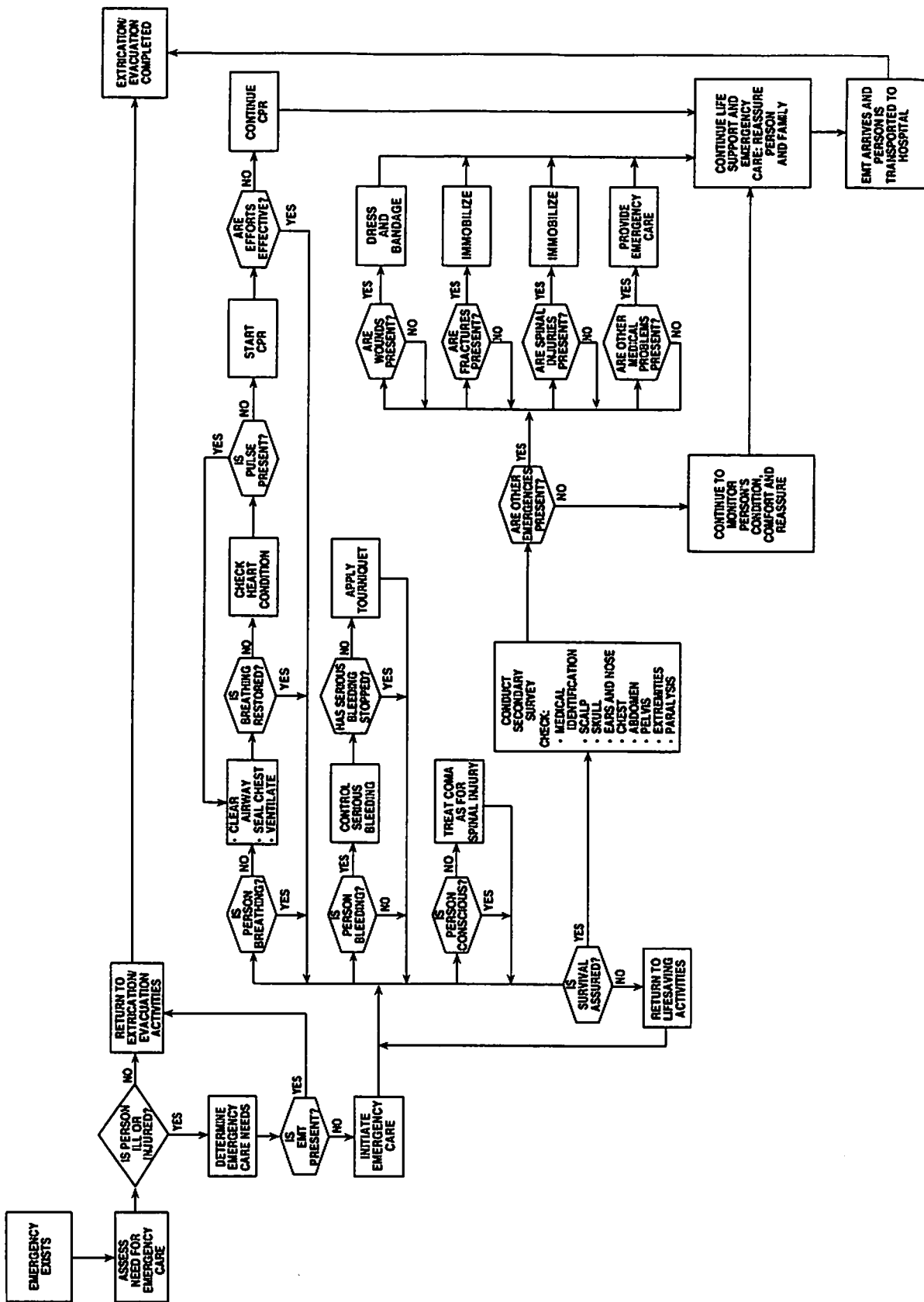
Bridges and trestles that cross over wetlands, lakes, rivers, or other bodies of water or over ravines (particularly those in isolated areas with no nearby roads) pose particular access problems. Helicopters or boats often provide the only approach to these locations.

Specific provisions for access to right-of-way structures and wayside facilities should incorporate the results of joint planning between the passenger train system operator and the emergency response organizations which consider all aspects of the local operating environment.

3.5.8 Emergency Care

While emergency response organization personnel are gaining access to the emergency site, the extent of injuries should be determined. While it is important to extricate persons who are trapped and to transport them to hospitals as soon as possible, it may first be necessary for emergency response personnel (or properly trained passenger train system operating organization personnel, if the emergency occurs in a remote area and a life-threatening situation exists) to perform life-support activities. Each person's condition must be evaluated. Figure 3-1 contains a reference flow chart of emergency treatment actions adapted from Reference 78. If persons seem to have spinal injuries or are paraplegic or quadriplegic, their entire bodies must be rigidly fixed to reduce the possibility of further injury.

Basic emergency care needed by small children or elderly or disabled individuals is not unlike that provided to other persons, but determining their injuries is much more difficult. Personnel may have to assume that individuals have suffered more serious injuries than their complaints indicate. For example, when the



Source: Adapted from Reference 78

FIGURE 3-1. Emergency Care Flowchart

general public suffer fractures, they will complain of pain to emergency response personnel, but a paraplegic may have a fracture and not be aware of it.

3.5.9 Extrication and Removal (Transfer)

If passenger cars or motive power units are damaged or overturned special extrication techniques and equipment may be necessary to remove and transfer individuals from the train.

Once emergency response personnel gain access to the inside of the passenger car, or motive power unit, and if necessary, begin to treat persons to stabilize their conditions, they must decide how best to prepare individuals who are trapped for removal and transfer from the train or other location. In some cases, extrication may have to be concurrent with medical treatment to minimize danger to both victims and emergency response personnel from spilled fuel or other hazards. The decision to extricate injured persons should only be made jointly by the EMS technician or otherwise qualified emergency response individual already inside the train (or at other location) and the emergency response organization officer-in-charge.

Removal and transfer of persons through emergency window exits will be slower because of their relatively small openings, their height and angle (if vehicles are overturned) in relation to the terrain or right-of-way structure/wayside facility, and the interference of seat backs.

If no emergency response personnel are on the scene during a life-threatening situation, if their arrival time is unknown or delayed and if the train is located in a isolated area, it may be necessary for the train crew, on-board service employees, or other passenger train operating system operator personnel, or "Good Samaritans" to take some type of extrication and removal action to avert major injuries to or death of individuals who are trapped.

Persons may have to be extricated from one or more of the following:

- Other individuals,
- Seats or fallen other interior components,
- Crushed or twisted metal (or components of other materials),
- Clothing,
- Wheelchairs and torso-restraint devices,
- Crutches, walkers, or other personal assistive devices, and/or
- Prostheses.

Depending on the condition of normal or other passenger car (or motive power unit) doors, injured or mobility-impaired persons may have to be removed via emergency window exits; it may take longer to remove persons through these exits because of their relatively small openings, their height and angle (if vehicles are overturned) in relation to the terrain, right-of-way structure, or wayside facility, and the interference of seat backs.

Wheelchair torso-restraint devices can usually be removed with a seat belt cutter, but because of vehicle damage, it may be difficult to access a portion of the device that can be cut without endangering the passenger.

Some passengers who appear to have distorted or severed limbs may be suffering from nothing worse than detached prostheses. Artificial limbs can be easily removed to facilitate extrication.

Once persons are extricated, their removal and transfer by emergency response organization personnel to another vehicle can also be complex. For example, if passenger cars have rolled down an embankment or plunged into a drainage ditch or a body of water, extrication of persons may require specialized equipment. Moreover, during inclement weather, special procedures may be

required if the train is located on an embankment or on an elevated structure, rather than on level ground.

3.5.10 Evacuation

The emergency plan, protocols, and procedures should specify the techniques and type of equipment to be used for evacuation from various types of situations. (For the purpose of the discussion in this section, "evacuation" is defined as the departure of persons from the passenger train and right-of-way structure or wayside facility under their own power under the direction of train crew or other system and response personnel. Although, mobility-impaired persons may need special assistance, the premise is that incapacitating injuries and/or severe train damage do not occur.

Immediate evacuation from trains located between stations is not the preferred approach unless passengers and crews are in immediate danger. Accordingly, in the majority of situations, if the train is unable to or cannot proceed because of hazardous conditions, passengers may be evacuated from the disabled train and transferred to a rescue train sent to the scene. Buses or other transportation may also be used to transport passengers who are evacuated from a train.

The first choice to evacuate both uninjured and injured passengers from the train is through the normal passenger car entry door. (In certain emergencies, normal egress routes may be blocked or inoperable as a result of equipment jamming; train emergency window exits provide an alternative if doors cannot be used. Evacuation from structures such as tunnels and bridges depends on site-specific construction and location.) Requests for assistance from uninjured able-bodied individuals and instructions for evacuating uninjured persons who need help should be given directly by the train crew or by the direction of emergency response personnel, whoever has command at the emergency scene. Care must be taken to ensure that persons are protected from following trains or those

on adjacent tracks, electrical hazards, and other dangerous conditions (see Section 3.5.4).

The management of the passenger train system operator and emergency response organizations should consider how to perform train evacuation during the inclement weather conditions (such as snow, ice, flooding, etc.) that are likely to occur in the train operating locale.

To avoid aggravation of pre-existing conditions, as well as to prevent additional injuries, emergency response personnel should be familiar with the various techniques and equipment which can be used to carry persons who are paralyzed or who have other mobility limitations (see examples in References 73 and 74). The decision and manner in which to evacuate individuals with or without a wheelchair should generally be handled on a case-by-case basis by appropriate passenger train system operating organization or emergency response personnel, whoever is in charge at the emergency scene. Before these persons can be removed from the train, securement devices, if used, must be disengaged, either by a quick release feature or by simply cutting the restraint straps. Electric wheelchairs pose special problems because of their weight and the electrical-related hazards of batteries. Although the quick emergency evacuation of a wheelchair user will generally require that the person be bodily removed from the wheelchair, the removal of lighter weight, non-powered types of wheelchairs can contribute to easier and swifter evacuation from the emergency scene once that person has reached the point of safety (depending on the location, (i.e., terrain, whether an access road is available, or whether the train is stopped at a station). In addition, given the wheelchair user's psychological attachment to and the cost of the wheelchair, an effort, as determined by the situation, should be made to retrieve the wheelchairs of any persons carried away from the emergency scene.

3.5.11 Debriefing

After an emergency is resolved, it would be beneficial for the management of the passenger train system operating operator and all responding organizations to hold a debriefing meeting for a review of the response actions taken by all personnel involved to determine what lessons can be learned. The results could be circulated for review, and summaries can be provided for information exchange with local, state, county, and regional emergency management agencies, as well as the FRA, so that knowledge can be shared and the overall emergency plan improved. The debriefing should help to determine:

- What standard passenger train system operator or emergency response organization procedures and techniques could not be used because of the special characteristics of the train, or passengers?
- What new techniques were improvised?
- How could the coordination of the passenger train operating organization personnel and the other participating organizations be improved?
- What improvements to the passenger train operating organization and emergency response organization procedures and/or emergency equipment are necessary?
- What special equipment might have been useful had it been available?
- What specialized kinds of training might increase the knowledge and skills of personnel (see Section 4.3)?

Section 3.7 and Section 4.7 provide additional guidance on evaluating overall emergency actions by all responding parties.

3.6 EMERGENCY PREPAREDNESS PLAN SUPPORTING DOCUMENTATION

An actual, dynamic, one-of-a-kind emergency situation is not easily portrayed, yet early decisions are crucial to all that follow. Sequences of calls or transfers of commands are usually based on a few key early decisions (often irreversible) by the passenger train crew, Train Dispatcher/Control Center personnel, or emergency

response organization personnel. Ideally, such decisions should be made in a logical fashion, with each piece of information being considered to narrow the list of alternative remedial strategies. The effectiveness of the documented emergency plan, protocols, and procedures documents is based on the assumption that key decisions must be made as quickly as possible. Table 3-1 lists examples of valuable supporting documents for the various parties that could facilitate the response to an emergency; these are discussed more fully in the following sections.

3.6.1 Decision-Making Aids

Individual procedures are typically written as if one person could ideally and simultaneously visualize concurrent events and actions occurring at various locations involving various individuals. The proper sequence and relative timing of information gathering, decision-making, commands, and responses of all participants are then portrayed as a series of entries on printed pages.

Emergency procedure documents intended for use in training, as memory aids, and for use in developing judgment may seem wordy and bulky when seen in terms of the action and decision-making time frame required of a train crew, passenger train system operating organization personnel, Train Dispatcher/Control Center staff, emergency response dispatcher, and other personnel during an actual emergency. It cannot be assumed that the type, location, and severity of an actual emergency will always be quickly identified and properly classified. Nor can it be assumed that the emergency will always elicit the proper initial commands or the proper initial response to the commands.

Simplified summary checklists ("decision-making aids") can be used as memory aids in an actual emergency. A checklist should exist for each critical position or task, and each checklist should address the expected actions of the particular position. These decision-making aids are useful to determine which particular set of emergency protocols and procedures to follow. They also should

TABLE 3-1 EXAMPLES OF EMERGENCY PLAN SUPPORTING DOCUMENTATION

- 1. Passenger Train System Operating Organization* Emergency Plan and Procedures**
 - o Policy and Protocols
 - o Procedures
- 2. Inter-Organizational Emergency Protocols and Procedures**
- 3. Decision-Making Aids for Operating Organization Train Dispatchers/Control Center**
 - o Check list reminders for notification (including "911" or other special telephone numbers and codes) and other key actions
 - o Definition and map of jurisdictional boundaries (EMS, local and state police, sheriff/highway patrol, fire department, hospital, etc.)
 - o Passenger train right-of-way route and facility maps
 - o City, town, county, and regional state highway maps
- 4. Decision-Making Aids for Operating Organization Personnel**
 - o Check list of procedures for notification (including "911" or other special telephone numbers and codes) and other key actions
 - o Wallet-size index of telephone numbers of EMS, local and state police/sheriff/highway patrol, fire department, hospitals, etc.
 - o Passenger train right-of-way route and facility maps
 - o City, town, county, and regional state highway maps
 - o Passenger car graphics including the operating organization name, location and instructions for emergency access/egress and simple instructions for power shut off, etc.
- 5. Decision-Making Aids for Emergency Response Personnel**
 - o Wallet-size index of telephone numbers of system operating organization system, EMS, local and state police, sheriff/highway patrol, fire department, hospitals, etc.
 - o Passenger train right-of-way route and facility maps
 - o City, town, county, and regional state highway maps
 - o Passenger car graphics including the operating organization name, location and instructions for emergency access/egress and simple instructions for power shut off, etc.
- 6. Other Supporting Documentation**
- 7. Training Materials**
- 8. Emergency/Disaster Management Plans**
- 9. Accident Investigation Reports**

* Including any or all operational entities

provide specific information regarding notification of emergency response organizations (use of a dedicated direct telephone line, "911" or other special code, special radio frequency, etc.), location of passenger train and right-of-way/wayside facility emergency equipment and exits, the most direct and alternate response routes, etc.

Decision-making aids also offer a means of shortening the response time of personnel. Each passenger train operating operator (including subcontractors) should have its own system-specific collection of such aids that are tailored to the individual needs of the personnel who will use them during emergencies.

3.6.1.1 Decision-Making Aids for Train Dispatchers/Control Center Staff - Once the type and location of the emergency are determined, the Train Dispatcher/Control Center staff use the protocols and procedures documented in the emergency plan to determine the appropriate type of emergency response required (e.g., fire department, EMS), select the best alternative, and initiates notification and other actions accordingly. In many instances, after the Train Dispatcher/Control Center personnel provides initial notification to emergency response personnel (e.g., disaster/ emergency response management center, such as "911," or fire department), the responsibility for further notification and coordination of other response personnel and command of the emergency scene is transferred from the passenger train operator. The following decision-making aids will help facilitate this process.

- **Checklists/Reminders of Key Personnel Actions** - The simplest example of a decision-making aid is a reminder checklist for notification protocols and procedures and other key actions summarized from the full set of emergency plan documents. Such aids will shorten the response time of Train Dispatchers/Control Center staff.
- **Definition of Jurisdictional Boundaries** - Schematics, maps, tables, or other system-specific operational documentation should be developed to aid the decision-making process associated with calling the proper emergency response organization for a given emergency

type and location. The details of jurisdictional boundaries should be established well in advance as part of the coordination element of emergency preparedness and documented in the "Inter-Organizational Emergency Protocol." This information should be summarized in the pertinent decision-making aid to reduce the response time.

- Train route right-of-way structures (including tunnels and bridges) and wayside facility maps.
- City, Town, County, and State Highway Maps - These maps should be available to pinpoint the location of the train, identify the jurisdictional boundaries of emergency response organizations, and determine the most direct route, as well as alternate routes, to the emergency scene.
- Automated emergency response systems containing a data base can be used to store the information in the items described above, as well as pre-determined procedures for certain types of emergencies (See Chapter 6 and References 79 and 80.)

3.6.1.2 Decision-Making Aids for Other Personnel - Wallet-sized checklists should be provided, as appropriate, for the train crew, on-board service personnel, and emergency response personnel. These should be consistent with the corresponding aids used by the Train Dispatcher/Control Center. See Table 3-1 for examples.

3.6.2 Other Documentation

Various sources of written information (such as personnel procedures, equipment manuals, and signs and symbols used on trains and related facilities) used during normal operations contain information that can be helpful during emergencies. It is essential that the portions of these materials containing emergency preparedness-related information are used in passenger train system operating organization and emergency response personnel training and passenger education programs, are consistent with the emergency plan, and are kept up to date.

3.6.2.1 Rule Books, Standard Operating Procedures, Guidelines, and Motive Power Unit and Passenger Car Handbooks - Most rule books, standard operating procedures (SOPs), guidelines, and handbooks contain sections describing the steps to follow during normal operations. These documents should contain protocols, procedures, notification lists, etc., consistent with those included in the master emergency plan.

3.6.2.2 Safety Rules and Emergency Procedures - Safety rules and emergency procedures are usually included in the same document with rules, SOPs, and guidelines. Safety rules are generally preventive in nature, whereas emergency procedures are reactive and correspond to specifically categorized unforeseen events, such as fire, collision, or derailment. Mastery of safety rules and emergency procedures by operating organization personnel should be considered just as important as mastery of the standard rules and SOPs.

Rule books contain emergency procedures for train crews, describe the proper procedures for various emergencies, and include instructions for operating emergency exits and procedures for passenger evacuation. Amtrak rulebooks contain this type of information [21-23]. Commuter train system operators possess similar types of rulebooks. The Amtrak manual for on-board service employees describes emergency-related policies and procedures for first aid, train emergencies, and evacuation [24].

3.6.2.3 Descriptions of Trains, Operational Environment, and Emergency Equipment - Information such as diagrams of passenger train car and motive power unit components and emergency equipment schematics, including stations and other emergency access/egress points, will help employees to understand and recall particular sets of rules or procedures in an emergency. Additional useful descriptions of equipment, such as maintenance manuals, are typically found in maintenance shops. The following recommendations pertain to these information resources:

- Handbooks describing passenger cars/motive power units that contain instructions for the normal, as well as the emergency operation of equipment, should be distributed to train crews, on-board service employees, and appropriate emergency response personnel.
- The passenger train system operator should require, as part of the procurement specification, that the manufacturer clearly provide such information in an easy-to-reference, uniform format; provision for permanent storage on board the power unit/car in an easily accessible location would make the information more useful.
- Descriptions and diagrams detailing the location and operation of communication equipment, emergency exits, and power shut-off switches should be provided to the train crew, appropriate on-board service personnel, and appropriate emergency response personnel.
- As new motive power units, passenger cars, equipment, or components are added to the passenger train system fleet, descriptions and diagrams should also be made available to the train crew, appropriate on-board service personnel, and appropriate emergency response personnel.
- Descriptions and diagrams of locomotives, other motive power units, passenger cars, and emergency equipment should be evaluated for their applicability as references in the overall emergency preparedness process. Specifically, these materials should be evaluated in terms of their usefulness as training aids, as a common reference to aid oral communication between persons at different locations, and as study aids to assist in visualization and decision-making.
- Descriptions of right-of-way structures and wayside facilities including tunnels and bridges should be provided.
- The availability and intelligibility of these materials to large numbers of personnel should be periodically evaluated.

One example of this type of information is contained in a Amtrak reference booklet [25] describing entry and evacuation procedures for passenger train locomotives and cars for use by Amtrak employees and public safety personnel.

3.6.2.4 Graphics - Signs and/or symbols can provide critical information to the train crew and emergency response personnel to identify the location of emergency exits and other equipment and to provide instructions for their use (see Sections 5.1.8, 6.1.12, 6.2.10, and 6.3.5).

3.6.2.5 Passenger Awareness Information - Depending on the type of the local operation, posters, passenger brochures, and schedule inserts which outline emergency procedures or instructions displayed on emergency exits and other emergency equipment may be provided to assist passengers in taking the necessary actions in emergencies (see Section 4.8.1).

3.6.3 Training Materials

Training materials such as brochures, lesson plans, classroom presentations, emergency scenarios, films, videotapes, slides, and mock-ups should also be used in preparing for emergencies. Two examples are an Amtrak employee training program for emergency situations [26] and a pilot training program for non-Amtrak employees relating to train and tunnel evacuation emergencies [27]. (See Chapter 4.)

3.6.4 Emergency/Disaster Management Plans

Municipal, county, regional, state, and federal emergency disaster/emergency plans can be a critical source of information and assistance for passenger train system operators.

3.6.5 Accident Investigation Information

Recommendations contained in accident investigation reports from the passenger operating organization itself, other passenger train system operators, state agencies, and the National Transportation Safety Board (NTSB) should be used in development and revision of emergency plans, protocols, and procedures.

3.7 GENERAL RESPONSE CAPABILITY CRITERIA

Adequately designed procedures for the sequence of activities described in Section 3.5 should ensure consistency between preparation and actual practice. Passenger train system operator and emergency response organization managements should examine their emergency plans, protocols, and procedures to evaluate the ability of their personnel to provide swift and efficient response to an emergency. The overview of these criteria is intended to provide a perspective and shared understanding of the overall type and sequence of actions which should be addressed by the management of the passenger train system operator and emergency response organizations. The text presented here is informational in nature and presented solely to assist various entities in preparing appropriately for a range of potential contingencies. Not all activities will be necessary for every type of emergency. Specific emergency plans, protocols, and procedures for these and other activities will reflect the mutual understandings developed by the particular passenger train system operator and the appropriate responding parties.

The following questions constitute a suggested decision-making checklist for establishing pre-determined protocols and procedures and evaluating the relative effectiveness of actions to be taken in a train emergency:

- What type of emergency exists, e.g., passenger injury or illness, derailment/collision, fire?
- Who initially reports the incident and its location?
- How is the location of the train (or other emergency) determined, particularly when train crew members are incapacitated? (The location of the telephone and number used to report the emergency should be given, if the train radios are not used.)
- What is the condition of the train crew?
- Who is "next-in-charge" if the conductor is incapacitated?
- What actions are initiated to verify or improve the initial report of the incident?

- What actions should be taken as a first reaction to the initial report of the incident?
- Who decides that the reported incident is, in fact, an emergency and determines the particular category?
- If the incident is first reported from a train that is traveling between stations, who decides if the train should stop or continue to the next station or emergency access/egress point?
- Who relays the initial report of the incident to the train system operating organization and emergency response organization dispatchers?
- If the emergency involves fire, who decides to call the fire department? What criteria are used to make the decision?
- How many families with small children and elderly or disabled persons are on the train?
- What are the impairments or disabilities of each person?
 - Limited or no mobility
 - Visual or hearing impairment
 - Medical, physical, or other condition
- What procedures and equipment are used to provide information and directions to passengers?
- Will passengers be able to understand oral directions? Are train crew, on-board service employees or emergency response personnel able to communicate by written means or with hand signals?
- What kind of injuries do passengers have? (The train crew could provide a "rough" indication, even though diagnosis must be performed by emergency response personnel.)
- If there are injuries or fatalities, who initially assesses the size, type, and level of emergency medical response required? What criteria are used to make the decision?
- Have factors such as access, egress, availability of equipment, visibility, communication, etc., been considered on all scheduled routes?
- Who decides which particular protocol and set of standard emergency procedures or combination of procedures are followed to resolve the particular emergency?

- How should the initial actions of personnel be modified to fit the verified actual reports of the nature, severity, and location of the incident?
- How many passenger operating organization or emergency response personnel can be sent to the scene?
- What kind of special equipment is available along the route or must be brought to the scene? Who provides this equipment?
- Once initial decisions regarding requests for assistance and/or evacuation are made, how are changes implemented in accordance with revisions in the chain of command system?
- As various groups of emergency response personnel arrive at the scene, how is the incident chain of command, control, and communication system changed or maintained?
- If evacuation appears to be necessary, who makes the decision to evacuate? What criteria are used to make the decision?
- Who decides the best procedure route, timing, etc., for evacuation? How are these choices determined?
- Who coordinates an evacuation: passenger train system operating organization personnel or emergency response organization personnel?
- Who decides when (in what order) persons are evacuated and on what basis?
- If special services appear to be needed (extrication equipment, coroner, etc.), who decides and specifies the need?
- What passenger follow-up services are required?
- Have provisions been made to maintain service on the train system's unaffected routes and to supply alternate service in the affected areas?
- Who decides when and how to resume normal service?



4. TRAINING

The train crew, other system operating organization personnel, emergency response personnel, and passengers constitute the most vital element of emergency response capability. (As noted in Chapter 1, the term "passenger train system operator" refers to the passenger car and motive power unit owner, train system operator, right-of-way structure/wayside facility owner, railroad carrier, subcontractor organization, or other entity, any or all of which which may be responsible for the actual operation and movement of intercity or commuter trains. All such entities should be included in training programs.) Their knowledge and ability to carry out procedures and use emergency equipment are essential to the success of emergency response actions. The guidelines presented in this chapter address the following issues:

- The knowledge of the train crew and other passenger train system operating organization personnel and state and local government agencies, as appropriate, about the system route characteristics, passenger cars and motive power units, and emergency plan, protocols, procedures, and emergency equipment;
- The knowledge of emergency response (fire, police, etc.) personnel about: (1) their own emergency plan, protocols, procedures, and emergency equipment, (2) the interface with the passenger train system operator and the types of trains operated in their jurisdiction, and (3) all available emergency equipment which they would use to respond to a train emergency; and
- Passenger awareness of appropriate emergency procedures and emergency equipment.

Passenger train operating personnel are familiar with their own equipment and facilities, just as emergency response personnel are familiar with theirs. Each group, however, knows less about the other. Personnel training and familiarization with the other's protocols, procedures, operations, and equipment assist in ensuring that the response is coordinated and effective. Joint training sessions are particularly important.

The quality and quantity of training will greatly influence the ability of personnel of each organizational entity to do the following:

- Implement the appropriate emergency response protocols and procedures, and operate emergency equipment,
- Identify, understand, and cope with the special needs of individuals and their conditions or injuries, and
- Evacuate individuals, if necessary.

The following types of training will assist persons who may be called upon to take response actions to develop and maintain the knowledge and skills required to respond to emergencies:

- Initial operational and emergency response training for all employees (Phase 1);
- Specialized emergency response training for certain groups of employees, depending on their specific job requirements (Phase 2); and
- Refresher and/or retraining courses for both Phase 1 and Phase 2.

Effective training enables the passenger train system operating organization and emergency response personnel to develop appropriate skills by familiarizing them with passenger train equipment and facilities and teaching the participants the latest evacuation procedures and techniques.

The information presented in the remainder of this chapter is intended to provide a perspective and shared understanding of the overall training activities which may assist individuals to carry out the protocols and procedures described in the emergency plan(s). The text presented here is informational in nature and presented solely to describe the various types of training which may be required to prepare for a range of potential contingencies. Specific training programs and the responsibilities for and the conduct of training will reflect the mutual understandings

developed by the management of the particular passenger train system operator and the appropriate responding parties.

4.1 PASSENGER TRAIN OPERATING ORGANIZATION PERSONNEL TRAINING

The actions of passenger train system organization personnel are primarily associated with standard operations. Similarly, the largest percentage of initial training is usually devoted to standard operating procedures (SOPs). This training should also include the proper rules and procedures to follow, as well as the correct use of equipment, if an emergency occurs. Although they may never have to use many of these rules, procedures, and equipment, personnel should be familiar with them.

Depending on their specific job responsibilities, train crews, on-board service employees, Train Dispatchers/Control Center staff, and other appropriate supervisory and maintenance personnel should, as a minimum, be taught the characteristics of and appropriate response to the emergency scenarios described in Chapter 2:

- Illness or injury,
- Stalled train,
- Sudden stop of train,
- Suicide/other collision with a person,
- Derailment/collision,
- Fire/smoke,
- Derailment/collision with fire/smoke,
- Derailment/collision with water immersion,
- Severe weather conditions/natural disasters, and
- Security situations.

Training for each scenario should involve proper procedures to notify the Train Dispatchers/Control Center, and communication procedures to keep passengers informed and provide them with

direction and instructions to ensure their safety. Training should also include how to assess the conditions, limitations, and injuries of passengers, including the specific needs of families with young children and mobility-impaired persons. Providing this type of information to the Train Dispatcher/Control Center can then help responding organizations to determine what level of assistance is necessary, particularly if evacuation is necessary. Training should include the specific characteristics of the particular passenger train operating route, terrain, right-of-way structures, and wayside facilities, and familiarization with the following:

- **Operating Rules**
 - All employees should be provided with rule books (sometimes referred to as handbooks) which allow for addition or deletion of pages to reflect revisions (including a change-item sheet).
 - Special rule notices, rule updates, and modifications should be disseminated in a variety of ways: provided by supervisors, posted on bulletin boards, presented in training sessions, and/or issued as employee timetable special instruction supplements.
 - Records should be maintained to document that personnel have received, read, and understood revised or new information.
- **SOPs**
 - SOPs should establish guidelines for handling of all normal, abnormal, and emergency operations.
 - Minimum training in emergency procedures should include discussion which defines types of emergencies and what occurrences that could endanger passengers and/or employees.
- **Layout and Operation of Train/Right-of-Way Structure/Wayside Facility Equipment**
 - A manual/handbook which describes the location and proper operation of emergency equipment for each passenger car and motive power unit should be provided by the manufacturer.
 - The location of normal and emergency exits, communication equipment, and other safety features should be identified, and instructions for their operation should be provided.

- **Communications**
 - All personnel should be taught to communicate priority information in order to minimize transmission time and to facilitate action.
 - Specific communication protocols should be identified.
 - Specific training should be provided on what to say to passengers and when and how to say it.
- **Air Conditioning and Ventilation Equipment**
 - Personnel should be trained in the operation of forced ventilation systems for both trains and tunnels in accordance with SOPs for managing ventilation during emergencies.
 - If train movement, natural air flow, and/or grates between tunnel and surface are used to provide ventilation, procedures and training in accordance with these limitations should be established.
- **Emergency Equipment**
 - Personnel should be taught how to use specialized emergency equipment (located on-board, along the wayside, or in facilities associated with their assigned duties).
 - Operating and maintenance personnel, supervisors, and inspectors, as appropriate, should be trained to report lost, stolen, or vandalized equipment.

Chapters 5 and 6 and Appendix B contain additional information relating to train and right-of-way/wayside equipment.

Training sessions should be designed to teach employees how to follow correct procedures and use equipment properly during an actual emergency. Emergency procedures as referenced in the overall emergency plan and protocols should be used as the basis for the training sessions.

4.2 EMERGENCY RESPONSE PERSONNEL TRAINING

To ensure a coordinated response to emergencies, passenger train system operators should include and encourage the firefighters, local police, ambulance personnel/paramedics, and other emergency response personnel (including dispatchers) who may respond in accordance with the "Inter-Organizational Emergency Protocol" to participate in training programs and drills/exercises.

Passenger train system operators should also encourage the management staff of EMS and ambulance services, police and fire departments, hospitals, and other appropriate public safety organizations to provide input to all proposed emergency preparedness training materials for programs which their personnel may participate in, before the materials are finalized. Emergency response personnel training subjects include:

- Overview of the passenger train system operations and right-of-way/wayside facility characteristics, including orientation and familiarization with routes, trains, equipment, passenger characteristics, and normal and emergency operating procedures;
- Orientation tours of trains to point out features described in formal presentations and to highlight the specific physical configuration of each type of train and right-of-way/wayside facility;
- Orientation tours of right-of-way tunnels, bridges, and other wayside structures, as well as stations, to point out hazards associated with train and right-of-way equipment, e.g., train or wayside electrical power;
- Training to provide an understanding of the emergency-related duties of key passenger train system operating organization personnel (These personnel can provide specific critical information about passenger car configuration, number and condition of passengers, hazards, etc.);
- Emergency drills/exercises involving all participating organizations to provide practice and to reinforce the emergency response and evaluation procedures;
- Periodic training to cover personnel shift assignment changes, area rotations, etc.

4.3 SPECIALIZED EMERGENCY TRAINING

Sections 4.1 and 4.2 provide a general introduction to different types of training for passenger train system operator and emergency response personnel. The overview presented in this section is intended to provide a perspective and shared understanding of the types of specialized emergency training which may be required to ensure the management of the passenger train system operator and emergency response organizations that their personnel are able to carry out the protocols and procedures described in the emergency plan. The text presented here is informational in nature and presented solely to describe specialized training which may be necessary to prepare for a range of potential contingencies. Specific training programs and the responsibilities for and the conduct of specialized training will reflect the mutual understandings developed by the particular passenger train system operator and the appropriate responding parties.

Depending on their job responsibilities, passenger train operating organization personnel may be given additional training that will assist them in responding to a variety of potential emergencies. It is advisable to teach the train crew and other appropriate on-board service employees how to perform the following tasks when a life-threatening situation exists and no other alternative is available:

- Use fire extinguishers, operate ventilation equipment, and shut off electrical power,
- Provide first-aid to stabilize injuries,
- Prepare passengers for evacuation,
- Evacuate them from the train, and
- Arrange to transport them to the nearest hospital, if necessary.

Additional training in these areas could be valuable for passenger train system operating organization and emergency response

personnel: fire safety, crowd control and panic prevention, use of tunnel equipment, and removal of power from trains. It is emphasized again that the value of this training would be enhanced by joint participation of personnel from the passenger train system operating organization and emergency response organization.

It is recognized that due to their knowledge, experience, and special training, emergency response personnel are the individuals most qualified to perform medical and rescue activities. However, if no emergency response organization personnel are on the scene during a life-threatening situation, if their arrival time is unknown or delayed, and if the train is located in a remote area, it may be necessary for the train crew and/or on-board service or other passenger train system operating organization personnel to take some type of life-support or other emergency action to stabilize a person's condition until emergency response personnel arrive.

4.3.1 Fire Safety

As a general rule, after reporting a fire, the train crew and/or other passenger train system organization personnel on the scene should evacuate passengers and help fire department personnel gain access to the fire. It is recognized that it is primarily the job of the fire department to actually fight the fire. However, to instill a sense of self-confidence and personal safety in passenger train operating organization personnel, they should be provided with basic training in fire safety awareness. This training will enable personnel to make better decisions during a fire, to fight small fires prior to the arrival of the fire department when prudent, and to promote fire prevention while performing their regular duties. Such training may be developed and conducted in cooperation with local fire department personnel. The fire safety awareness training programs should include the following areas for appropriate personnel:

- Familiarity with the location and use (when and how) of fire extinguishers;

- Familiarity with the location and use (when and how) of ventilation and air conditioning controls;
- Procedures for reporting used and missing fire extinguishers so that they can be promptly refilled or replaced; and
- Procedures for reporting fire safety hazards.

4.3.2 Train and Operational Environment Familiarization

Passenger train system operating organization and emergency response personnel should be able to recognize hazards and to locate and use emergency equipment provided at designated points in tunnels or on bridges and other points along the right-of-way, or relating to wayside facilities (see Chapter 6).

Personnel should be familiarized with train and right-of-way/wayside facility structures and equipment in a variety of ways, including: classroom instruction, demonstrations and/or practice sessions, and on-the-job training. As a minimum, the manual/handbook mentioned in Section 4.5.1.2 should be reviewed for each type of passenger car and motive power unit operated by the passenger train system and provided to personnel to use as a reference. Similar types of training materials should be used for right-of-way structures, wayside facilities, and associated equipment. Training should include:

- Visual aids depicting trains and the operational environment (including tunnels and bridges), walking (or riding) orientation tours, and demonstration of appropriate application of emergency procedures and use of equipment;
- Information on hazards such as third rails, collector shoes, catenary wire, and pantographs;
- Information on the location and operation of emergency exits;
- Procedures for forced ventilation systems in accordance with SOPs for managing ventilation during emergencies; and

- Information and understanding of ventilation resources available for specific tunnels and tubes, such as train movement, natural air flow, grates between tunnel and surface, and fans.

4.3.3 Command, Control, and Communications

Passenger train system organization and emergency response organization personnel must be familiar with the command, control, and communication procedures and equipment that are described in the emergency plan. Training should help ensure that the proper notifications are performed, that coordination of activities is achieved, and that personnel understand who is in charge at the emergency scene. (Civil authorities may very likely supersede the passenger train system operating organization personnel.)

4.3.3.1 Procedures - Training should be provided to appropriate personnel as follows:

- Terminology of the passenger train system operating organization, and terminology of the other participating responding organizations;
- Proper notification procedures, in terms of how, when, and who to contact, including titles of officials, telephone numbers, radio frequencies, and call numbers or codes, as applicable, for all times of the day;
- Explanation of the chain of command, control, and communication to be followed at the emergency scene;
- Proper procedures to inform passengers and direct their actions; and
- Methods of communicating with persons who have visual, hearing, speech, or other impairments (see Appendix C and References 73 and 74).

4.3.3.2 Communications Equipment - Appropriate personnel should be provided with training in the proper use of the types of communications equipment which they may be expected to operate:

- On-board train, right-of-way/wayside, and passenger station radios and telephones,

- Train and station public address systems,
- Direct phone lines between the Train Dispatcher/Control Center (if provided) and the EMS/police/fire department alarm center(s),
- Telephone conference call equipment, and
- Radio links between the EMS/police/fire department alarm center(s) and personnel at the emergency scene.

4.3.4 Removal of Electrical Power

The Train Dispatcher/Control Center is responsible for issuing instructions and operating equipment to control the movement of trains and to isolate electrical power from the train and right-of-way. In addition, the train crew and fire department and other response personnel should be taught how, when, and when not to remove power from the train, including traction power, train-lined (head-end) power to individual cars, and battery power. Training to carry out the Occupational Safety and Health Administration (OSHA) high-tension wire and cable rules and lock-out/tag-out procedures, as well as the power isolation procedures for the specific right-of-way/wayside facility should, also be provided. The handbooks mentioned previously would be a valuable reference; actual practice in operating the cut-out switches or other means to remove power would also be useful. **THE PRUDENT APPROACH FOR ALL PERSONS IS TO ASSUME THAT THE ELECTRICAL POWER IS ALWAYS ON.** This topic is discussed further in Section 3.5.7; references 75 and 76 contain extension information regarding this subject.

4.3.5 Passenger Extrication/Evacuation

Evacuation of persons from a train, train-related facility, or surrounding area may be complicated due to the nature of the emergency, the condition of passengers, the position of the passenger car/motive power unit, the right-of-way structure, location of wayside facility, the local environment, the time of day, etc. (see Chapter 2). In addition, persons may:

- Not be rational;
- Have physical, medical, or other conditions which could be aggravated by the evacuation;
- Be trapped or immobilized by seats, other interior components, and aids that generally improve mobility (e.g., wheelchairs, walkers, crutches, prostheses);
- Not be able to physically contribute to extrication or evacuation maneuvers;
- Be unstable in walking, if they are wearing "inappropriate" footwear or are carrying babies or young children;
- Have to be immobilized before they can be removed from the passenger car, motive power unit, or right-of-way structure/wayside facility, or surrounding location; and
- Not be able to communicate or understand instructions.

Training programs in crowd control and panic prevention techniques should provide personnel with the knowledge necessary to communicate with persons in an authoritative and calm manner and convince them to follow directions.

Section 4.3.6 extensively discusses special considerations related to mobility, etc.

Training should include specific procedures for removing individuals from specific types of passenger trains and right-of-way structures/wayside facilities. Passenger train system operating organization and emergency response personnel should be trained in the proper operation of doors, window emergency exits, and other evacuation-related equipment. As a minimum, the knowledge of the location and proper use of each piece of equipment and hands-on practice in their proper use should be provided. The value of this training would be enhanced by joint participation of personnel from both groups.

4.3.6 Mobility and Other Special Considerations

To the extent possible, persons with disabilities should not be isolated from general passengers during an emergency. With proper procedures, training and equipment, it should be feasible to provide an equivalent level of safety to all persons, although it is not possible to provide a complete guarantee to any or all individuals.

Families with young children and persons who are elderly or disabled may require greater care and assistance at an emergency scene. In addition, many individuals have impairments which are not obvious, while others who may have disabilities which appear to hinder them in an emergency are, in fact, quite capable of carrying out actions. It is essential not to make assumptions as to what assistance any one individual does or does not need. Personnel should ask what assistance is needed. Moreover, for persons to provide appropriate information, they must understand the nature of the task to be performed, e.g., walk, climb, etc. If persons cannot see, hear or comprehend emergency instructions or information, alternative effective means of communication must be developed and used. It is also important for personnel to understand that individuals with a functional impairment, such as blindness, do not need to be spoken to in a louder than normal voice.

To respond more effectively, passenger train operating organization and emergency response personnel should be familiar with the following:

- Characteristics of children, and elderly and disabled individuals, i.e., mobility, communications, and medical/physical/other impairments (see Section 2.5 and References 73 and 74);
- Methods of communicating with persons who have visual, hearing, speech, or other impairments (see Appendix C and References 73 and 74),
- Characteristics of prosthetic, orthopedic, and sensory aids;

- Proper methods for lifting, carrying, and moving persons who use wheelchairs, braces, prostheses, and other personal assistive devices (see References 73 and 74),
- Instructions for dealing with guide or helper dogs that may adopt a very protective attitude especially if the person is injured and/or unconscious; and
- Policies and procedures regarding evacuation of persons with disabilities, e.g., wheelchair users.

When wheelchairs are at an emergency scene, they are generally regarded as obstacles. The decision to evacuate an individual with or without a wheelchair is generally best handled case-by-case by appropriate passenger train system operating organization and emergency response personnel, depending on the type of wheelchair and environmental conditions. Wheelchair use on the typical right-of-way is not recommended. Passengers with spinal injuries may have to be lifted from wheelchairs in a specific manner to avoid putting pressure on their spines; being lifted the wrong way may be fatal. Although quick evacuation of a wheelchair user during an emergency usually requires that the person be carried bodily from the vehicle, wheelchairs can actually be excellent evacuation devices under certain conditions. By pulling a wheelchair back onto its two large wheels, one individual can lift even a heavy person over objects such as curbs.

Drills/exercises can be useful in providing hands-on experience with wheelchairs and their users.

4.4 RETRAINING/REFRESHER TRAINING PROGRAMS

Operational documentation relating to emergency preparedness is less expensive, easier to improve, and more likely to change than equipment. Therefore, training sessions to implement operational documentation changes should be held more frequently to keep personnel abreast of such revisions. On the other hand, improvements in equipment associated with emergency preparedness tend to be more expensive and less frequent than operational changes.

Thus, after the initial round of personnel training, further review training in the use of equipment should be held periodically.

The objectives of retraining/refresher training programs are:

- To inform passenger train operating organization and emergency response personnel of changes in procedures and equipment;
- To ensure that the skills of operating organization and emergency response personnel remain at a level that enables them to execute their responsibilities effectively;
- To reinforce a segment of the program for an individual who has not performed properly; and
- To recertify operating organization and emergency response personnel in job positions.

Employee skills, equipment and procedural changes, and drills/exercises should be reviewed on a regular basis to determine the need for refresher training. Personnel should be made to understand the importance of training repetition.

4.5 TRAINING METHODS AND EQUIPMENT

Passenger train system operators should have formal methods for training train crews, on-board service employees, other operating system personnel, and emergency response personnel. These formal methods should include, but not be limited to, classroom instruction, on-site familiarization, and emergency drills/exercises. References 26, 27, and 81 are examples of training program curricula.

Regular training and review should be used to identify inconsistencies in operating rules, SOPs, and personnel duties. Elimination of such inconsistencies will help prevent potential confusion during an actual emergency.

4.5.1 Classroom Instruction

The key elements of classroom instruction are presentation of the contents of written material (e.g., rule books, SOPs, guidelines, and emergency protocols and procedures), discussion of the material, and examinations to test comprehension of the participants. Classroom instruction can be substantially enhanced through audio-visual training programs and use of equipment mock-ups.

4.5.1.1 Rule Books, SOPs, Guidelines, and Emergency Procedures - Training materials should be thoroughly discussed, and examinations should be administered to appropriate passenger train system operating and maintenance personnel and emergency response personnel. Training materials should stress the importance of teamwork and inter-organizational coordination and communication. The types of specific evacuation procedures to be followed by the train crew and responding units should also be described.

4.5.1.2 Train Manual/Handbook - A manual/handbook, preferably prepared by the manufacturer, describing the proper operation of train emergency equipment (e.g., manual operation of doors, operation of emergency window exits, and power cut-off switches) is an extremely valuable tool for training and reference purposes. Amtrak has prepared a booklet for public agencies containing such information for its trains [25] that is also used for training Amtrak employees.

4.5.1.3 Audio-Visual Training Programs - Films, videotapes, and/or slide presentations should be used to illustrate the emergency response and evacuation procedures to be used by passenger train crews and on-board service employees, passengers, Train Dispatchers/Control Center staff, yard supervisors, and emergency response personnel. These tools should also be used for ongoing refresher training courses. Many training materials have been adapted for use on a mini-computer for individualized instruction. Amtrak has developed videotapes which describe emergency procedures

for passenger train system operating personnel [28] and emergency responders [29]. Other videotapes have been produced by the PATH and the Toronto GO Transit commuter train system operators [81] and 82] to provide employee familiarization with equipment and to serve as records of emergency simulations.

4.5.1.4 Mock-ups - When available, small scale mock-ups of particular types of equipment, such as operating cabs, radios, and power shut-off controls, should be used.

4.5.2 Demonstrations/Practice Sessions

Actual hands-on practice sessions to raise the skill level and decrease response time during actual emergencies should follow information presented in demonstrations by the instructor, videotape, or films of equipment and procedures.

4.5.3 Field Training

Following classroom instruction and demonstration/practice sessions, supervised on-the-job training should be given that provides the trainee with hands-on experience and an operational understanding of rules, procedures, trains, and right-of-way structures/wayside facilities as they relate to emergency response.

4.5.4 Small-Scale Simulations

As an adjunct to classroom training, small-scale simulations can be used for training small groups for selected activities such as emergency evacuation.

4.6 EMERGENCY DRILLS/EXERCISES

One of the most effective training techniques is simulation of specific emergencies. Simulations may vary from a drill only for passenger train system operating organization personnel to a full-scale emergency exercise that also includes operating organization and emergency response personnel. Emergency

simulations are particularly important as training tools because the joint involvement of emergency response organizations, such as police and fire departments, provide valuable practice to personnel who do not otherwise have access to specialized training in passenger train equipment and operations.

Realistic drills/exercises can be particularly helpful for ensuring that emergency plans, procedures, and equipment address the particular needs of various types of passengers. The drill/exercise enables the passenger train operating organization and emergency response personnel to use procedures, to practice techniques, and to test their effectiveness. Whenever possible, joint involvement of emergency organizations, such as EMS, police and fire departments, and hospitals, should be encouraged.

Drills/exercises may be held during revenue service or non-revenue service periods (if they exist) or prior to the start-up phase of operations. Participation by various personnel will vary depending on the scope and objectives of the drill/exercise.

Drills/exercises can serve as a means for evaluating the overall emergency response capabilities through careful selection of the time and location of the simulation; participation by personnel from the passenger train system operating organization and emergency response organizations and "volunteer passengers"; and the performance of a critique/debriefing to identify areas for improvement.

To be most effective, drills/exercises should:

- Reinforce classroom training in emergency response and passenger evacuation for the passenger train system operating organization personnel and for the emergency response units;
- Include programs which teach personnel to identify the emergency and distinguish its unique demands, and to follow through with the appropriate responses;

- Be planned to minimize hazards which could create an actual emergency or cause injuries;
- Provide a mechanism for simultaneous testing and reinforcement of emergency operating procedures for specific types of emergencies, evacuation procedures, etc.;
- Test the communication capabilities of the passenger train system operating organization and emergency response organization, as well as the operability and effectiveness of other emergency equipment; and
- Test training and retraining procedures, response capability, and any changes in these areas.

4.6.1 Tabletop Exercises

The tabletop exercise is the simplest to stage as it involves only a meeting room and knowledgeable managers from the passenger train system operating organization and the appropriate responding organizations. For an imaginary emergency, the actions to be taken by the appropriate personnel are described; the time, equipment, and personnel necessary are estimated; and potential problems are predicted. Conflicts of functional areas, lack of equipment, procedural weaknesses or omissions, communication difficulties, and confusing terminology are among the problems which can be identified.

4.6.2 Drills

Passenger train system operating organizations can drill their train crews, other on-board employees, supervisors, and dispatchers on emergency operating procedures by posing a hypothetical emergency for employees to resolve without dispatching emergency response personnel to the scene. A drill could also involve personnel of a particular response organization, e.g., fire department. The same type of problems as indicated for the tabletop exercise can be identified, and the actual response capabilities of personnel in terms of their knowledge of procedures and equipment can be evaluated.

4.6.3 Full-Scale Exercises

A full-scale exercise is the total application of the resources of the passenger train system operator and the participating emergency response organizations to a simulated emergency. Such an exercise can reveal the degree of familiarity of both the passenger train system and emergency response organization personnel with train operations, the physical layout of trains, right-of-way structures and wayside facilities, emergency exits, and emergency equipment. Thus, shortcomings in the emergency plan and specific response protocols and procedures, as well as equipment can be identified and corrected. Appendix D outlines the overall process which can be used in planning a full-scale exercise.

4.6.4 Frequency of Emergency Drills/Exercises

Emergency drills/exercises should be conducted at regular intervals of at least once every year. This frequency will help ensure that all new passenger train system operating organization and emergency response personnel are familiar with the characteristics of various trains and right-of-way structures/wayside facilities, passengers, and emergency equipment. Annual drills/exercises will also provide refresher training to appropriate personnel at sufficient intervals, and will permit testing of new techniques, procedures, and equipment.

4.6.5 Drill/Exercise Participants

Although many drills/exercises primarily involve passenger train operating organization personnel, participation by various emergency response organization personnel and "volunteer passengers" would add realism and provide valuable coordinated training. This type of joint training for both passenger train system operating organization and emergency response personnel is particularly important for systems that operate in suburban and rural areas because of the longer response distances involved.

Potential passenger train system operating organization participants (to include contractor employees and others as appropriate for each individual system) include:

- Board members (for informational purposes),
- Operations and other appropriate management and supervisory staff,
- Train crew and on-board service employees,
- Train Dispatchers/Control Center personnel,
- Line supervisors,
- Maintenance mechanics, and
- Other appropriate personnel.

Potential emergency response organization participants are:

- Federal Emergency Management Agency (FEMA) staff,
- Municipal/county/state/regional disaster/emergency management planning agency staff,
- Management staff (e.g., managers, directors, chief, and assistant chief),
- Dispatchers (fire department, EMS, etc.),
- Fire Department/EMS personnel (e.g., firefighters and mid-staff personnel such as lieutenants, captains, and battalion chief),
- Fire department members,
- Ambulance service and hospital personnel,
- Police (Local, County, State, Sheriff, Highway Patrol),
- Utility personnel (e.g., electric, water, gas, and telephone), and
- Other relevant personnel.

To add realism to the emergency drill/exercise and to help evaluate the effectiveness of specific procedures and equipment, the following persons could participate as "volunteer passengers":

- Passenger train system operating organization employees and
- High school and college drama students/clubs.

4.6.6 Evacuation Equipment Evaluation

Drills/exercises are the best non-emergency means of determining the effectiveness of evacuation equipment and the different types that may be needed in different situations. They also give personnel the opportunity to use evacuation equipment provided that such use is not too expensive for non-emergencies. Even simulated use would provide good practice for passenger train system operating organization and emergency response personnel.

4.6.7 Evaluators

A formal evaluation process should be used to maximize the value of the drill/exercise. To increase the effectiveness of the evaluation, personnel from the passenger train system operating organization and from the emergency response organizations and outside observers should be designated as evaluators to provide different perspectives on how well the emergency plan and procedures were carried out. Evaluators should be given copies of the emergency plan(s) of the passenger train system operator and emergency response organizations to review before the drill/exercise is conducted. A preliminary meeting should be held to familiarize the evaluators with the exercise and to assign functional areas of concern for evaluation (i.e., communications, evacuation time, etc.). The evaluators should receive critique sheets which should be collected and used in the critique/debriefing (see examples in Appendix E).

Evaluators can also use video cameras to record the sequence of events, actions of personnel, use of equipment, etc. Videotaping the drill/exercise provides observers with an overview of the entire operation.

The locations for the evaluators selected should allow evaluators to view the following events:

- The initial phase of communications between the passenger train crew and Train Dispatcher/Control Center and between the Train Dispatcher/Control Center and the emergency response organization dispatcher,
- The implementation of evacuation procedures, if necessary, by the train crew, other passenger train system operating employees, and responding units,
- Use of communication procedures and equipment,
- Use of evacuation equipment,
- The actual evacuation process,
- EMS technicians treatment of victims in the triage area,
- Emergency command post operations,
- Firefighters' efforts, and
- Other responding unit(s) efforts.

4.6.8 Critique/Debriefing

The purpose of a critique/debriefing is to review the reports of the evaluators, to present comments or observations from other persons, and to assess the need for any remedial action, either to correct deficiencies or to generally improve the effectiveness of the emergency operations and procedures.

Persons responsible for conducting the critique/debriefing should be trained to ask questions that will test procedures, assess training, and evaluate equipment. After a drill/exercise, these persons should debrief all participants (including simulated victims) who can offer valuable insights and thus help operating organizations and emergency response organizations to revise their procedures. The following examples are a few of the many questions (see also Sections 3.5.11 and 3.7) which can and should be asked:

- How long did it take for the first emergency response unit to arrive at the emergency scene?
- Did the passenger train operator personnel and emergency response personnel use appropriate methods to lift, carry, or move passengers?
- Were instructions audible and clear?
- Did individuals get the appropriate help needed to evacuate the train or right-of-way structure/wayside facility?
- How long did it take to completely evacuate the train or right-of-way structure/wayside facility and/or extinguish a fire (real or simulated)?

4.7 EMERGENCY CRITIQUE/DEBRIEFING

Answers to the questions noted in the drill/exercise discussion should also be used to evaluate the reaction to an actual emergency by the passenger train system operating organization personnel and emergency response personnel. Weaknesses in emergency procedures and equipment and areas for improving training should be identified. All persons involved should be debriefed.

Group and/or individual psychological counseling should be available to personnel, passengers, and other involved persons after the emergency has been resolved. This critical incident stress (CIS) debriefing may help persons to cope with any resulting emotional trauma. Additional guidance transferable to passenger train systems is contained in a recent article discussing airline post-accident trauma [77].

4.8 PUBLIC EDUCATION

Passenger awareness of emergency procedures deserves special consideration. Behavioral response, as anticipated by the designers of emergency procedures and equipment, is crucial. However, due to the large numbers of passengers carried, the general public cannot be trained in a classroom environment. Other methods of information are needed.

Passenger train system operators should employ the following methods to improve the ability of the public to react to emergencies:

- Safety and other procedures for passengers publicized on posters inside trains and stations;
- Safety brochures, brochures, schedule inserts, etc. for public distribution; and
- Selected public involvement in drills/exercises.

4.8.1 Passenger Awareness

Programs should be conducted to make passengers aware of emergency procedures and to enable them to respond properly during an emergency. All passenger awareness efforts must emphasize that passengers must follow the directions of the train crew during an emergency.

If passengers are on a disabled train but are not injured or face no imminent danger, they could safely await the arrival of trained personnel with appropriate evacuation equipment. However, in a serious emergency involving smoke or fire, passengers may have to evacuate the train before emergency response personnel arrive. Thus, passenger train system operators should take steps to increase passenger awareness about the train system and basic evacuation procedures and equipment. Since passengers could inadvertently jeopardize their safety, it is appropriate for them to take the initiative only if the train crew or on-board service employees are incapacitated.

Passenger train system operators should educate passengers about their role in cooperating in emergencies by distributing pamphlets, posting information in stations and inside trains, the review of procedures by the train crew by public address announcements. All brochures or on-board train signs must emphasize that passengers must follow the directions of the train crew during an emergency.

The information in these various sources must be consistent in content and sufficient for first-time users of the system (especially from posters), but not so overwhelming as to arouse undue concern. All information should be printed in English, but systems serving large non-English speaking communities should consider printing information in other relevant languages as well. Materials for persons who are visually-impaired should be printed in large type format and in braille. Finally, for persons with other types of disabilities, appropriate passenger awareness materials should provide information about evacuation policies and procedures and other emergency actions.

Passenger awareness education should include information that may permit passengers to do the following:

- Recognize and immediately report potential emergencies to the train crew and other operating organization personnel;
- Recognize hazards;
- Recognize and know how and when to operate appropriate emergency-related features and equipment, such as:
 - Fire extinguishers,
 - Train side and end doors,
 - Emergency exits such as windows, and
 - Devices for assisting evacuation of young, elderly, and disabled passengers; and
- Recognize the potential special needs of fellow passengers (children, elderly and disabled persons, etc.) during emergencies.

Participation of "volunteer passengers" who have mobility impairments in emergency drills/exercises would help to determine the types of assistance necessary to address their special needs.

Various media could also be notified of drills/exercises. Drills/exercises can provide an opportunity to establish a productive relationship with the media and an opportunity to establish and evaluate a system to deal with information while allowing rescuers to carry out essential activities.

Appendix F contains examples of public education material related to emergency exits. General passenger safety and emergency-related awareness programs could also be publicized through the various media, i.e., radio, television, and newspapers.

4.8.2 School Safety Programs

Passenger train system operators should conduct regular safety programs in the schools of the communities through which the system operates. Such programs should be designed to educate children and teenagers about safety hazards (such as catenary or third-rail power) on system property, as well as the dangers of crossing or walking on or along the right-of-way tracks, climbing on wayside structures, playing with equipment, throwing rocks, tampering with switches, and placing objects on the tracks (or guideway). Such programs are especially important for passenger train system operators in the process of developing a new system or extension, and before initiating operations.

4.8.3 Operation Lifesaver

Operation Lifesaver is a public/private program which provides educational materials intended to reduce the number and severity of casualties related to grade crossings.

4.9 INFORMATION SHARING

Passenger train system operators and emergency response organizations should consider sending some of their employees to training programs and drills/exercises held by other passenger train operating systems. Although this approach may be limited because of the site-specific nature of local operations, equipment, and local inter-organizational protocols, sharing ideas and perspectives regarding emergency response capabilities would be in the interest of all participating parties and could provide valuable insights on how to improve procedures and equipment.

5. TRAINS

The passenger train is a unique environment as it is a dynamic, yet confined "envelope," with movement and outside access/egress controlled by the train crew, and/or by the Train Dispatcher/Control Center, depending on the degree of automation. Moreover, the passenger car represents both a potential safety hazard (e.g., a fire in the interior) and an area of refuge from such a hazard (i.e., passengers can move to other unaffected cars of the train).

To reduce hazards in an emergency, the train crew, other passenger train operating organization personnel, and emergency response personnel must all respond effectively. Persons who are called upon to respond must have the proper knowledge and tools to gain access into passenger train equipment and to assist evacuation, if it is determined necessary. (As noted in Chapter 1, the term "passenger train system operator" refers to the passenger car and motive power unit owner, train system operator, right-of-way structure/wayside facility owner, railroad carrier, subcontractor organization, and any other entity, any or all of which may be responsible for the actual operation and movement of intercity or commuter trains. All such entities should be familiar with passenger train equipment used.) Accordingly, train design should minimize the effects of an emergency on passengers, shorten emergency response time, and improve the effectiveness of passenger evacuation. The passenger train system operator emergency plan, protocols, procedures, and training should reference train equipment which is actually in use.

The performance-oriented guidelines contained in this chapter are intended to reflect the best practices of the passenger train industry and provide a reasonable basis for planning improvements when rehabilitating existing or procuring new passenger train equipment. In each instance, the guidelines are generic, allowing for site-specific differences between systems.

Accordingly, recommendations may not be appropriate for particular passenger train system routes or operation.

The guidelines have been developed from discussions with intercity and commuter passenger system personnel and from review of available literature sources, including industry design guidelines, codes, and standards.

These guidelines are not intended to supersede or conflict with the legal requirements of existing federal regulations and local regulations or codes in effect at the date of train procurement. Passenger train system operators are in no way precluded from requiring more stringent requirements relating to emergency preparedness.

5.1 PASSENGER CARS

The types of passenger cars used for intercity and commuter train operations are described in Section 2.2.

5.1.1 Construction/Interior Arrangement

Sufficient structural integrity and resistance to deformation are necessary to minimize injury to the train crew, on-board service employees, and passengers, and to prevent them from being trapped inside the passenger car during a collision or derailment. Moreover, an intact structure should be maintained from which passengers can evacuate. The FRA is conducting a research program to determine how to address passenger car structural requirements for high-speed steel-wheel-on-steel-rail and maglev systems which operate on dedicated right-of-way. The first phase of this work effort is described in Reference 20.

Although passenger trains are designed to withstand high "G" loadings, certain accident scenarios could exceed these limits. Passenger train impact with another train, an obstruction on the right-of-way structure or with a wayside facility, may cause seats

to rotate, or food service equipment and entertainment equipment to break away from their mountings. Secondary impacts with these objects and unsecured or inadequately restrained luggage may cause passenger and crew injuries, and block interior aisles and exit paths.

The NTSB has expressed its concerns concerning seat attachments and locks, luggage restraints, and interior equipment mounting and retention in various accident investigation reports. Several recent Amtrak recent specifications [30, 34, 35, and 36] contain provisions which address the NTSB concerns.

The FRA has addressed passenger train fire safety by issuing guidelines for flammability and smoke emission performance criteria which apply to interior materials [2]. The intent of these guidelines is to prevent fire ignition and to increase the evacuation time available if a fire does occur. Amtrak has issued a specification [31] for interior materials which is consistent with the FRA guidelines. In addition, the Amtrak specification requires that several other factors (e.g., quantity of material present, configuration, and proximity to other combustibles) be considered in combination with the material test data to develop a fire-hazard assessment which will be used to select materials on the basis of function, safety, and cost. Moreover, the Amtrak specification requires testing of an assembly to provide information about the actual behavior of materials in a "real world" vehicle fire.

An Amtrak specification [32] contains fire safety-related requirements for wire and cable.

Another Amtrak specification provides requirements for smoke alarms [32]. NFPA 130, Standard for Fixed Guideway Transit Systems [58], contains flammability and smoke emission criteria for interior materials; in addition, NFPA 130 includes requirements for structural fire resistivity, electrical fire safety, wiring, and overload protection.

The FRA is sponsoring a study by the National Institute of Standards and Technology (NIST) to investigate passenger train fire safety in terms of U.S. and foreign approaches [61]. Initial findings by NIST indicate that the specified individual test requirements for interior materials provide an indication of relative fire performance which is equivalent in most cases. However, advances in fire mathematical modeling and fire hazard analysis could now permit the use of test methods based on heat release rate (HRR) to better predict the real-scale burning behavior of materials and assemblies. Further work by NIST to apply the new approaches to U.S. passenger train fire safety is currently under consideration by the FRA.

The Americans with Disabilities Act (ADA) [40] requires that intercity and commuter train equipment provide designated areas for securing wheelchairs and other mobility aids. In some cases, existing interior seat arrangement may restrict passengers using wheelchairs or personal assistive devices from reaching emergency exits, depending on exit location. The issue of wheelchair and other mobility aid securement is the subject of continuing research sponsored by the Federal Transit Administration. One type of prototype securement system has been crash sled tested under load with a dummy strapped to the mobility aid at 48 km/h (30 mph) velocity and 10 G deceleration and without the dummy at 48 km/h at 20 G. More extensive information is contained in Reference 83. Technology transfer and information sharing relating to this research would assist intercity and commuter passenger train system operators in meeting the ADA requirements and providing users of wheelchairs and other passengers with adequate protection from unsecured mobility aids in a collision.

Recommendations are:

- The system safety concept should be applied early in the new passenger car design phase to identify and resolve all prospective safety hazards associated with emergency response capability.

- As a minimum, the design of seat attachments and seat locking devices, luggage racks, and food service, entertainment, and other interior equipment should address the concerns indicated by the NTSB and meet the requirements described in Amtrak specifications. These items should also be secured in a way which prevents the loss of their contents in an accident situation.
- Interior fixtures should be attached to the car in a manner which allows them to withstand lateral and vertical loads three times the weight of the fixture and longitudinal loads six times the weight of the fixture.
- Storage areas, e.g., overhead racks, space under seats, and baggage compartments, should be provided which minimize movement of luggage. Overhead racks and underseat areas should have dividers or other restraining means to limit longitudinal and lateral movement of stowed luggage. Baggage compartments and other storage areas should have partitions which limit the longitudinal movement of stowed luggage.
- The design of the car interior, particularly seat backs, should minimize the exposure of passengers to tripping hazards, hard metal edges, and sharp corners.
- The seating arrangement within cars should be designed to provide direct, short distance, unhindered access by mobility-impaired persons to an emergency exit.
- Technology transfer and information sharing of transit system mobility aid securement research should be utilized by passenger train system operators in meeting ADA requirements and providing users of wheelchairs and other passengers with adequate protection from unsecured mobility aids.
- Storage provisions should be provided so that, when not in use, passenger wheelchairs (and footrests), wheelchair securement devices, and personal assistive devices do not protrude or present other hazards.
- The existing FRA guidelines and Amtrak specifications for flammability and smoke emission performance criteria relating to interior materials should be used for new passenger car design and construction, pending the completion of the continuing NIST fire safety work effort.
- Other provisions in the FRA guidelines and Amtrak specifications relating to fire endurance testing, smoke alarms, wiring, etc. provide additional direction.

- Portions of requirements cited in Chapter 5 of NFPA 130 for structural fire resistivity, electrical fire safety, wiring, overload protection, etc., provide a means to enhance passenger car fire safety.

5.1.2 Lighting

Emergency lighting is a crucial factor which contributes to the level of visibility needed during emergencies. Passengers will benefit from having as much visibility as possible to see where they are going when they try to reach an exit. Lighting also has a psychological, calming effect. If the normal lighting or emergency lighting fails, passengers may believe that conditions are worse than they really are. Inadequate lighting may also make it difficult or impossible to read emergency information posted in the car, to locate doors and emergency exits, or to move about within the interior. In darkness, persons, especially those with impaired vision, could stumble or fall while trying to reach an exit or while exiting from or entering the train.

Normal interior lighting, if not lost during an emergency, can permit individuals to see more clearly and thus proceed more quickly when exiting the car. Amtrak [35] requires a minimum of an average light intensity of ten foot-candles at the floor level, and five foot-candles at the center tread of each step for stairways, in vestibules and along the length of passageways and aisleways. In addition, the provisions of the ADA require that all doorways have, when the door is open, at least two foot-candles of illumination measured on the door threshold, under all normal and emergency conditions; doorways of cars not operating at lighted station platforms shall have outside lights which, when the door is open, provide at least one foot-candle of illumination for a distance of three feet perpendicular to all points on the bottom step edge.

Amtrak specifies that passenger car emergency lighting intensity in vestibules, stairways, passageways, aisles, toilet rooms, and food service areas will equal or exceed five foot-candles measured at

the floor under all conditions. Amtrak also requires that strip lighting shall be provided either on the floor or within one (1) foot of the floor and shall provide direction to the nearest exit and that light shall operate during all lighting modes.

Exterior car marker lights are required by 49 CFR, Part 221.

Recommendations are:

- Minimum normal car lighting intensities should meet the requirements cited in Amtrak specifications.
- Emergency lighting should be activated automatically if the normal lighting power source fails.
- Emergency lighting intensity should meet the requirements cited in Amtrak specifications.
- Car floor and strip lighting at other locations should be installed which provides directions towards the nearest exit, according to the requirements cited in Amtrak specifications.
- Lighting fixtures which are connected to the emergency power system should be provided at all car doors and emergency window exit locations.
- Emergency lighting fixtures, circuits, etc., should be protected to ensure that the emergency lighting will perform when needed.
- Lighting circuits within the normal power system are considered to be emergency lighting if a designated number of fixtures are connected to a separate, independent emergency power source.
- Consideration should be given to providing lighting fixtures at all doors with power sources (e.g., solar) independent of the normal and emergency power circuits and supplies to provide emergency lighting capability in the event of loss of head-end or battery power.
- As a minimum, power should be available for the normal lighting and emergency lighting systems for a time period of 30 minutes.
- As a minimum, passenger trains which travel long distances during hours of darkness should have power available for emergency lighting for a time period of one hour.

- Lighting fixtures located in the train operator cab should be connected to the emergency power system.

5.1.3 Access/Egress

The normal location and manner for persons to enter and exit a passenger car is at a station platform through doors on the side of the train. When a disabled train cannot be moved to the nearest station, however, alternate methods of evacuating individuals must be used. Emergency access to and egress from a passenger car may be achieved through outside doors, end doors, and windows. For example, in some emergencies (such as fire confined to a single car), persons may be moved through the end door(s) to safety in an adjacent unaffected car. Other emergency situations require transfer of passengers from a disabled train. As mentioned previously, persons should only be evacuated when the train is not in a station, as a last resort.

Not all passenger cars have side doors on both ends, and/or end doors; outside doors cannot usually be opened by passengers. If a power loss occurs, personnel may be unable to open both of the car side doors from the normal control station (in the car or control cab). If side-door emergency controls permit opening of only one bi-part sliding door, it could be very difficult to move certain individuals through the side doorway. Furthermore, if the doors cannot be opened immediately from either the inside or the outside, persons may panic and could be injured as others scramble to leave the car.

Regardless of the number and location of doors that are operable, mobility-impaired individuals may be unable to evacuate the car through the windows or may risk injury if they try to do so. Lack of clear identification or lighting could make it difficult for any passenger to find the doors or other emergency exits. Because of confusion or anxiety, individuals may not understand operating instructions. Persons with impaired mobility or other physical or medical conditions may have extreme difficulty climbing down from

the train at the end doors, moving from the side doors to the benchwalls (walkways), or down to track level, if the train is not located at a high-platform station.

49 CFR, Part 223.15 (c) requires that each passenger car be equipped with at least four emergency windows, in addition to normal entry doors.

49 CFR, Parts 231.13 and 231.14 contain requirements for side and end handrails, handrails, and side steps. The ADA requires that where provided, interior handrails and stanchions shall be sufficient to permit safe boarding by persons with disabilities; such handrails and stanchions would also assist these persons and the general public to evacuate the car in an emergency.

Recommendations are:

- Contrasting colors and luminous paint or materials should be used for floor and wall areas to identify the area around exit doors.
- For electrically-powered doors:
 - Auditory and visual warning signals on the car should be provided to alert passengers to closing doors.
 - Pressure sensitive or electrical obstruction detection (or push back) should be provided for each train door to automatically recycle the door to the full open position for a fixed time delay.
 - The propulsion control should be interlocked with outside door operation so that the train cannot be allowed to move until all car doors are fully closed and locked.
 - An interlocking door control should be located in each car vestibule and train operator control cab to permit opening and closing of all outside doors and to indicate open exterior doors on either side of the train.
- For non-electrically powered doors, a "door open" indicator for each exterior door should be provided next to each door and in a designated car vestibule location to indicate the status of all doors of the individual car.

- Each normal side and end car door should be capable of manual operation (requiring no electrical power) by both interior and exterior controls. Provisions should be made for discouraging unnecessary operation of these controls.
- Each sleeping compartment door should be capable of being unlocked from the outside by the train crew, on-board service employee, or other "authorized person."
- If cars have more than one level, emergency exits should be located on each level.
- Each individual room located in sleeping cars should be equipped with an emergency window.
- Windows should be removable from either the inside or outside of the car. Provisions should be made for discouraging unnecessary opening of the windows.
- Each passenger car opening, door, or window which can be used as an emergency exit should be clearly marked by an emergency exit sign on both the inside and outside of the car. Each emergency exit should have instructions for its use clearly posted on or next to the exit.
- Locking of the end doors between cars is to be discouraged unless an interior emergency door release is provided.
- Current collector assemblies (if used) should not be located directly under side doors designated for emergency exit use.
- Provisions for passenger car egress and response personnel access should be consistent with the evacuation strategy formulated jointly by the passenger train system operator and local emergency response organizations. All aspects of the local operating environment should be considered.
- Specific means to be used to evacuate mobility-impaired passengers should be coordinated with the passenger egress provisions described above.

5.1.4 Communications

Five methods of voice communication, other than personal face-to-face contact, may be available on passenger trains: permanent locomotive/control cab or portable radios, intercoms, cellular telephones, and public address systems. The train intercom and radios are used by the train crew to communicate with the Train Dispatcher/Control Center and among themselves; some

trains and crew have cellular telephones. Special intercoms, where provided, allow passengers to talk to the train crew in an emergency. Public address systems enable the train crew to provide announcements and provide instructions to passengers, either in one car or throughout the train.

49 CFR, Part 220.37 requires that each radio used in railroad operations outside yard limits shall be voice tested at least once during a tour of duty by the train conductor and engineer to verify that the engine radio is operating properly.

Recommendations are:

- Cars should be equipped with an intercom system which allows persons to communicate with the train crew, onboard service employees (attendants) and/or, as appropriate, the Train Dispatcher/Control Center (if operations are automated).
- Each passenger car should be equipped with a public address system permitting the train crew or other operating organization personnel to make announcements which are intelligible to passengers.
- The public address and intercom systems should be capable of independently continuing to operate for at least 30 minutes in case of normal power failure (in the absence of major structural damage).

5.1.5 Ventilation

A critical element of emergency preparedness is the ability to provide fresh air in the passenger car interior, or to prevent smoke from entering the interior, prior to or during emergencies. Otherwise, visibility may diminish, making it difficult for individuals to find exits. Smoke or an inadequate oxygen supply may also aggravate respiratory conditions. Breathing may become difficult and stamina may decrease, thus diminishing ability to withstand the rigors of evacuation.

The location, capacity, and ability to control fresh air intakes, fans, and dampers, etc., play a key role in maintaining sufficient breathing and visibility levels.

The Amtrak smoke alarm specification [33] requires a system with smoke detection sensors which, when annunciated, will shut down air dampers and blower fans in the car ventilation system.

Recommendations are:

- A means to manually control or shut off the outside and inside air intake dampers, fans, and other air circulation equipment should be provided in each end of all passenger cars.
- A means to control or shut off the outside and inside air intake dampers, fans, and other air circulation equipment should be provided in sleeping compartment rooms.
- Amtrak's smoke alarm concept to shut down air dampers and blower fans should be considered by other passenger train system operators for new car design and construction. For sleeping cars (where each unit has an individual fan), a system should be designed such that only the fan in a fire-involved unit would be shut down. This would help the rest of the car remain more smoke free.

5.1.6 On-Board Support Equipment

Passenger cars are equipped with various types of on-board support equipment, depending on the local operational environment.

Recommendations are:

- Fire extinguishers, first aid kits, and emergency tools should be provided at accessible and visible locations in each car.
- If carried on-board cars, evacuation equipment for use during emergencies should be accessible and its location on cars should be clearly indicated by signs.

5.1.7 Special Mechanical Equipment

The passenger car should be equipped with certain types of mechanical equipment, such as controls for emergency brakes, motive power and battery power isolation, and car uncoupling.

5.1.7.1 Emergency Brakes - 49 CFR, Part 229.47 (b) requires that MU and control cab locomotives operated in road service shall be equipped with an emergency brake valve that is accessible to another crew member in the passenger compartment or vestibule. 49 CFR, Parts 231.13 and 231.14 require that passenger cars be equipped with hand brakes; these brakes provide a back-up to air brakes (which can release due to loss of air pressure if the air line is not recharged after a train is stopped for a long period). 49 CFR, Part 232.1 includes requirements for braking system availability before departure. Current U.S. practice allows the train operator to immediately override automated systems when necessary and to initiate maximum braking effort at any time, speed, and location. Current U.S. passenger train speeds are limited to 200 km/h (125 mph).

Recommendations are:

- Each passenger car and power motive unit should be equipped with a fail-safe friction brake to provide manually-activated braking.
- Emergency braking independent of the train engineer/operator should be automatically activated if any car within a train is uncoupled.
- A device to activate train emergency brakes should be located in each passenger car, with appropriate instructions in when and how to use it. A warning should also be posted that unnecessary use subjects the user to criminal penalty.
- Braking systems should be designed with devices which allows all brakes to be released if the train is stopped in a hazardous location (e.g., in a tunnel or on an elevated structure). These devices should not require the train crew to leave the interior of the train.

- For train speeds over 200 km/h (125 mph), the train should be equipped with an alternate means to initiate emergency stops safely, which minimizes injury to passenger and crew.

5.1.7.2 Power Isolation - Shutting off headend and trainline power and isolating pantograph and third rail current collector shoes from a car or the entire train may be necessary during an emergency. 49 CFR, Part 229.77 specifies requirements for pantograph arrangement and locking and grounding devices. Part 229.79 specifies that when locomotives are equipped with both third rail and overhead third rail shoes, the latter shall be de-energized at stations when current collection is exclusively from the overhead conductor. Part 229.81 requires that each locomotive equipped with a pantograph shall have an emergency pole suitable for operating the pantograph. In addition, each locomotive equipped with third rail shoes must have a device for insulating the current collecting apparatus from the third rail. References 75 and 76 contain more extensive information concerning motive power isolation.

5.1.7.3 Couplers - The majority of U.S. intercity passenger trains are assembled into variable consists based on changing service conditions. (The Turbo trains operated by Amtrak in New York State are one exception.) For example, peakloads during holiday seasons may require additional coaches, sleeping cars, and food service cars. Commuter trains also may have variable consists due to peakloading in mornings and evenings. Due to the higher number of scheduled trains, it is likely that these commuter trains usually operate with the same (higher) number of motive power units and cars for convenience of operations. MU cars are likely to be semi-permanently coupled together; they remain in fixed trainsets except for maintenance.

Motive power units and passenger cars utilize "tightlock" couplers which are designed so that cars do not separate as easily as freight car-type couplers when a derailment or collision occurs. This increases the probability that cars will remain connected and

upright in an accident, thus reducing the potential for injuries to passengers and crew. When a train is stopped, the design of these couplers allows the train crew to readily uncouple cars without the use of special tools. Certain types of foreign motive power units and passenger cars proposed for U.S. operations (e.g., X2000 and TGV) are designed to be semi-permanently coupled together.

It may be necessary to rapidly uncouple cars in an emergency, especially when the train is located on a bridge or in a tunnel. 49 CFR, Part 231 requires that coupling levers shall be applied so that they can be operated by a person standing on the ground. It is also currently possible to operate the coupling levers from on-board passenger trains. However, it is a time-consuming, difficult process for the train crew. Consideration should be given to providing a means that will more readily allow the train crew to operate the couplers from on-board the train. The issue of providing a means to rapidly separate semi-permanently coupled trainsets in an emergency should also be addressed.

5.1.8 Graphics

Graphics are the informational symbols indicating the location and operation of crucial car components, such as doors, emergency exit windows, intercoms, and emergency equipment.

Recommendations are:

- Signs should contain brief yet intelligible information.
- Multilingual and/or pictographic signs should be provided to increase the understanding of information presented.
- Standardized emergency graphics should be used.
- Reflective and luminous sign materials should be used.
- Location signs and instructions should be provided within the vehicle for intercom operation, window and door emergency exits, fire extinguishers, etc.
- Signs and instructions for emergency equipment should be illuminated by normal and emergency lighting fixtures.

- The name of the passenger train system operator and the car/vehicle identification number should be displayed inside and on the exterior of each passenger car and motive power unit.

5.2 MOTIVE POWER UNITS

49 CFR, Part 229 contains several requirements for locomotives, MU units, and control cabs which are emergency preparedness-related. For example, Part 229.47 requires that each road locomotive (except for those designed for occupancy by only one person) shall be equipped with a brake pipe valve that is accessible by a member of the crew other than the engineer, from that crew member's position in the cab. (Section 5.1.7.1 of this document notes other braking requirements.) 49 CFR, Part 229.93 specifies requirements for a fuel line safety cut-off device. Other provisions cover cab lights, pilots, headlights, sanding devices, grounding of equipment, and wheel slip/slide alarms. The AAR Manual of Standards and Practices, Section F, Locomotives and Electrical Equipment [67], contains locomotive cab requirements for seat attachments, radio mounting equipment, protective equipment design and cover, etc. The reader is referred to the complete text of the AAR Manual and 49 CFR, Part 229 for further information relating to motive power units.

5.3 TRAIN SYSTEM VEHICLES USED IN EMERGENCIES

Various types of train system vehicles may be used to respond to emergencies: electric and diesel-electric locomotives, MUs, maintenance vehicles, empty passenger trains, hi-railer vehicles, and other equipment. Hi-rail vehicles are rubber-tired trucks that are also equipped with four flanged steel wheels to allow travel on rails.

The following recommendations pertain to "emergency response vehicles" which possess unique capabilities to handle emergencies occurring within the right-of-way structure/wayside facility:

- Vehicles should be stored at locations offering ready access to the right-of-way structure/wayside facility. Access to tunnel portals, bridges and elevated structures is particularly important.
- Auxiliary vehicles should be designed so as to allow for travel over the right-of-way track or guideway structure.
- Vehicles should possess a motive power source independent of wayside traction power.
- Special auxiliary vehicles used in tunnels and underwater tubes should possess a motive power source that does not emit exhaust gases which are toxic or reduce visibility.
- Vehicles should be equipped with auxiliary power generators for lighting and other special tools.
- There should be a radio or some other communication system to provide contact between the vehicle and the Train Dispatcher/Control Center personnel.

6. RIGHT-OF-WAY STRUCTURES/WAYSIDE FACILITIES

This chapter presents guidelines for passenger train systems which are operated along routes using fixed right-of-way track or guideway structures and wayside facilities. Depending on the local environment, tunnels and elevated structures may be used. Wayside facilities include the electric power supply system (if third rail or catenary is used), the command, control, and communications system (including signals and automatic train control), Train Dispatcher/Control Center, and passenger stations.

Passenger trains operate in various physical environments. The design and construction of the right-of-way structures and wayside facilities vary between and within train systems. The conventional right-of-way may contain one or more tracks and may have separate tracks for local and express trains. Trains may operate in tunnels and underwater tubes, on elevated structures, and on the surface (at grade, on embankments, and within open cuts). Track or guideway segments may use separate "dedicated" rights-of-way or may share rights-of-way with other railroads, transit systems, roads, power lines, or pipelines. Each of these environments presents different concerns which must be addressed by the passenger train system operator to ensure the safety of individuals during emergencies, particularly with respect to evacuation. (As noted in Chapter 1, the term "passenger train system operator" refers to the passenger car and motive power unit owner, train system operator, right-of-way structure/wayside facility owner, railroad carrier, subcontractor organization, and any other entity, any or all of which may be responsible for the actual operation and movement of intercity or commuter trains. All such entities should be familiar with the local right-of-way structures and wayside structures in existence along the passenger train routes located in their own and adjacent jurisdictions.)

To reduce right-of-way structure/wayside facility hazards in an emergency, the train crew, other passenger train operating organization personnel, and emergency response personnel must all respond effectively. It is essential that persons who respond have the proper knowledge and tools to gain access to passenger train equipment from different types of right-of-way structures/wayside facilities in order to assist passenger evacuation, when it is required. Accordingly, the design of these train system elements should minimize the effects of an emergency on passengers, shorten emergency response time, and improve the effectiveness of passenger evacuation. The passenger train system emergency plan, protocols, procedures, and training program should reference the right-of-way structures and wayside facilities which are actually in use.

The performance-oriented guidelines contained in this chapter are intended to reflect the best construction practices of the passenger train industry for right-of-way structures and wayside facilities and provide a reasonable basis for planning improvements during rehabilitation programs. In each instance, the guidelines are generic, allowing for site-specific differences between systems. Accordingly, recommendations may not be appropriate for particular passenger train system routes or operations.

The guidelines have been developed from discussions with intercity and commuter passenger system personnel, and the review of available literature sources, including industry design guidelines, codes, and standards. Portions of requirements contained in the NFPA 130 Standard for Fixed Guideway Transit Systems [58] are considered transferable to passenger train system right-of-way structures and wayside facilities. Accordingly, portions of NFPA 130 are cited in several subsections of this chapter.

These guidelines are not intended to supersede or conflict with the legal requirements of existing federal regulations in effect at the date of construction of rights-of-way structures and wayside facilities. Local jurisdictions may also have building codes or other legal requirements for right-of-way structures and wayside

facilities. Passenger train system operators are in no way precluded from requiring more stringent requirements.

Section 6.1 presents guidelines for right-of-way structures and wayside facilities ("right-of-way/wayside" is often used as an abbreviation in this chapter) which are directly track or guideway related. Sections 6.2 and 6.3 contain separate guidelines for passenger stations and the Train Dispatcher/Control Center.

6.1 OPERATIONAL ENVIRONMENT

The main concern related to the passenger train operational environment is providing access to emergency response personnel and egress for passenger evacuation. The preferred method of evacuating passengers during emergencies is to move all or part of the train to the nearest station. In some cases, however, passengers may have to exit the train while it is located between stations, so that they can walk to another train, the closest station, or an emergency exit to reach a point of safety, or to a point where alternate transportation can be provided.

6.1.1 Construction

The typical railroad right-of-way track structure consists of ties, rails, and a roadbed of ballast or concrete. (Steel or concrete structure are proposed for maglev guideways.) The right-of-way may be located on an elevated structure (including bridges and overpasses, trestles, causeways, and viaducts), on the same general ground level as other vehicles (at grade), in an uncovered depression (open cut), or in an underground tunnel or an underwater tube. Rights-of-way may also be located on fill, an embankment or berm, in hilly or mountainous terrain, or over or adjacent to rivers or other bodies of water.

Right-of-way structures and wayside facilities should be designed to enable passenger evacuation and emergency response personnel access for various potential emergency scenarios.

Recommendations are:

- Right-of-Way construction should meet the requirements of Sections 3-2.1, 3-3.2, and 3-4.2 of NFPA 130.
- The system safety concept should be applied in the track (and guideway) design phase to identify and address prospective safety hazards associated with emergency response capabilities.
- Critical egress paths should be identified in the system design phase and should remain unobstructed.

Sections 6.1.3 and 6.1.5 of this document contain more specific information about and guidelines for right-of-way/wayside access and egress.

6.1.2 Lighting

Normal and emergency lighting can assist individuals in several ways. The following sections discuss lighting in terms of access/egress points and avoiding obstacles when it is necessary to evacuate the train along the right-of-way/wayside.

6.1.2.1 Underground - Adequate lighting in tunnels and underwater tubes is critical for successful passenger evacuation during emergencies. In addition, emergency response personnel depend on sufficient lighting for visibility during fire suppression and/or rescue operations.

Recommendations are:

- Emergency lighting systems should meet the requirements of Section 3-2.4.7 of NFPA 130.
- Consideration should be given to locating a designated number of lighting fixtures toward the bottom wall of tunnels or tubes (near the top of the rail or guideway surface), to provide visibility under smoke conditions.
- The minimum illumination level for emergency lighting should furnish sufficient visibility to enable passenger evacuation from an underground tunnel or underwater tube to safety.

6.1.2.2 Surface - In general, emergency lighting has not been provided along the surface portions of the right-of-way/wayside. The level of lighting varies according to the design and location of the structure or facility. The belief has been that because of daylight and the less confined environment (in contrast to the dark and constricted area within the underground right-of-way/wayside), emergency lighting is not always necessary. For example, elevated and at-grade right-of-way structures and wayside facilities benefit from natural lighting during daylight hours. However, most passenger train system operators provide service during hours of darkness, and thus problems of insufficient visibility could arise during emergencies. Adjacent street lights may not exist, or may provide insufficient illumination. For these reasons, some type of transportable emergency lighting should be considered for use along the right-of-way/wayside during emergencies.

6.1.3 Access/Egress

The preferred method of evacuating passengers when the train is unable to move to the nearest station is to transfer passengers to another train (or alternative transportation). Passengers may have to step down from the train onto the right-of-way/wayside and walk along it (possibly on a benchwall/walkway) or across it to reach a rescue train. (As noted in Chapter 3, the movement of other trains must be stopped while persons are transferring from the disabled train to the rescue train or alternative transportation in order to ensure their safety.) If a rescue train or other vehicle is not available or cannot be used (because of the type or location of the emergency) or if a station is nearby, passengers may move along the right-of-way/wayside to the nearest station. Emergency exits located along fenced right-of-way, in adjoining facility structures, or in tunnels could also be used to evacuate passengers from emergency scenes.

Mobility-impaired or visually-impaired persons may have greater difficulty than other passengers leaving the train because of the height of the floor in relation to that of the right-of-way/wayside

or benchwall/walkway. Because of mobility limitations (including unstable footwear), visual impairments, or other conditions, some persons may also find it difficult to negotiate the track, benchwall/walkway, or exit. Hazards could cause individuals to trip or could otherwise hinder them as they attempt to leave the emergency scene. Such hazards include ties, rails, ballast, cable, and debris along the track roadbed, benchwalls/walkways, and adjacent property; water leakage or flooding; and uneven or slippery walking surfaces. The components of the track structure itself, such as the ties, drains, and ballast, that lie between the rails or near the rails may cause loss of footing. There is also the danger that persons, particularly those who are disoriented or have mobility limitations, may touch downed wires or the third (power) rail, if provided. In emergencies where wayside traction power is lost or de-energized by the Train Dispatcher/Control Center, the electrical hazards of catenary wire or third rail contact are reduced. However, if power is restored manually or automatically before evacuation is completed, individuals in the vicinity could be fatally injured. Moreover, each person must watch for track switches, signaling apparatus, train control apparatus, and movement of other trains. Reduced visibility due to darkness, power loss, or heavy smoke could aggravate these hazards.

The reliability of emergency exit door operation is a concern. Exit doors may be stuck or jammed, difficult to open, or locked. Some exit doors must be pushed open from below, a task that can be difficult even for the general public, particularly with very heavy horizontal exit doors, unless they are properly counterbalanced.

Finally, the counterflow of emergency response personnel at access and egress points where passengers are exiting can create confusion and prevent personnel and equipment from reaching the emergency scene. This may create special difficulties for mobility-impaired persons who may have to wait for response personnel and specialized evacuation equipment. Specific provisions for right-of-way structure and wayside facility egress and access should incorporate the results of coordinated planning by responding parties.

local emergency response organizations should consider all aspects of the local operating environment to identify evacuation strategies which should be used for particular situations and train locations.

Specific aspects of access/egress applicable to the respective types of right-of-way/wayside are discussed in the following subsections.

6.1.3.1 Underground - Tunnels constructed using the cut and cover method are usually located just below street level in urban areas. Their relatively shallow depth facilitates provision of vent shafts and emergency exit stairways (in some cases located adjacent to each other) leading up to the surface. Because of their depth or location, deep bore tunnels and sunken caissons provide limited exit capability directly to the surface. Some tunnels, because of their location or construction, provide emergency access or ventilation only at portals. Tunnels may contain vertical shafts with stairways, ladders, or a combination of both leading to an emergency exit. Vertical exits, in general, are hazardous because they can act like chimneys if there is a fire, exposing persons to fire and smoke. Moreover, these vertical shafts would be extremely difficult for most mobility-impaired persons to ascend. For these individuals, the nearest exit may not be the appropriate pathway for egress. For example, if egress must be accomplished by ascending a ladder, it is likely that many mobility-impaired persons will either not be able to use it at all or be very slow in climbing. For this reason, underground right-of-way structures and wayside facilities should contain other types of emergency exits. Options used have included cross passages and/or fire doors leading to the opposite track area, or a separate center passageway between the adjacent track areas.

Recommendations are:

- Emergency exits should meet the requirements of Section 3-2.4 of NFPA 130 and NFPA 101.

- Each emergency exit should be identified by graphics and by a light of distinctive color, and should have dual light power circuitry.
- Emergency exit doors should not be locked on the inside at any time.
- Emergency exit doors on the surface level should not open onto a hazardous area such as a vehicle roadway or parking area, and should be kept free of natural or manmade obstructions.
- Emergency exits should have the capability of being readily opened from the outside by the fire department or other rescue personnel.
- Installation of vertical ladders in emergency exits should be prohibited.
- All doors, ladders, etc., that do not provide egress should be clearly labeled "Not an Exit."
- The needs of passengers with special egress requirements (such as those who have mobility or visual impairments) should be addressed. Exits should be evaluated for ease of evacuation by those passengers.

6.1.3.2 Elevated - Emergency exits, which are vital for underground right-of-way structures/wayside facilities are rarely provided along elevated segments. Although the height of structures presents a confined environment similar to that of an underground tunnel, an important difference exists: if passenger doors can be opened, the complete availability of open air minimizes the problem of poor ventilation found in tunnels. However, most existing elevated right-of-way structure and wayside facilities are not wide enough to evacuate persons via the train side doors; the side doors and steps will often open out onto thin air. As noted previously, the preferred methods of moving persons to safety involve moving all or part of the train to the nearest station, or moving a rescue train up to the front, rear, or alongside the disabled train to transfer passengers. It is recommended that emergency access/egress points meet the requirements of Sections 3-4.5 and 3-4.6 of NFPA 130.

Walkways/benchwalls have been used as an alternate means of reaching safety (e.g., emergency access/egress point or the next station); these are discussed in Section 6.1.4 of this document.

6.1.3.3 At Grade/Open Cut - With certain exceptions, emergency exits are not usually provided along the surface right-of-way/wayside unless it is fenced. However, it is common to provide emergency access gates which can be opened by passenger train system operating organization personnel or emergency response crews. The dangers inherent in a confined tunnel or elevated structures are not present during surface passenger evacuation. In most instances, persons are able to simply leave the train via steps or a short ladder and walk directly to safety. However, difficulties in reaching safety may exist when the right-of-way/wayside is shared with roads, highways, or other railroad tracks, or is located in a isolated area. In addition, certain sections of a surface right-of-way/wayside may be protected by retaining walls of varying heights; recent practice has been to provide emergency stairs or other types of exits to enable passengers to leave the right-of-way/wayside in these cases.

Recommendations are:

- Access/egress gates located along the right-of-way/wayside should meet the requirements of Sections 3-3.5 and 3-3.6 of NFPA 130.
- Access/egress gates should be capable of being readily opened from the inside, without keys or special tools.
- Fire department personnel should possess keys or other methods of opening the access gates from the outside.
- Gaps in the third rail (if used) and crosswalks should be provided at access gate locations.
- When the surface right-of-way is shared with highways, other railroads, or transit systems, provisions should be made for some means of exit which does not require individuals to encounter other moving traffic when evacuating a train.

6.1.4 Benchwalls/Walkways

Benchwalls (e.g., walkways) located within an underground/underwater tunnel or alongside an elevated right-of-way structure may consist of a ledge, preferably located at the floor height of the train. Some walkways consist of a flat surface located at track level. However, the narrow width of most benchwalls/walkways may limit movement of persons once they exit the train.

Benchwalls/walkways located along one side or in the center of elevated or tunnel rights-of-way provide an alternate means of moving individuals through the train side doors to safety (e.g., an emergency access/egress point or the station). Benchwalls/walkways are typically part of tunnel construction in large metropolitan areas.

The typical benchwall/walkway is 51 to 76 cm (20 to 30 in) wide and located along one wall of the right-of-way structure. Benchwalls/walkways are typically built 76 to 107 cm (30 in to 42 in) above track level; however, they may also be located at grade level. Some benchwalls/walkways have handrails; others do not. Benchwall/walkway surfaces may be slippery, uneven, or quite narrow. A benchwall/walkway may be wide enough for the general passenger, yet too narrow for persons using walkers, crutches, or wheelchairs. In tunnels and underwater tubes as well as on elevated structures, it will be difficult to negotiate benchwalls/walkways if there are no handrails, the structure curves, the benchwall/walkway is narrow, or the electrical equipment or pipes protrude, especially for persons with impaired mobility. Because most wheelchairs are too wide to negotiate the typical 51 cm (20 in) wide benchwall/walkway, the vast majority of wheelchair users would not be able to use it; these persons would have to be bodily carried or transported in an evacuation chair (described in Appendix B). Even if the benchwall/walkway were 76 cm (30 in) wide (standard wheelchair width), passage would still be precarious, particularly if the third rail is next to the benchwall/walkway.

Recommendations are:

- Where feasible, benchwalls/walkways should be installed along one side of all right-of-way structures/wayside facilities to reduce the possibility of stumbling and falling; crossover points should be provided to allow passengers, emergency response personnel, and equipment to cross from one track to another.
- Benchwalls/walkways should have even, non-skid surfaces.
- Handrails should be installed along benchwalls/ walkways wherever possible so that mobility-impaired persons can walk along the evacuation route with minimal or no assistance.
- Benchwalls/walkways and exits should be illuminated and clearly marked.
- When constructing new systems or rehabilitating existing ones, wherever feasible, benchwalls/walkways that are the same height as the train side door should be installed to eliminate the need to step down to track level.

6.1.5 Communications

Effective on-scene communications are vital during emergencies and provide the major source of information for coordinating rescue/fire suppression efforts at the emergency scene. Especially useful communication devices are direct-line emergency telephones connecting with the Train Dispatcher/Control Center, maintenance telephones, and mobile radio units.

Recommendations are:

- Communication systems should meet the requirements of Section 7-3 of NFPA 130.
- A means of voice communication should be installed at all emergency exits and at selected locations along the right-of-way/wayside, and should be conspicuously identified with graphics and lighting.

6.1.6 Ventilation

Ventilation systems are considered essential components in underground right-of-way structures and wayside facilities, as they can be used during a fire to control smoke and heat and to provide visibility and fresh air to passengers and rescue/fire suppression teams. In addition, properly operated fans and dampers can play a critical role in confining fire and smoke to a limited area. It is recommended that ventilation equipment meet the requirements of Section 3-2.2 of NFPA 130.

6.1.7 Fire Protection Equipment

Chapter 3 of NFPA 130 contains fire protection provisions which could be applied to passenger train right-of-way structures and wayside facilities. Local building codes will probably also apply.

6.1.8 Infringement/Obstacle Alarm

Trains are often operated along a shared corridor. The right-of-way structure may be located adjacent to highways or to freight or other passenger railroads, or rail transit systems, or in highway medians. Motor vehicle accidents or train derailments may thus infringe upon the track or guideway area and present serious hazards to train crews who may be unaware that any problem exists.

Equally serious is the presence of trespassers on right-of-way structures or in wayside facilities.

Landslides, washouts, and other obstructions or damage to right-of-way structures, such as bridges which could cause a derailment or collision must also be detected.

It is essential that both the passenger train system train crew and Train Dispatchers/Control Center are immediately alerted to accidents, trespassers, or obstructions that infringe on or into the right-of-way structures and wayside facilities.

Recommendations are:

- Consideration should be given to the installation of either physical barriers to protect the right-of-way/wayside and/or a detection and alarm system to alert passenger train system operating organization personnel and right-of-way/wayside owner organization personnel (if different) to infringements/obstacles.
- Consideration should be given to integrating the infringement/obstacle detector within the train command, control, and communication system so that an infringement/large obstacle automatically causes wayside and/or cab signals to display a stop aspect or automatically stop the train.

6.1.9 Flammable and Combustible Liquid/Vapor Intrusion

Flammable liquid or vapor intrusion into a tunnel creates the potential for a serious fire or explosion that could cause damage to the right-of-way/wayside and/or injury to passengers and personnel. This hazard also exists where the right-of-way/wayside is shared with railroad freight operations. Extensive specifications to minimize the hazards of such an intrusion are presented in Section 3-2.8 of NFPA 130 and other standards.

6.1.10 Flood Protection

Underground and surface right-of-way structures and wayside facilities in many areas may be subject to water leakage or flooding. In addition, storm water drainage may enter at portals and shafts and below-grade passenger stations. Local building codes will probably apply.

Recommendations are:

- The drainage pumps should be the proper size to handle water intrusion from rain/snow, floods, broken pipes, firefighting operations, etc.
- Two separately powered alternate pumps should be provided at each pump location.

- Where pumps operate automatically, local controls should be able to manually override the system.
- Primary drainage should be achieved through proper roadbed design and construction. Excessive water should drain into grates, to be carried in culverts to a sump pit or away from the right-of-way/wayside.
- Pumping stations should be provided at low points along the right-of-way/wayside.

6.1.11 Wayside Traction Power

Wayside traction power removal should be addressed for various train emergencies. References 75 and 76 contain extensive additional information relating to wayside traction power control during emergencies.

Recommendations are:

- Implementation of the capability to remove or restore wayside traction power during emergencies should be provided. Requirements should include redundant power supplies or specific system design features to meet the power needs of the passenger train operating system.
- Where feasible, means for locally removing power from specific sections of the catenary or third rail should be provided at secured locations. (This could be accomplished by local emergency trip stations.)
- Where feasible, the Train Dispatcher/Control Center should be able to remove power from specific sections of catenary or third rail.
- Direct access telephone hot lines should be located along the right-of-way/wayside to permit communication between the train crew and emergency response personnel to the passenger train system operator Train Dispatcher/Control Center and/or "electrical power director," whomever has responsibility for wayside traction power removal.
- A means should be incorporated for physically grounding those specific sections of the catenary/ third rail that have been previously de-energized.

- Installing grounding devices in and of itself can be a time-consuming operation and may have to be done at the same time as other emergency response actions. Accordingly, it may be appropriate to consider the use of grounding devices at the output of the traction substations to achieve automatic grounding capability.
- Lock-out/tag-out devices, as well as procedures for verifying that power has been removed from the power sections, should be incorporated.

6.1.12 Graphics

Graphics are informational symbols and devices indicating the location and use of crucial facilities and equipment; they are essential in identifying emergency exits and routes, fire extinguishers, and communications.

Recommendations are:

- Standardized emergency graphics should be used.
- Reflective and luminous sign materials should be used.
- Multi-lingual and/or pictograph signs should be used as appropriate, to increase understanding of the information presented.
- Location marker signs which are highly visible to the train engineer/operator and other train crew, passengers, and emergency response personnel should be posted at regular intervals along the right-of-way/wayside.
- Information signs should be located at decision points for maximum visibility.
- Signs indicating the distance to and direction of the closest passenger station and emergency exits should be posted in underground sections and along retaining walls next to open-cut sections.
- Each emergency exit should be identified by a lighted sign and should include instructions for use.
- "Danger, No Trespassing" signs should be posted on the exterior of right-of-way/wayside exits.

6.1.13 Emergency Power

To ensure continuous operation of vital components such as lighting, ventilation systems, and pumping stations, two options for furnishing uninterruptible power must be considered: (1) dual controls and feeder cables to provide redundancy in case of failure of one component, and (2) an alternate power source in case the normal power source becomes unavailable. The following components should be connected to alternate power systems:

- Tunnel emergency lighting,
- All illuminated exit signs,
- Selected signs,
- Ventilation system (in tunnels and tubes),
- Public address system,
- Fire alarm system, and
- Pumps (in areas below the water table).

The components of an emergency power system should be located so that they are protected from damage by water or by normal maintenance to adjacent equipment.

6.2 PASSENGER STATIONS

Passenger stations are an important element of emergency preparedness because they provide a means for rapid passenger evacuation and rapid access by emergency response personnel during emergencies. Several references discuss station emergency preparedness issues [58, 59, and 60].

Passenger stations are located in four basic environments: underground, elevated, at grade, and in open cuts. Although passenger stations located in these different environments have unique characteristics, there are a number of elements common to almost all passenger stations. This section presents guidelines for these common elements.

Section 6.1 of this document contains additional information pertaining to specific stations located in different environments.

6.2.1 Construction/Arrangement

The construction materials, design, and layout used in stations affect passenger safety in an emergency. Use of construction materials which resist ignition and do not support fire spread or smoke generation is essential to allow adequate time to exit the station. In addition, passenger safeguards to prevent falling or tripping in the station after passengers exit the train are important. Local building codes must be followed. Provisions of NFPA 101 Life Safety Code [59] may also be applicable.

Recommendations are:

- The system safety concept should be applied in the new station planning phase to identify and resolve potential safety hazards which could impact on emergency response.
- Stations should meet the provisions of Section 2-2 of NFPA 130.
- Non-slip surfaces should be provided on station floors, and the floor at the edge of the station platform should be marked with contrasting color.
- Critical station egress and access paths should be identified in the construction planning phase, and should remain unobstructed after the station is built.
- Where turnstiles or other fare-collection-related barriers are employed, a means to deactivate them for rapid emergency egress should be provided.
- Access gates for emergency response personnel should also be considered.

6.2.2 Lighting

Lighting is an essential factor during many emergencies, particularly in underground stations and after dark at other passenger stations.

Recommendations are:

- The minimum illumination level for emergency lighting should furnish sufficient visibility in passenger stations to allow passenger evacuation from platforms, mezzanines, ticketing areas, passageways, and entrances.
- Emergency lighting systems should meet the requirements of Section 2-5.6 of NFPA 130 and NFPA 101.
- The emergency lighting system should be activated automatically upon loss of the normal lighting system and should provide continuous operation for an amount of time specified by the local building code. This time-span should be determined by the amount of time necessary for safe evacuation of passengers from the station.
- Emergency lighting fixtures and power sources should be protected from damage caused by accidents, water, maintenance of adjacent equipment, or vandalism.
- The normal lighting system may be considered emergency lighting if a designated number of the fixtures are powered by a separate or independent power source.
- Consideration should be given to locating a designated number of lighting fixtures toward the bottom of the walls of the station to provide visibility for passenger evacuation under smoke conditions. (Such fixtures should be "vandal proof.")
- Emergency lighting should be tested at prescribed intervals.

6.2.3 Access/Egress

At the majority of passenger train stations outside densely populated areas, passengers enter and exit the train while it is stopped at stations located at grade and open to the elements. However, the number of available and adequate emergency access and egress points is an important design consideration for passenger stations located underground or on elevated structures. Safe and swift evacuation from a passenger train in an emergency can generally be accomplished if the passenger train is able to reach a station in an emergency. Access and egress to the train while it is located at a station are typically easier than along the right-of-way; evacuation of mobility-impaired and visually-impaired

persons is quicker, especially at those stations that are equipped with ramps, elevators, or escalators.

The number and location of entrances and exits (as well as the arrangement of concessions, station attendant kiosks, fare gates, revolving gates, public stairways, escalators, and elevators within the passenger station) determine the extent to which access/egress is adequate for evacuation during emergencies.

Recommendations are:

- Emergency exits should meet the requirements of Sections 2-5.2, 2-5.3, and 2-5.4 of NFPA 130.
- Each emergency exit should be identified by graphics and by a light of distinctive color, and should have dual-light circuitry.
- Emergency exit doors should not be locked on the inside at any time.
- Emergency exit doors on the surface level should not open onto a hazardous area such as a vehicle roadway or parking area, and should be kept free of natural and man-made obstructions.
- Emergency exits should have the capability of being readily opened from the outside by the fire department or other rescue personnel.
- Installation of vertical ladders in emergency exits should be prohibited.
- All doors, ladders, etc., that do not provide emergency egress should be clearly labeled "Not an Exit."
- The needs of passengers with special egress requirements (e.g., those with mobility or visual impairments) should be addressed. Exits should be evaluated for ease of evacuation by those passengers.
- Consideration should be given to developing a means of limiting access to station platforms during over-crowded conditions.

- In stations adjacent to concourses, access/egress through department stores or other buildings should not be designated or used as emergency exits for stations.

6.2.4 Communications

Communication systems in passenger stations make possible reporting of emergencies and crimes, requests for assistance, announcements to passengers, visual surveillance, and coordination of fire/rescue efforts. The types of equipment available for use in stations include radios, private automatic branch exchange (PABX), direct-line telephones, maintenance line telephones, public address (PA) systems, intercoms, cellular telephones, data transmission cables, and closed circuit television (CCTV).

Recommendations are:

- Communication systems should meet the requirements of Section 2-6.2 of NFPA 130.
- A communication system should be provided between all stations and the Train Dispatcher/Control Center to permit rapid and coordinated communication.
- PA speakers should be installed in a manner which allows announcements made by a station attendant or Train Dispatcher/Control Center to be clearly understood by passengers.
- The PA system should have an alternate power source to permit use when the normal power system fails.
- PA system components should be protected from unauthorized use, vandalism, and other damage.
- The direct two-way-line telephones should receive redundant power from an alternate power source.

6.2.5 Ventilation and Air Conditioning

Station ventilation and air conditioning systems provide passenger comfort through temperature and humidity control, by removal of objectionable odors, and dissipation of heat from train and station operations. Special ventilation systems are used to purge smoke

and heat during a fire. Properly operated fans and dampers may play a critical role in confining fire and smoke to a limited area. Proper design of ventilation systems is essential for passenger stations.

Recommendations are:

- Ventilation systems should meet the requirements of Section 2-3 of NFPA 130.
- The local fan and damper controls should be clearly identified by lighting and/or graphics.
- Consideration should be given to providing a portable standby power source or other auxiliary power to operate ventilation systems.
- Fans and dampers should be remotely controlled from Central Control.
- Emergency ventilation systems should be tested at prescribed intervals.

6.2.6 Support Equipment and Systems

Various types of emergency-related support equipment are typically provided at stations.

6.2.6.1 Fire Protection Equipment - Section 2-6 of NFPA 130 contains provisions for fire protection equipment.

6.2.6.2 Emergency Equipment - Emergency equipment should be stored in designated station areas (such as attendant kiosks or equipment rooms) according to passenger train system operator requirements. Items that could be considered for storage include fire axes, crowbars, saws, ladders, and stretchers. Rescue equipment should be inspected at regular intervals to ensure that it is available and in usable condition.

6.2.7 Flammable and Combustible Liquid/Vapor Intrusion

Flammable liquid or vapor intrusion creates the potential for a serious fire or explosion in passenger stations. Extensive specifications to minimize the hazards of such intrusions are contained in Section 3-2.8 of NFPA 130 and other standards.

6.2.8 Flood Protection

Passenger stations may be subject to water leaks and floods. In addition, storm water drainage may enter at portals and shafts. Local codes will probably apply.

Recommendations are:

- Pumping stations should be provided at low points within passenger stations.
- The drainage pumps should be the proper size to handle water intrusion from rain/snow, flooding, broken pipes, firefighting operations, etc.
- There should be two separately powered alternate pumps at each pump location.
- All automatic pumps should have local controls that can manually override the system.
- Pumps should be inspected and tested at prescribed intervals.

6.2.9 Wayside Traction Power

Section 6.1.11 of this document contains wayside traction power guidelines which are also applicable to stations.

6.2.10 Graphics

Section 6.1.12 of this document defines the term "graphics" and lists their uses.

Recommendations for passenger station graphics are:

- Standardized emergency graphics should be used.
- Multi-lingual and/or pictograph signs should be used as appropriate, to increase understanding of the information presented.
- Reflective and luminous materials should be used for signs.
- Advertising should be segregated from informational graphics.
- Advertising should be avoided entirely at decision points.
- Information signs should be located at decision points for maximum visibility.
- Signs should be posted in stations providing instructions for reporting unusual occurrences and procedures for emergency evacuation.
- Audio and visual alarms should be provided for passengers with impairments which do not permit them to hear or read emergency alarms or announcements.
- Location signs and instructions for operation of emergency exits, fire extinguishers, and emergency intercoms or alarms should be provided.
- Signs and instructions for emergency equipment should be illuminated by normal and emergency lighting fixtures.

6.2.11 Emergency Power

To ensure continuous operation of vital components such as lighting, ventilation systems, and pumping stations, two options for furnishing uninterruptible power must be considered: (1) dual controls and feeder cables to provide redundancy in case of failure of one component, and (2) an alternate power source in case the normal power source becomes unavailable. The following components should be connected to alternative power systems:

- Emergency lighting,
- All illuminated exit signs,

- Selected signs,
- Ventilation system,
- Public address system,
- Fire alarm system, and
- Pumps (in areas below the water table).

6.3 TRAIN DISPATCHER/CONTROL CENTER

Most passenger train movements are controlled by Train Dispatchers or by a "Control Center." It is very likely that personnel will be located at facilities which are remote from the right-of-way/wayside. These facilities consist of the necessary command, control, and communications equipment to maintain normal train operations, to control power, and to maintain communications throughout the system. In addition to these functions, the Train Dispatcher/Control Center helps coordinate responses to emergencies by using equipment such as radio communications systems, direct "hotline" telephones, wayside power removal controls, and ventilation controls under the direction of emergency response personnel, according to the emergency plan protocols and procedures.

The guidelines in this section are intended to assist the Train Dispatcher/Control Center personnel to respond effectively to emergencies.

6.3.1 Emergency Exits

Diagrams indicating the exact location of every emergency exit in each station and along the entire right-of-way/wayside route should be available to the Train Dispatcher/Control Center personnel.

6.3.2 Communications

It is recommended that the Train Dispatcher/Control Center should possess the following minimum communication capabilities:

- Audible and visible alarms that indicate when safety-critical communications, command, and control equipment fails or malfunctions;
- Means to directly receive alarms which signal obstacles, infringement, intrusion, flooding, etc. onto the right-of-way/wayside at the Train Dispatcher/Control Center, and means to directly and immediately notify the appropriate railroad control center when an intrusion occurs from other railroads into the right-of-way/wayside or vice versa;
- Plan for reacting to train system command, control, communication failures and malfunctions;
- Means to communicate with emergency response organization or emergency response alarm dispatcher facilities, as appropriate; and
- Means to communicate with passenger train crews and other personnel located along the passenger train route, including locations such as right-of-way structures (e.g., tunnel) and wayside facilities, such as power substations.

6.3.3 Ventilation Equipment Controls

Consideration should be given to developing a series of predetermined ventilation control system scenarios and procedures which may be used to respond to various types of emergencies.

6.3.4 Wayside Traction Power Removal

The Train Dispatcher/Control Center personnel should be able to remotely remove catenary or third-rail power and other wayside traction power from any location for which Train Dispatcher/Control Center personnel is responsible. References 75 and 76 contain extensive information relating to wayside traction power safety and protection.

6.3.5 Graphics

Some means of clearly indicating the location of every emergency exit, standpipe connection, pump station, ventilation fan, emergency telephone, wayside traction power cut-off control, power substation, and various safety-critical alarms should be available to the Train Dispatcher/Control Center personnel.

6.3.6 Automated Emergency Response System Capability

In order for the Train Dispatcher/Control Center personnel to quickly and accurately take appropriate action, information relating to pre-planned procedures, equipment, and facilities must be available in a readily retrievable format. Key emergency telephone numbers; the location of traction power controls, ventilation fans, emergency exits, access roads, etc; and procedural checklists are examples of the type of information which could be stored in a database and called up on a computer display screen during an emergency. Use of this computer-based technology can save valuable time during an emergency by eliminating the need to refer to hard copies of various maps, charts, lists, and handbooks. Reliance on memory alone for seldom used information would also be avoided. The Federal Transit Administration has published two reports which describe the development and refinement of a computer-based emergency response system for rail transit systems [79 and 80]. This concept is transferable to passenger train system operations.

7. NATIONAL TRANSPORTATION SAFETY BOARD (NTSB) REPORTS

Railroad Safety/Special Study Reports

Safety Study--Passenger/Commuter Train and Motor Vehicle Collisions at Grade Crossings (1985). Report no. NTSB/SS/86/04. December 12, 1986.

Special Study--Railroad Emergency Procedures. Report no. NTSB-RSS-80-1. January 18, 1980.

Special Study: Train Accidents Attributed to the "Negligence of Employees." Report no. NTSB-RSS-72-1. May 24, 1972.

Special Study: Signals and Operating Rules as Causal Factors in Train Accidents. Report no. NTSB-RSS-71-3. December 2, 1971.

Safety Recommendations Issued by NTSB, not Contained in Intercity and Commuter Rail Passenger Train Accident Reports:

R-88-74 through 88-76. Incident Concerning National Railroad Passenger Corporation (Amtrak) Train No. 19, the Crescent on May 12, 1988. November 30, 1988.

Intercity and Commuter Rail Passenger Train Accident Reports (by Date of Accident Occurrence)

Railroad Accident Report: Derailment and Collision of Amtrak Train No. 87, with Rail Cars on Dupont Siding of CSX Transportation, Lugoff, South Carolina, July 31, 1991. Report no. NTSB/RAR/93/02. September 13, 1993.

Railroad Accident Report: Derailment of Amtrak Train 87, the Silver Meteor, in Palatka, Florida, on December 17, 1991. Report no. NTSB/RAR-93/02/SUM. July 26, 1993.

Railroad Accident Report: Derailment of Southeastern Pennsylvania Transportation Authority Commuter Train 61, Philadelphia, Pennsylvania, March 7, 1990. Report no. NTSB/RAR/91/01. April 23, 1991.

Railroad Accident Report: Derailment of Amtrak Train No. 6 on the Burlington Northern Railroad, Batavia, Iowa, April 2, 1990. Report no. NTSB/RAR/91/05. December 10, 1990.

Railroad Accident Report: Derailment and Collision of Amtrak Passenger Train 66 with MBTA Commuter Train 906 at Back Bay Station, Boston, Massachusetts, December 12, 1990. Report no. NTSB/RAR/92/01. February 25, 1992.

Railroad/Highway Accident Report: Derailment of Amtrak Passenger Train 708, on Atchinson, Topeka and Santa Fe Railway with Tab Warehouse and Distribution Co. Tractor-Semi Trailer, Stockton, California, December 19, 1989. Report no. NTSB/RHR/90/1. October 23, 5, 1990.

Railroad Accident Report: Collision of Amtrak Train 66, the Night Owl with On-Track Maintenance-of-Way Equipment, Chester, Pennsylvania, January 29, 1988. Report no. NTSB/RAR-89/01. January 6, 1989.

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APPENDIX A. INTER-ORGANIZATIONAL EMERGENCY PROTOCOLS

The content of inter-organizational emergency protocols should encompass the following elements for each of these suggested organizations (including primary and back-up response):

A. Fire Departments

- Establish appropriate fire department jurisdiction.
- Establish level of service (equipment, personnel, etc.) to be delivered in response to various types and levels of passenger train system emergencies.
- Specify level of notification, command and control, and degree of responsibility on-site.
- Determine appropriate methods of communication and develop procedures for continuous coordination and transfer of command.
- Provide training for fire department personnel to familiarize them with passenger train equipment, right-of-way structures and wayside facilities, and access/egress procedures.
- Include liaison with passenger train system operating organization personnel, use of tools, handling of passenger train system operating system equipment, motive unit and wayside traction power removal and restoration, use of support personnel, etc., which will assist firefighting and rescue operations.
- Conduct periodic drills involving fire department participation.
- Identify any special tools and equipment which the fire department might need that they would not normally possess to address with passenger train emergencies.

B. Emergency Medical Service (EMS)

- Establish appropriate EMS unit jurisdictions.
- Establish level of service (equipment, personnel, etc.) to be delivered in response to various types and degrees of emergencies.
- Establish appropriate methods of communication for continuous coordination during a response.
- Familiarize EMS personnel with the operating system trains and facilities.

- Conduct periodic drills involving participation by EMS personnel.

C. Police Departments

- Establish a full understanding of jurisdictional responsibilities between any internal passenger train system operating organization security group and the local police department(s).
- Establish level of service (equipment, personnel, etc.) to be delivered in response to various types of train and facility emergencies (as opposed to assistance delivered in response to security or crime related incidents such as "assist officer" calls).
- Establish appropriate methods of communication for continuous coordination during a response.
- Establish procedures corresponding to the types of emergency service anticipated (e.g., crowd control, authorized access control, security threat) unique to emergency situations.

D. Right-of-Way Owners, if Different from Passenger Train System Operator, as well as Adjacent Railroads

- Establish procedures for risk management in joint corridor emergency incidents.
- Reach an agreement on the principal points of reciprocal contact when an emergency occurs.
- Establish information exchange methods regarding the occasions and procedures for hazardous material or excess dimension movements on adjacent railroads.

E. Public Utilities

- Coordinate an agreement with local public utilities regarding points of contact in an emergency, and services to be provided by each.

F. Hospitals

- Establish the level of emergency services generally available at various hospital locations in the vicinity of the passenger train route and facilities.
- Establish the manner in which patients will be assigned or routed to various hospitals (e.g., by the fire/rescue communications center, fire department, emergency medical services, etc.)

G. Local/State/Regional/Federal Government

- Establish appropriate system-specific agreements with one or more of the following government agencies: Public Utilities Commission, Emergency/Disaster Management Highway and Railroad Departments, National Guard, Governor's or Mayor's Emergency Action Center, and FEMA. In the event of emergencies that may require investigation, coordination with the appropriate representatives of these agencies (e.g., FRA, NTSB) for reporting serious problems, or for requesting support when needed, should be established.

APPENDIX B. EMERGENCY EQUIPMENT

To evacuate passengers as swiftly and as safely as possible, passenger train system operating personnel and emergency response organization personnel must have a sufficient amount of the proper equipment and should be familiar with and know how to operate such equipment.

This appendix lists and describes the items of equipment that could be of value when evacuating the general public, as well as elderly and disabled persons. Some of these items are currently used by passenger train system operators (or rail transit systems) and emergency response organizations, while the other items should be evaluated for possible use through emergency simulations (see Section 4, Training). The type and quantity of emergency equipment provided will vary according to the contents of the emergency plan (s), local inter-organizational emergency response protocols, and the type of passenger train cars and motive power units, right-of-way structures and wayside facilities, and the local operating environment of the passenger train route.

BACKBOARDS

Backboards can be used in circumstances where it would be difficult to maneuver flexible stretchers -- for example, through a window while removing a passenger from a rail car. Because of their rigidity, backboards may make removal easier, particularly when emergency response personnel are carrying a passenger down (or up) a ladder. Because they provide greater support, they are also useful for passengers who have chronic back problems or who suffer from a spinal injury. However, the width of backboards can be a problem. In addition, it is difficult to carry people long distances because of the weight of the individual carried and the uncomfortable position of the carriers' arms (either straight or at a slight angle).

CLOSED CIRCUIT TELEVISION (CCTV)

A potentially valuable piece of equipment for passenger train system operators to consider, where feasible, is closed-circuit television (CCTV) cameras. Many systems have installed a CCTV system for security at certain stations. Activation of CCTV during emergencies could help rescue personnel locate an emergency immediately, assess the degree of risk and damage, evaluate the conditions in the emergency location, determine what emergency equipment rescue personnel should bring, monitor the progress of evacuation and rescue efforts, and provide a record of events. A valuable auxiliary use of CCTV would be to record emergency simulations, which could help trainers improve emergency drills, study emergency response personnel in action, and refine emergency procedures.

EMERGENCY CARTS

Emergency carts which can use the rails along the right-of-way structure to reach the emergency scene can be used in two ways. They can carry emergency response personnel and equipment to the train location, and they can carry passenger from the emergency scene, freeing personnel who might otherwise have to carry them bodily from the site. If the carts are unpowered, however, they may have limited value on inclined sections of the right-of-way.

EVACUATION CHAIRS

Evacuation chairs can be a valuable device for moving mobility-impaired persons down a staircase and, possible, on evacuation ladders. These chairs are designed to descend the staircase or ladder at the typical angle of inclination and have wheels large enough to take them over the trackway. They are lightweight folding chairs that can be stored on passenger cars, in stations, or in tunnels.

FLEXIBLE STRETCHERS

Flexible stretchers are often used to evacuate mobility-impaired passengers because of their relatively light weight (an important feature if they have to be carried to the scene of an accident) and their maneuverability. Two persons can carry an uninjured passenger on a flexible stretcher, but it is difficult because the sides fold in over the victim and one carrier has to walk backwards. Four persons are needed to carry an injured passenger, and the four-person carry is generally difficult inside a vehicle because of the narrow aisles and vertical stanchions. Flexible stretchers are also inconvenient for moving a victim through a vehicle window because of their lack of rigidity.

HI-RAIL VEHICLES

Hi-rail vehicles provide auxiliary access to rail track structures independent of railroad equipment. This type of vehicle could be used for carrying passengers to stations, emergency exits, or tunnel portals. The concept of auxiliary access could be adapted for maglev guideways.

LADDERS AND LADDER PADS

Ladders, especially those that are collapsible, could be stored conveniently in a small space on the passenger car, such as in a storage room or in an overhead holder, in a location where they are protected from damage during a collision or derailment. The location of ladders should provide easy access so that passengers can retrieve them if train crew become incapacitated during an accident.

A ladder pad is small platform on which to place an evacuation ladder. It may simply be a flat wooden platform about three feet long and slightly narrower than the track gauge to fit between the rails. Such a platform can alleviate the problem of irregular and unstable surfaces and thus ensure stability.

BARRIER TAPES

Barrier tapes (reflective tapes or battery-powered string lights) placed about a foot up from the ground on the walls of tunnels or on the floors of passenger cars and motive power units can help guide emergency response personnel and persons on-board the train. Because smoke rises and obscures visibility higher up, life tapes should be placed close to the floor. When the lighting is poor or when smoke hinders visibility, they can help orient passengers and lead them to car doors and emergency exits.

RAMPS

Ramps eliminate the need to step up a series of stairs and can expedite the evacuation of passengers who are injured but still able to walk. However, ramps may be very heavy, awkward and difficult to store. During an interagency simulation several years ago, PATH used a fabricated ramp instead of its standard ladder on one of the participating vehicles. The ramp proved to be highly effective in evacuating ambulatory and injured passengers. Indeed, one firefighter interviewed after the simulation stated that he did not even realize it was a ramp. Difficulties associated with the PATH ramp were its excessive weight and lack of compactness for storage. An evacuation ramp similar to those that are stored within rental trucks and used to move household goods may be suitable for passenger train cars. Also, folding aluminum ramps are available and could be used by personnel to evacuate wheelchair passengers in their wheelchairs when conditions permit. However, aluminum ramps cannot be used on or near the third rail.

TELEPHONES

As an aid to communication in evacuation operations, the telephone can complement the CCTV monitor and crews. The mere presence of telephones, placed at regular intervals along the right-of-way in a tunnel or on an elevated structure with a direct connection to Central Control, can provide psychological assurance to persons being evacuated. By knowing that there is a communication link with the "outside," individuals would probably be calmer during the emergency. Furthermore, by using the telephone, lost, disoriented, or stranded persons can contact the Train Control Dispatcher/Control center, alert personnel of their difficulty, and receive instructions for assurances as they wait to be rescued. In addition, if the person watching the TV monitor observes that elderly and disabled passengers are involved in an emergency, that person can quickly estimate the number of individuals involved,

quickly assess their needs, and then call response personnel. It should be noted that portable, cordless and cellular telephones, do not transmit and receive signals well in tunnels; therefore, phones using cables should be considered for use in tunnels.

OTHER TYPES OF EMERGENCY EQUIPMENT

The following is a list of specialized emergency equipment that emergency response personnel may need to use in order to respond effectively to a passenger train emergency.

- Air bag rescue and lifting system with the power to lift, move or shift weights of up to 146,000 pounds
- Axes
- Bolt Cutters
- Flood Lights
- Hand Lights
- Hand Tools (hammers, wrenches, saws, etc.)
- Hydraulic Jacks and other hydraulic tools used to pry, pinch, push, bend, tear, shear and force metal, masonry, and timber, to gain access to or release for trapped persons
- Insulating aprons, mats, blankets, gloves to provide protection from high voltage and electrical shock
- Ladders (for assisting persons to exit overturned cars)
- Jumpers or Stingers for Catenary or Third Rail Power
- Maintenance Phone Headsets
- Oak Blocking and Cribbing
- Pry Bars
- Radios equipped with an emergency frequency
- Self-Contained Breathing Apparatus (SCBA)/Spare Air Bottles
- Shoe Lifts (to inhibit third rail traction power collection)

**APPENDIX C. BASIC COMMUNICATION PROCEDURES FOR VISUALLY,
HEARING, SPEECH, AND MENTALLY IMPAIRED PERSONS***

A. RULES FOR ASSISTING VISUALLY IMPAIRED PASSENGERS

1. Never take hold of a person using a white cane without first telling him/her who you are, what you plan to do and you receive acknowledgment.
2. Never take hold of or move a person's white cane until you have told him/her exactly what you are doing and why, and you receive acknowledgment.
3. When leading, stand on the side opposite the white cane.
4. Always stay one-half pace ahead of the person you are leading. Remember, if you forget to tell him/her the direction of movement, the one-half pace will allow him/her to follow the movement of your body. If the person being led is staying beside you, s)he may well fall if you forget to tell him/her the direction of movement.
5. Remember to first tell your passenger the direction of movement (up, down, over) and then the distance of movement (for example, step down six inches).
6. Remember, drop your lead arm back when you and the person are walking through narrow areas. (Be sure to tell the person what you are doing).
7. Be alert to changes in the regularity of the environment (different heights of steps, changes from hard to soft surfaces, etc.).
8. Inform Person of changes in terrain and call out maneuvers to be made, (going up steps, etc.).
9. Remember the three orientation points for your passenger to enter or exit a vehicle: the door, door sill, and vehicle seat.
10. Take time to describe new areas to the vision impaired person.

* Adapted from Appendices B-F, Passenger Assistance Techniques: A Training Manual for Vehicle Operators of Systems Transporting the Elderly and Handicapped, by W.H. Henderson, R. L. Dabney, and D. D. Thomas, 1982. By permission of Transportation Management Associates.

B. RULES FOR ASSISTING HEARING IMPAIRED PASSENGERS

Individuals who are deaf communicate in primarily two ways: (1) lip reading with an oral response; and (2) the use of hand signs and finger spelling.

In communicating with a lip reader:

1. Be sure to face him/her directly so your lips may be seen easily.
2. Do not exaggerate your speech or lip movement. To do so changes the way you form your words.
3. Speak with moderate speed.
4. Do not hesitate to repeat yourself. Remember, a good lip reader will understand fifty to sixty percent of what is said. An excellent lip reader will understand seventy to eighty percent of what is said. Repeating helps him/her fill in the blanks.
5. Remember that some peoples' lips cannot be read easily. This does not necessarily have anything to do with the way they sound. If you should find that your lips are not easily read, simply have someone else repeat your message to the lip reader.

In communicating with persons using hand signs and finger spelling, remember:

1. To become skillful in the use of hand signs and finger spelling takes quite a bit of practice. However, the manual alphabet and simple signs can be learned quickly.
2. To keep a pad and pencil available for written messages.
3. Older persons who have been deaf since birth may not have learned how to read and write.
4. For individuals who have been deaf since birth, learning to speak is quite difficult. Their speech will tend to be quite flat and nasal.
5. A person who is not deaf but who has lost the ability to speak, such as one who has had a laryngectomy (removal of the vocal chords), may use hand signs.

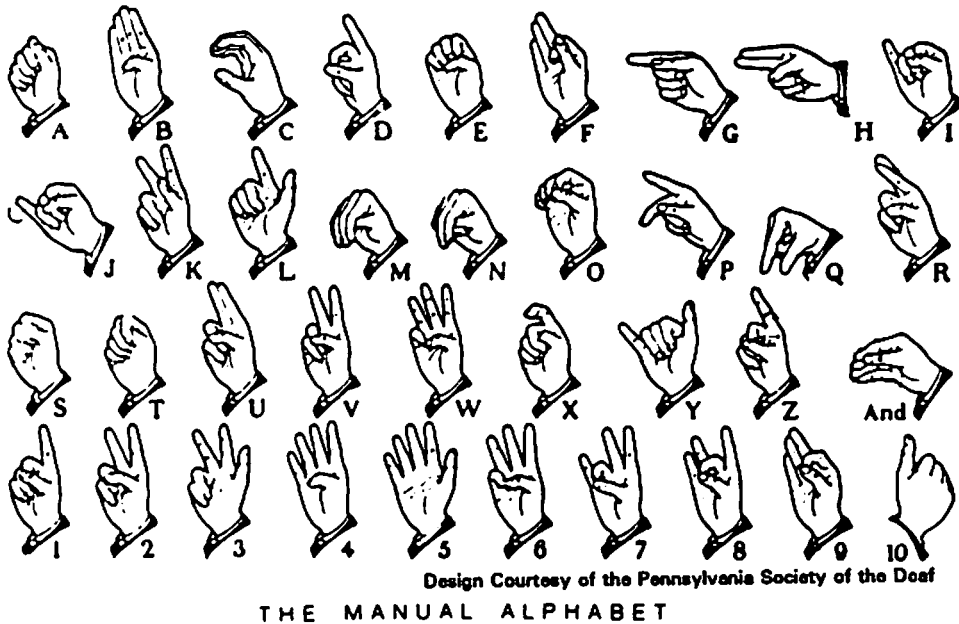


Figure Courtesy of the Goodrich Center for the Deaf, Fort Worth, Texas.

C. RULES FOR ASSISTING SPEECH IMPAIRED PASSENGERS

1. Do not acknowledge that you understood what a person has said, if in fact, you have not.
2. Repeat what you "thought" the person said. This gives him/her a chance to confirm or deny your interpretation of what she said.
3. Ask the person to repeat the part you are having trouble understanding. Remember, a person with communication difficulties is quite used to being misunderstood and will appreciate the fact that you are making an effort to fully understand.
4. Put the person at ease when you ask him/her to repeat something. If a person becomes tense, almost any type of speech impediment will become worse.

D. GUIDELINES FOR ASSISTING MENTALLY IMPAIRED PASSENGERS

Individuals who have lost some part of their mental functions may have:

1. Lessened ability to give or understand directions.
2. A lack of orientation (not aware of where they are or what time it is).
3. Agitation, excitability or lack of emotional control.
4. A harder time learning and remembering rules and routines of the transportation system.

In assisting mentally impaired passengers you should:

1. Repeat - It is often useful.
2. Have patience - It is always necessary.
3. Be firm - Persons may want to do things that are unsafe.

When trying to understand the problems of mentally impaired passengers remember:

1. Everyone - has at times been confused or disoriented by a new situation.
2. Everyone - has at time had a hard time following directions for a new task.
3. Everyone - has at times had trouble finding their way around a new environment.
4. Everyone - has at times become agitated, irritated or excited when a familiar routine has been suddenly changed.

Note: A person with mental difficulties will tend to respond to situations on more of an emotional level than an intellectual level. Emotions come into play more quickly than do intellectual responses. Therefore, a person with mental difficulties will tend to be quite sensitive to another individual's mannerisms, the way in which they say things as well as what they say, and even facial expressions and body movements.

APPENDIX D. EMERGENCY PREPAREDNESS EXERCISE PLANNING

1. Determine Goal and Objectives of Exercise
2. Develop Emergency Scenario
 - Evacuation
 - Fire
 - Derailment/Collision
 - Other scenario
3. Review Procedures which should be followed for each scenario.
4. Select and Arrange for Use of Location for Exercise
 - Conduct Classroom Briefing and Tabletop Exercise
 - Conduct Field Exercise
5. Arrange for Use of Passenger Car(s) and Other Equipment
6. Prepare Plan and Schedule for Type of Exercise
 - Internal
 - Single Outside Response Agency
 - Multiple Outside Response Agencies
7. Identify Evaluators and Arrange for their Participation
8. Notify and Assemble Involved Internal and External Organization Management
 - Assign Duties and Arrange for Coordination
 - Passenger Train System Operating Organization Personnel (including right-of-way/wayside facility owner, carrier, and/or subcontractors, as appropriate)
 - Training personnel
 - Fire Services

- Police
 - Emergency Medical Services
 - EPA, Other Agencies and Other Interested Parties
- Review Plan and Schedule
 - Revise Plan and Schedule as Necessary
9. Develop Handouts (critique sheets, etc.)
 10. Send Out Invitations to Media and other Interested Parties (if determined appropriate)
 11. Ensure that Train Cars are Moved to Exercise Site
 12. Conduct Participant Briefing for Exercise
 - Review Exercise Goals
 - Knowledge
 - Skills
 - Assign Roles and Distribute Critique Sheets
 - Moulage
 13. Conduct Field Exercise
 - Evacuation
 - Fire
 - Other Scenario
 - Perform activities in Items 14 - 20, as appropriate
 14. Utilize Communication/Notification Procedures and Equipment
 15. Perform Hazard Control Techniques
 - Deenergizing Wayside Traction Power
 - Removal of headend engine or trainline power
 - Passenger Car/Motive Power Unit Stabilization
 - Perform Fire Suppression

16. Perform Passenger Car/Motive Power Unit Access Techniques
 - Normal Operation/Opening Side and End Doors from Inside and Outside Passenger Car
 - Emergency Operation of Side and End Doors from inside and Outside of Passenger Car
 - Operation of Window Emergency Exits from Inside and Outside Passenger Car
 - Use of Ladder
 - Opening Doors/Windows from Outside the Motive Power Unit

17. Carry Out Evacuation Techniques for Various Types of Passengers
 - Able-Bodied
 - Persons who need special assistance
 - Elderly and disabled, families with small children
 - Visually-impaired
 - Physically-impaired
 - Mentally-impaired
 - Injured

18. Review Triage Area Set-Up - Public Safety Agency Coordination
(Include properly trained passenger train crew and on-board service personnel)
 - First Aid
 - Immediate Treatment for Severely Injured
 - Removal to Hospital
 - Removal to Mortuary

19. Perform Clean Up
 - Train Removal
 - Site Restoration

20. Restore Normal Operations (if interrupted)

21. Perform Critique/Debriefing
22. Prepare Report as Required
23. Complete Management Review
24. Institute Follow-Up Corrective Actions (in terms of retraining, modification of procedures and equipment, or other appropriate actions)
25. Send Thank You letters (if appropriate)

APPENDIX E. SAMPLE DRILL/EXERCISE CRITIQUE SHEETS

I. PASSENGER TRAIN SYSTEM OPERATING ORGANIZATION EVALUATION

**EVALUATOR'S NAME
ADDRESS
PHONE**

1. Time exercise initiated:
2. Did personnel try to initiate radio call immediately?
3. How long did it take for personnel to reach and inform the Train Dispatcher/Control Center of the emergency situation?
4. Method of notification to the Train Dispatcher/Control Center:
 - Onboard radio
 - Wayside radio (if equipped)
5. Was there adequate radio communication equipment? Was it used properly? Did it work properly?
6. Did personnel know proper emergency number to call from the wayside telephone?
7. Did personnel identify him/herself to the Train Dispatcher/Control Center by name and location?
8. Did personnel inform Train Dispatcher/Control Center of exact location of train?
9. Did personnel report the number and status of passengers?
10. Did personnel make appropriate PA announcement to passengers? How many minutes elapsed before announcement was made?

11. Did personnel operate fire extinguisher correctly?
12. Did personnel apply handbrakes, shut down electrical power, and apply power isolation shoes for third rail pick up shoes?
13. Did personnel notify Power Director and request third rail and catenary power de-energizing?
14. Did personnel request that train movements be halted?
15. Did personnel give clear, proper directions to those persons evacuating from the passenger cars?
16. Did personnel instruct passengers to stay clear of third rail or downed catenary wires and any adjacent tracks?
17. Did personnel appoint other passengers to help with evacuation?
18. Did personnel ask for help with persons who are blind, or have mobility impairments?
19. Did personnel search the cars for any remaining persons before getting off?
20. How many minutes did it require to evacuate all persons from the train?
21. Principal weaknesses observed?
22. Principal strengths observed?
23. Additional remarks:
24. Recommendations:

II. COMMAND, CONTROL, AND COMMUNICATION (C³) EVALUATION

EVALUATOR'S NAME
ADDRESS
PHONE

1. Time exercise initiated:
2. Method of notification to Fire Departments, Police, Ambulance Service, EMS, Hospitals:
3. Upon arrival at scene, how was the Command Post established? Who assumed incident command?
4. Was passenger train system operating organization system liaison established?
5. Was there adequate radio communication equipment?
6. When responding units arrived on the scene, did they report to the Command Post?
7. Principal weaknesses observed?
8. Principal strengths observed?
9. Additional remarks:
10. Recommendations:

III. FIREFIGHTING EVALUATION

EVALUATOR'S NAME
ADDRESS
PHONE

1. How was the initial information received?
2. How were the firefighting personnel notified by Train Dispatcher/Control Center as to location of scene?
3. At what time did fire department equipment arrive?
4. Was the response to the scene made in a safe but timely manner?
5. How many personnel were dispatched to the scene?
6. Was there direction given to those firefighting personnel on the scene by the officer in charge?
7. Was a Command Post established?
8. Did the Fire Chief retain command of the scene?
9. Was there adequate communications equipment available at the scene?
10. How many firefighters entered the passenger cars/locomotives/other power units to begin extrication?
11. Were victims being extricated in a safe manner?
12. Were any firefighters relieved to take breaks during the exercise?
13. Additional remarks:
14. Recommendations:

IV. OVERALL MEDICAL (EMS) EVALUATION

EVALUATOR'S NAME
ADDRESS
PHONE

As the Overall Medical (EMS) Evaluator, it is anticipated that you will feel free to roam at will and evaluate any and all medical aspects of this exercise. The questions listed below are merely indicators of areas that should receive attention during the exercise.

1. Time exercise initiated:
2. After extinguishing the simulated fire, did the Fire ambulance service, EMS personnel attend to the victims in a timely and professional manner?
3. Was the triage area established at a safe distance from the vehicle?
4. Was the triage area clearly identified?
5. What was the approximate distance victims had to be carried to the triage area?
6. Was there adequate room within the triage area to attend to the victims?
7. Approximate time first ambulance arrived:
8. Upon arrival of the ambulance services, who directed the ambulance services to the staging area?
9. Approximate time first victim was brought to the triage area:
10. When victims were transported to the triage area, were they placed in the appropriate areas? (Areas are categories I, II, and III):

11. Were triage tags used appropriately?
If not, describe the problem(s):

12. Were there adequate litter bearers?

13. Was the dispatch of ambulance services done in a timely manner?
If not, explain:

14. Were medical supplies adequate to meet the needs?

15. What supplies, if any, were in short supply?

16. How were DOAs handled?

17. What weaknesses were observed?

18. What principal strengths were observed?

19. Additional remarks:

20. Recommendations:

V. SECURITY AT THE SCENE

EVALUATOR'S NAME
ADDRESS
PHONE

1. Time exercise initiated:
2. Did responding Police agencies arrive in a timely manner?
3. Were adequate Police personnel on the scene?
4. Upon arrival on the scene, did Police personnel set up in strategic locations?
5. Did Police personnel have adequate communications?
6. Could you determine the number of Police agencies on the scene?
7. How many vehicles actually were set up within the Command Post area?
8. Was the individual or individuals in charge at the Command Post easily identified?
9. Should there have been messengers posted at the Command Post?
10. Were adequate directions given to those extricating victims from and around the passenger cars/locomotives/ other motive power units?
11. Major points of weakness:
12. Principal strengths:
13. Additional remarks:
14. Recommendations:

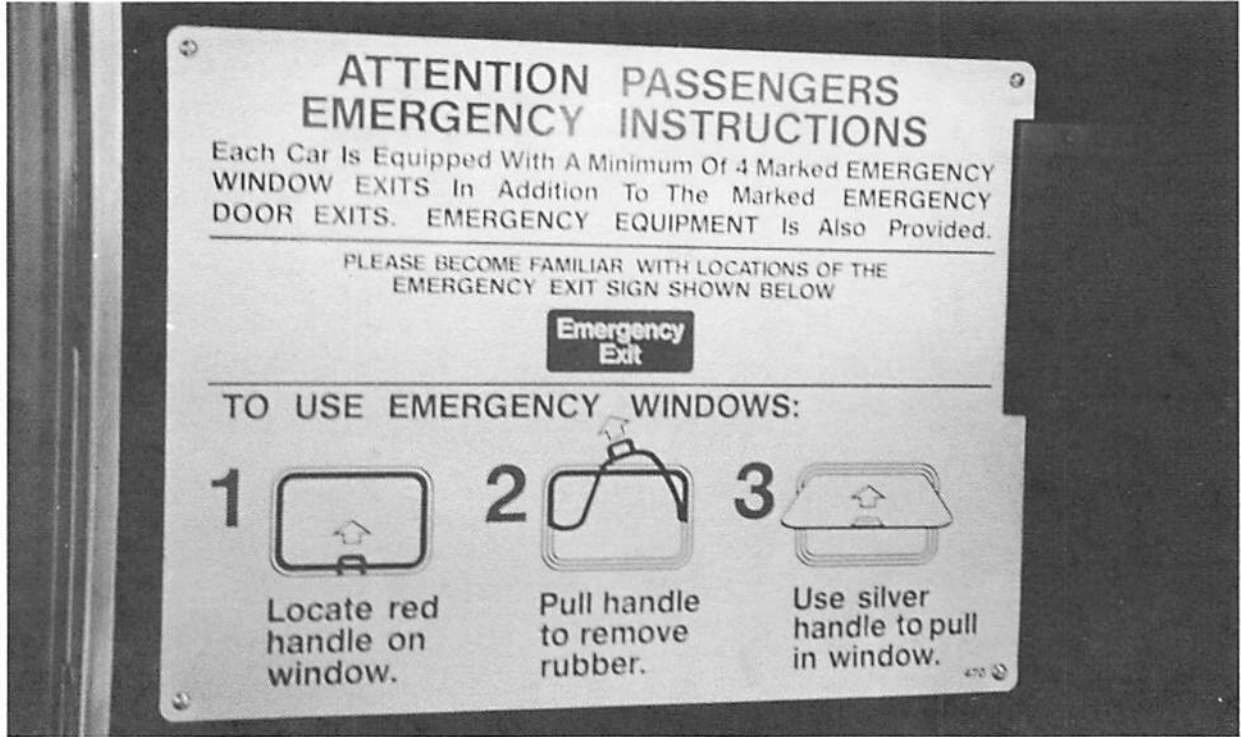
**APPENDIX F. EXAMPLES OF PASSENGER TRAIN SYSTEM
EMERGENCY EXIT SIGNS AND INSTRUCTIONS**



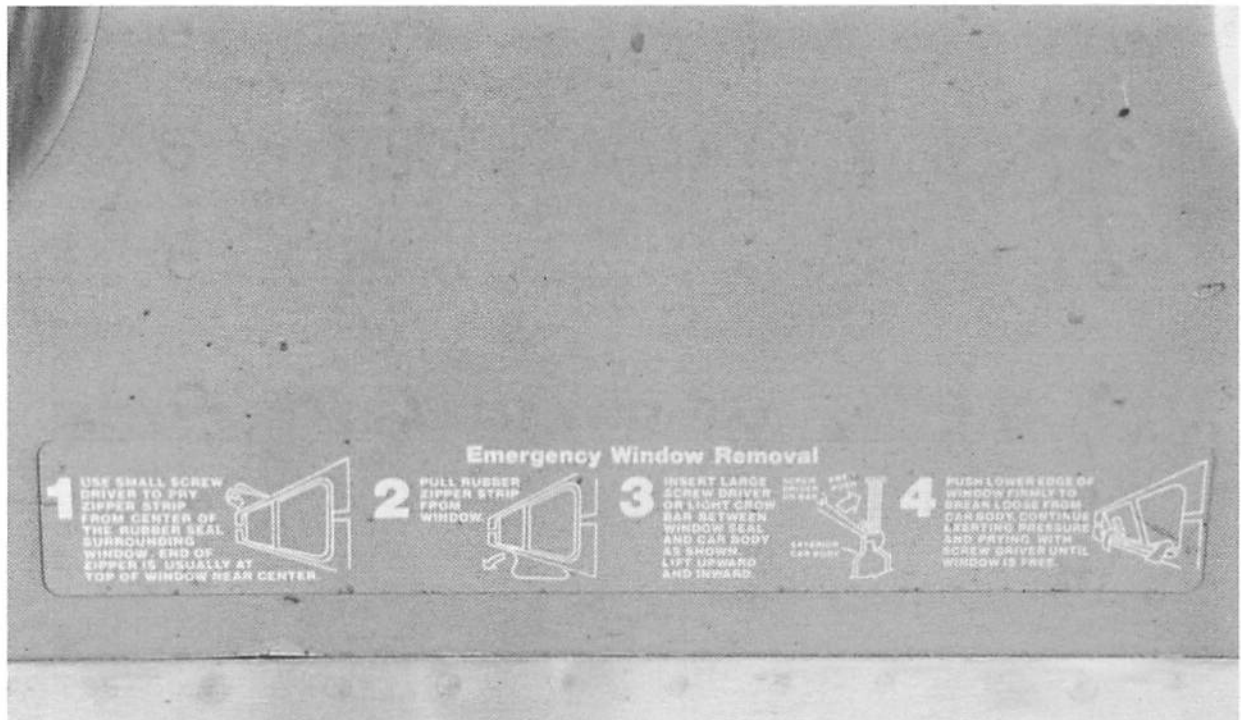
Interior View of Emergency Exit and Handle



Close-up of Interior Emergency Window Exit Handle



Passenger Emergency Instructions - Passenger Car Interior



Emergency Window Exit Removal Instructions
- Affixed to Exterior of Passenger Car

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