UMTA-MA-06-0152-85-1
DOT-TSC-UMTA-84-26

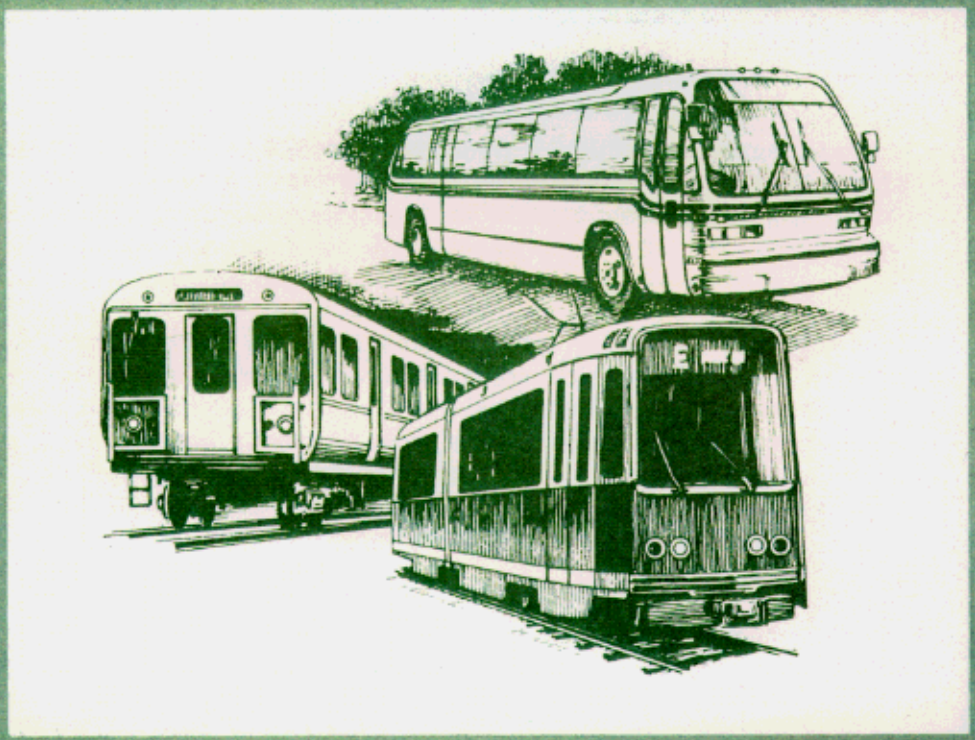
U.S. Department
of Transportation

**Urban Mass
Transportation
Administration**

Recommended Emergency Preparedness Guidelines for Rail Transit Systems

John A. Volpe National
Transportation Systems Center
Cambridge, MA 02142

March 1985
Final Report
Reprint
December 1991



UMTA Technical Assistance Program

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
UMTA-MA-06-0152-85-1		

4. Title and Subtitle	5. Report Date	6. Performing Organization Code
RECOMMENDED EMERGENCY PREPAREDNESS GUIDELINES FOR RAIL TRANSIT SYSTEMS	March 1985 Reprint December 1991	DTS-65

7. Author(s)	8. Performing Organization Report No.
William T. Hathaway, Stephanie H. Markos, Robert J. Pawlak	DOT-VNTSC-UMTA-84-26

9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
U.S. Department of Transportation Research and Special Programs Administration John A. Volpe National Transportation Systems Center Cambridge, MA 02142-1093	UM478/R4607
	11. Contract or Grant No.

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
U.S. Department of Transportation Urban Mass Transportation Administration Office of Technical Assistance Washington, DC 20590	Final Report April 1982 - March 1984
	14. Sponsoring Agency Code URT-6

15. Supplementary Notes

16. Abstract

The Recommended Emergency Preparedness Guidelines contained in this document are designed to help rail transit systems to assess, develop, document and improve their capability for responding to emergency situations, and to coordinate these efforts with emergency response organizations in a manner which best protects the traveling pubic and transit system facilities and equipment.

Four major areas of emergency preparedness are addressed. The first section presents recommendations for Emergency Plan Development, including emergency response procedures, agreements with emergency organizations, and supporting documentation. The training section outlines recommended training for both transit system and emergency response personnel, as well as programs to promote public awareness. The last two sections --Facilities and Equipment, and Vehicles--focus on performance requirements and emergency equipment recommendations to facilitate passenger evacuation and minimize transit property damage.

These guidelines have been developed over the past several years, with input obtained from discussions and workshops with transit system and emergency response organization personnel, and from literature sources such as industry guidelines, codes and standards.

17. Key Words	18. Distribution Statement
Rail, Rail Transit, Emergency Preparedness, Emergency Plan, Emergency Response, Emergency Equipment, Evacuation, Access/ Egress	DOCUMENT IS AVAILABLE TO THE PUBLIC THROUGH THE NATIONAL TECHNICAL INFORMATION SERVICE, SPRINGFIELD, VA 22161

19. Security Classification (of this report)	20. Security Classification (of this page)	21. No. of Pages	22. Price
UNCLASSIFIED	UNCLASSIFIED	68	

PREFACE

This document contains recommended guidelines which ate designed to assist rail transit systems to assess, develop, document and improve their capability for responding to emergency situations, and to coordinate these efforts with emergency response organizations in a manner which best protects the traveling public and transit system facilities and equipment.

These guidelines have been developed over the past several years, with input obtained from discussions and workshops with transit system and emergency response organization personnel, and from literature sources such as industry guidelines, codes and standards.

The Recommended Emergency Preparedness Guidelines were prepared under the sponsorship of the Urban Mass Transportation Administration (UMTA), Office of Technical Assistance, Safety and Security Staff. The authors wish to thank Lloyd G. Murphy and Roy Field of UMTA, who provided direction and contributed valuable insights and helpful comments to enhance the final document.

The authors also wish to acknowledge the important contributions of the Emergency Preparedness/Fire Life Safety subcommittee of the American Public Transit Association (APTA) Rail Safety Committee. Additional thanks go to Ralph S. Weule of the Bay Area Rapid Transit District, sub-committee chairman, and Donald J. Dzinski, APTA staff advisor, for their detailed review and comments on the final draft of the Recommended Guidelines.

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, in^2)	=	6.5 square centimeters (cm^2)
1 square foot (sq ft, ft^2)	=	0.09 square meter (m^2)
1 square yard (sq yd, yd^2)	=	0.8 square meter (m^2)
1 square mile (sq mi, mi^2)	=	2.6 square kilometers (km^2)
1 acre = 0.4 hectare (he)	=	4,000 square meters (m^2)

MASS - WEIGHT (APPROXIMATE)

1 ounce (oz)	=	28 grams (gm)
1 pound (lb)	=	0.45 kilogram (kg)
1 short ton = 2,000 pounds (lb)	=	0.9 tonne (t)

VOLUME (APPROXIMATE)

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, ft^3)	=	0.03 cubic meter (m^3)
1 cubic yard (cu yd, yd^3)	=	0.76 cubic meter (m^3)

TEMPERATURE (EXACT)

[(x-32)(5/9)] °F = y °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 (k)	=	0.6 mile (mi)

AREA (APPROXIMATE)

1 square centimeter (cm^2)	=	0.16 square inch (sq in, in^2)
1 square meter (m^2)	=	1.2 square yards (sq yd, yd^2)
1 square kilometer (km^2)	=	0.4 square mile (sq mi, mi^2)
10,000 square meters (m^2)	=	1 hectare (he) = 2.5 acres

MASS - WEIGHT (APPROXIMATE)

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

VOLUME (APPROXIMATE)

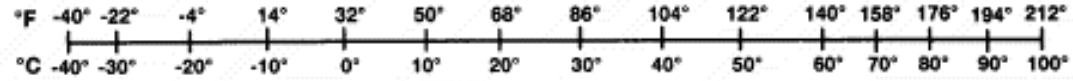
1 milliliter (ml)	=	0.03 fluid ounce (fl oz)
1 liter (l)	=	2.1 pints (pt)
1 liter (l)	=	1.06 quarts (qt)
1 liter (l)	=	0.26 gallon (gal)
1 cubic meter (m^3)	=	36 cubic feet (cu ft, ft^3)
1 cubic meter (m^3)	=	1.3 cubic yards (cu yd, yd^3)

TEMPERATURE (EXACT)

[(9/5) y + 32] °C = x °F

QUICK INCH - CENTIMETER LENGTH CONVERSION

QUICK FAHRENHEIT - CELSIUS TEMPERATURE CONVERSION



For more exact and or other conversion factors, see NBS Miscellaneous Publication 286, Units of Weights and Measures.
Price $2.50 SD Catalog No. C13 10286

Updated 1/23/96

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

LIST OF TABLES

1. INTRODUCTION

While the record of rail transit safety has been very good and few major accidents have occurred, it cannot be assumed that serious emergency events will not take place in the future. A review of past experience reveals that many minor incidents could easily have developed into life-threatening events had they not been detected and dealt with in a timely and effective manner.

In order to respond effectively to such occurrences, transit systems must engage in careful advanced planning. The level of a transit system's preparedness will directly influence the magnitude of hazard or damage in an emergency situation.

Recognizing this need, and in response to recommendations made by the National Transportation Safety Board's hearing concerning rail transit system safety, the Urban Mass Transportation Administration (UMTA) commenced development of recommended emergency preparedness guidelines, with the cooperation of the American Public Transit Association and representatives from various transit systems and emergency response organizations. These guidelines are intended to help rail transit systems to assess, develop, document and improve their site-specific capability for responding to emergency situations, and to coordinate these efforts with emergency response organizations in a manner which best protects the traveling public and transit system facilities and equipment.

1.1 EMERGENCY PREPAREDNESS CONCEPT

Safety planning is composed of two basic phases: a preventive phase and a reactive phase. The preventive phase is concerned with preventing the occurrence of the incident or accident. The reactive phase is concerned with the response once an incident or accident has occurred, and with minimizing its effect. The recommended emergency preparedness guidelines address this reactive phase and as such are directed not at preventing the incident or accident itself but at assisting rail transit systems in preparing for and responding to its occurrence in a timely and effective manner.

1.2 SCOPE

The emergency preparedness guidelines address four primary elements of a transit system's preparedness: Emergency Plan Development, Training, Facilities and Equipment, and Vehicles. Developed from input obtained from discussions and workshops with transit system and emergency response organization personnel, and from literature sources such as industry design guidelines, codes and standards, they are intended to reflect the best practices of the industry. These performance-oriented guidelines should serve to stimulate the improvements and innovations necessary to provide the public with safe and reliable transit operations.

The contents of the Emergency Plan Development and Training sections present minimum recommendations, procedures, and criteria which should be employed by all transit systems to evaluate and improve their respective emergency response capabilities. The contents of the Facilities and Equipment and Vehicles sections present minimum recommendations for the timely and effective evacuation of passengers as well as for the protection of equipment. It is intended that the guidelines in these two sections be used primarily for the planning of new systems, system extensions, and system rehabilitation. As such, they are not expected to have a major impact on existing rail transit system facilities and equipment or vehicles.

1.2.1 Emergency Plan Development

This section outlines the general elements which should be included in emergency plans. These elements are: policy, scope, agreements with emergency response organizations, rail transit system functions and responsibilities, general response capability criteria, and emergency preparedness supporting documentation.

1.2.2 Training

This section deals with the training of transit employees and emergency response organization personnel in the operational and emergency procedures of rail transit systems. Education of the riding public in regard to emergency procedures and equipment as well as required passenger emergency response is also included.

1.2.3 Facilities and Equipment

The major elements of a rail transit system's facilities and equipment are passenger stations, trainway, and Central Control. Components of these elements addressed in the guidelines include construction, lighting, access/egress, communications, ventilation, fire protection support equipment, intrusion protection (i.e., flammable/combustible liquid/gas, flood, highway), traction power removal, graphics, and emergency power.

1.2.4 Vehicles

For the purposes of these guidelines, "vehicles" are considered to be of two general types: passenger rail vehicles, and rail vehicles used for emergencies. The passenger rail vehicle section addresses transit vehicle construction, lighting, access/egress, communications, ventilation, on-board support equipment, mechanical equipment, graphics, and emergency power. The section for rail transit vehicles used in emergencies concerns vehicles used to respond to emergencies which occur within the confined trainway environment.

1.3 OTHER EMERGENCY PREPAREDNESS DOCUMENTATION

In addition to the Recommended Emergency Preparedness Guidelines for Rail Transit Systems contained in this report, the following resource documents should be utilized by rail transit systems to assess the status of their emergency response capability and to plan needed improvements:

(1) NFPA 130 Fixed Guideway Transit Systems. 1983.

(2) Guidelines for Design of Rapid Transit Facilities. APTA, 1981.

(3) Moving People Safely. APTA, 1977. (Under revision.)

(4) UMTA, "Light Rail Transit Car Specification Guide." Final Report, December 1981, Report No. UMTA-MA-06-00250-81-4.

(5) UMTA, "Transit Industry Technical Specifications for the Procurement of Rapid Railcars." Final Report, ~uly 1981, Report No. UMTA-IT-01775-81-3.

(6) NTSB, Special Study: Railroad Emergency Procedures, Report No. NTSBRSS-80-1.

2. EMERGENCY PLAN DEVELOPMENT

The recent experiences of several transit systems have demonstrated the need for development of formal emergency plans. Lack of planning and formal agreements specifying jurisdictional boundaries, chain of command and communications has, in some cases, hampered the ability to respond effectively to emergency situations. In addition, the absence of clear emergency procedures or information has resulted in confusion and delayed emergency response. The recognition of difficulties in these areas has prompted many transit systems to develop individual emergency plans which address the task of responding to emergencies in a timely and effective manner.

An Emergency Plan should contain the following elements: statement of policy, definition of scope, agreements with emergency response organizations, transit system functions and responsibilities, emergency procedures, general response capability criteria, and documentation supporting the emergency plan.

2.1 POLICY

The statement of policy should set forth the goals and objectives to be addressed by the tail transit system in developing its own emergency response capability and coordinating it with other emergency response organizations. The policy statement should indicate an explicit commitment to safety on the part of the top-level management of the rail transit system.

2.2 SCOPE

The plan should establish what constitutes an emergency. In addition, procedures should be developed for:

- Reporting the emergency,
- Evaluating and establishing the parameters of the emergency,
- Notifying emergency response organization personnel,
- Dispatching emergency response personnel and equipment to the emergency site,
- Coordinating the activities of all emergency response personnel,
- Protecting passengers, personnel, and equipment at the emergency site,

- Evacuation of passengers,

- Keeping passengers, employees, emergency response personnel, and other agencies informed, and

- Restoring the normal operations of the transit system.

2.3 INTER-ORGANIZATIONAL AGREEMENTS

Many emergency situations which occur in transit systems require or involve emergency response efforts from organizations outside the transit system. To maximize the effectiveness of this response and thereby minimize the effects of the emergency situation, there must be coordination among all the involved organizations. To ensure proper coordination and response, rail transit systems should establish agreements with these outside organizations prior to the occurrence of emergencies (see Appendix A).

Agreements represent the broad, top-level structure of legislative, legal, or political documents that serve as the formal basis of mutual understanding between parties. They should exist between the transit system and emergency response organizations outside the transit system, such as fire departments, emergency medical services, and police departments. Each agreement should be negotiated, consented to, and maintained within the transit system and each emergency response organization. Contents should include an outline of the type, quality, and response time of emergency-related services that can be made available to the transit system. They should also define financial responsibilities (where applicable) and establish the means for developing detailed procedures.

With the aid of these agreements, coordination during actual emergency situations should simply consist of following pre-established procedures. Any additional coordination needed because of the uniqueness of a specific emergency situation should be accomplished by following 1) the previously established chain of command contained in the agreements and 2) general precedent as documented in existing procedures, agreements, etc. inter-organizational agreements should contain as a minimum:

- 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.

- An outline of emergency response personnel and equipment to be provided to the transit system.

- When appropriate, an outline of the means for developing detailed response procedures and financial responsibilities.

- A definition of jurisdictional boundaries for responding organizations.

- A statement of how the document was developed, reviewed, and approved for use by the participating organizations.

- A statement of how subsequent proposed document changes will be reviewed, approved, and implemented as formal revisions by the participating organizations.

- A "Definition" section for special terms peculiar to the document, terminology of the transit system, and terminology of the other participating organizations.

- A section identifying training responsibilities.

2.4 TRANSIT SYSTEM FUNCTIONS AND RESPONSIBILITIES

The internal organizational structure of a rail transit system together with Rule Books, Standard Operating Procedures for Operating Personnel (SOPs), and emergency plan supporting documentation should provide sufficient basis for internal transit system coordination. The establishment of a chain of command assigning functions and responsibilities to appropriate personnel is crucial to the emergency response capabilities of a transit system. The following list contains the basic elements which should enable transit systems to coordinate internal and external response:

- Definition of functions and responsibilities during emergency situations of transit system personnel at supervisory centers, including operations, maintenance, and security. These should include the functions of Central Control, power, remote towers, tower control, station supervision, security dispatching office, and maintenance desk.

- List of telephone numbers of responsible transit system and emergency response personnel to be notified (covering 24 hours).

- Specification of criteria for deciding that an emergency requiring assistance from emergency response organizations exists and that the "Inter-Organizational Emergency Procedures" are therefore applicable.

- Procedures for determining the specific type, location and severity of the emergency and, thus, which "Inter-Organizational Emergency Procedure" is applicable.

- Procedures for notifying appropriate participating emergency response organizations when an emergency exists.

- Procedures and decision-making criteria for the establishment of various alternatives for local emergency control posts.

- Procedures and decision-making criteria for the orderly transfer of command responsibility between personnel of participating organizations and personnel at different control centers.

- Procedures and decision-making criteria for deciding that the emergency situation no longer exists and that the "Intet-Organizational Emergency Procedures" are no longer applicable.

2.5 EMERGENCY PROCEDURES

Emergency procedures for each of several emergency categories should be established. The procedures should specify necessary tasks to be performed within a time or event sequence by appropriate transit system and emergency response personnel. The emergency procedures should as a minimum address the following emergency categories:

- Train fires,
- Trainway fires,
- Station fires,
- Train derailment/collision,
- Death or injury to patron,
- Train evacuation,
- Bomb threat,
- Total power failure,
- Flammable/combustible liquid or vapor intrusion,
- Trainway intrusion,
- Suicide/trainway injuries or fatalities,
- Natural disasters (high winds, flood, earthquake, etc.).

2.6 GENERAL RESPONSE CAPABILITY CRITERIA

Each transit system should address the following key response areas:

- Notification,
- Communications,
- Removal of traction power from vehicles,
- Ventilation,
- Coupling and uncoupling of vehicles,
- Evacuation,
- Firefighting.

Adequately designed procedures for these emergency preparedness response areas should insure consistency in their preparation. The following questions comprise a suggested checklist:

- Who provides the initial report of the incident?
- What actions should be taken as a first reaction to the initial report of the incident?
- Who relays the initial report of the incident to Central Control?
- What actions are initiated to verify or improve the initial report of the incident?
- Who decides that the reported incident is in fact an emergency and determines the particular category?
- Who decides which particular set of standard emergency procedures or combination of procedures is best used with the particular emergency at hand?
- How should the initial actions be modified in response to verified reports of the nature, severity, and location of the incident?
- If the incident is first reported from on board a train while it was moving between stations, who decides if the train should be stopped or moved to the next station?
- If it appears necessary to turn off traction power, who makes the decision to do so?
- Who turns off the traction power and how is it done?
- What provisions are made to assure that traction power is in fact off in the appropriate section(s)?
- If the incident is a fire/smoke situation, who makes the decision to call the fire department? What criteria are used to make the decision?

- If there are injuries or fatalities, who makes the initial assessment as to size, type and level of emergency medical response required? What criteria are used to make the decision?
- If it appears that evacuation of a station or train may be necessary, who makes the decision to evacuate? What criteria are used to make the decision?
- If it is decided to uncouple derailed or burning cars from trains for evacuation of passengers, who makes the decision to use this strategy?
- If it is decided to evacuate a train, who decides the best procedure, route, timing, etc., for evacuation? How are these choices determined?
- What special services for the evacuation of elderly and handicapped are necessary?
- If there is a fire/smoke situation in a tunnel, who decides the initial ventilation strategy? How is it determined?
- If it appears that special services are needed (bomb squad, coroner, extrication equipment, pumps, etc.), who decides and specifies the need?
- As various groups of emergency response personnel arrive on the incident scene, how is the chain of command changed and maintained?
- Once initial decisions regarding requests for assistance, evacuation, or ventilation are made, how are changes implemented in accordance with revisions in the chain of command?
- Have such factors as access, egress, availability of equipment, visibility, communication, etc., been considered?
- Have provisions been made to maintain transit service on unaffected portions of the system and to supply alternative service in the affected areas?
- Who decides when traction power can be restored to the incident area? What criteria are used to make this decision?
- Who decides when normal service can be resumed through the incident area?

2.7 EMERGENCY PLAN SUPPORTING DOCUMENTATION

Individual procedures are typically written as if one person could ideally and simultaneously visualize concurrent events arid actions taking place at various locations and involving various people throughout the transit system (Table 2-1 lists examples of transit system emergency

plan supporting documentation). 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 training, memorization, and developing experience may seem wordy and bulky when seen in terms of the action and decision-making time frame required of a Central Controller or other operating personnel in a true emergency situation. It cannot be assumed that an actual emergency will be quickly identified and properly classified as to type, location and severity. Nor can it be assumed that the emergency will elicit the proper initial commands, or the proper initial response to the commands.

A real-life, one-of-a-kind, dynamic emergency situation is not easily portrayed. Yet early decisions are crucial to all that follow. Sequences of calls or handoffs of commands are usually based on a few key early decisions (often irreversible) by rail transit system personnel, such as the decision to cut traction power in certain sections, the decision to evacuate a train between stations, or the decision to call the fire department. Such decisions should ideally 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 emergency preparedness plans and/or procedures document should be based on the assumption that key decisions must be made as quickly as possible. To facilitate this, simplified summary checklists should be instituted as memory aids for use in an actualemergency. A checklist should exist for each central position. Each checklist should be specially prepared to address the expected actions of that position.

2.7.1 Decision-Making Aids

Transit systems have developed various forms of "decision-making aids" for emergency preparedness information. These decision-making aids are used to determine which particular set of emergency procedures to follow, and also provide specific information regarding location of equipment, exits, etc. The decision-making aids also offer a means of shortening the response time of the Central Controller. Each rail transit system should have its own system-specific collection of such aids, tailored to the individual needs of the transit personnel who will use them during emergencies. Examples of typical decision-making aid concepts that may prove useful to rail transit systems are described below and listed in Table 2-1.

TABLE 2-1. EXAMPLES OF TRANSIT SYSTEM EMERGENCY PLAN SUPPORTING DOCUMENTATION

1. Policy and Agreements.

2. Inter-Organizational Emergency Procedures.

   - "NYCTA Executive Interagency Standard Operating Procedure."
   - BART "Emergency Plan".
   - WMATA METRO "Rapid Rail Transit Fire/Rescue Operations Procedure Guidelines."

3. Decision-Making Aids for Central Controllers.

   - Checklist reminders of key actions.
   - Definition of jurisdictional boundaries (fire service, hospital, EMT, etc.)
   - Emergency Facility Location Schematics

     CTA Milwaukee-Kimball and State Street Subway Maps

     "Fire Maps" used at WMATA.

     PATH Carousel of slides (maps) in Central Control console.

   - BART Microcomputer Data Retrieval System.

4. Decision-Making Aids for Operating Personnel.

   - Emergency Facility Location Schematics
   - Wallet-size index of emergency exits and emergency phone numbers used at MBTA.

5. Decision-Making Aids for Emergency Response Personnel.

   - Emergency Facility Location Schematics

6. Major "Accident Investigation" reports from past emergencies.

2.7.1.1 Decision-Making Aids for Central Controllers - Once the Central Controller determines the type and location of the emergency incident, it is possible to evaluate various alternative evacuation routes, ventilation strategies, and access routes for emergency response personnel. After careful consideration, the best alternative is picked and commands initiated accordingly. These commands might use location information such as power section numbers, pump numbers, and fan designations, obtained from other sources. In order to act effectively, the Central Controller must have immediate access to this type of information. The decision-making aids that follow will help facilitate this process.

- Checklists/Reminders of Key Personnel Actions -The simplest example of a decision-making aid is a reminder checklist of actions summarized from the full set of emergency procedures documents. Such memory and decision-making aids will shorten the response time of the Central Controller.
- Definition of Jurisdictional Boundaries - Schematics, maps, tables, or other system-specific operations documentation should be developed to aid the decision-making process associated with calling the proper fire department, police department, emergency medical response unit, etc., for a given emergency type and location on the transit system. The details of jurisdictional boundaries for responding organizations should be worked out well ahead of time as part of the coordination element of emergency preparedness and documented in the “Inter-Organizational Agreements” document. This information should be encapsulated in the pertinent decision-making aid to reduce Central Controller response time.
- Emergency Facility Location Schematics - Schematic maps which show the location of passenger stations, city streets, vent shafts, emergency exits, exhaust fans, hydrants, distance markers, and telephones for sections of trackway are useful decision-making aids. This type of decision-making aid should be developed for use by the Central Controller for making decisions regarding the best routes for passenger evacuation, the best access routes for emergency response personnel, ventilation strategies, and the like. If available, this information could aid the Central Controller's command/control functions during emergencies.
- Information Retrieval Systems - A computerized information retrieval system has been utilized by a number of transit systems in an effort to store the type of information contained on the schematic maps previously described. During an emergency, this information can be accessed more quickly. In addition, predetermined evacuation strategies and ventilation control, depending on the location of the train incident, are available.

2.7.1.2 Decision-Making Aids for Other Operating Personnel and Emergency Response Personnel - Decision-making aids for operating personnel other than Central Controllers should be portable, handy, and consistent with the corresponding aids used by the Central Controllers. Such documentation should be considered as essential.

2.7.2 Accident Information from Other Transit Systems

Major "Accident Investigation" reports from other transit systems should be utilized in the development and revision of emergency plans. Specific examples of these are the "PATH, Investigation Report, March 16, 1982 Fire;" NTSB accident investigation reports such as the "BART Fire on Train ~117 and Evacuation of Passengers While in Transbay Tube, San Francisco, January 17, 1979;" and other analysis reports such as "Reports on the Transbay Tube Preferred Evacuation Method."

2.7.3 Standard Operations Documentation Used During Emergencies

Facilities, equipment, personnel, and procedures regularly utilized during normal transit operations are also frequently utilized during an emergency. Table 2-2 contains examples of rail transit system standard operations documentation which may be used during emergencies. It is essential that these materials containing information relating to emergency preparedness be kept up to date.

- A formalized process of review, revision and reissuance of documents in whole or part relating to emergency preparedness should be established.

2.7.3.1 Rule Books and Standard Operating Procedures - Most rule books and standard operating procedure books (SOPs) contain sections describing what steps to follow when certain kinds of emergencies occur.

- These rule books and SOPs should contain procedures, notification lists, etc., consistent with those included in the master emergency plan.

2.7.3.2 Safety Rules and Emergency Procedures - Safety rules and emergency procedures are often included in the same document with standard operating rules and procedures. Safety rules are generally preventive in nature whereas emergency procedures are reactive and correspond to specifically categorized unforeseen events such as derailment, fire, collision, etc.

- Mastery of safety rules and emergency procedures on the part of operating personnel should be considered just as important as mastery of the standard rules and standard operating procedures.

2.7.3.3 Descriptions of Facilities and Equipment - Facility and equipment information such as maps showing the location of emergency exits, track plans, and yard areas, diagrams of vehicle subsystems, and colored pictures of signal aspects will assist in employee understanding and recall of particular sets of rules or procedures in the event of an emergency. Additional descriptions of facilities and equipment such as aids to maintenance, signal and communications systems, vehicles, etc., are typically found in maintenance shops.

- Descriptions of facilities and equipment should be evaluated for their applicability as reference in the overall emergency preparedness process.

- This evaluation should include their use as training aids, as a common reference to aid verbal communication between persons at different locations, and as study aids to assist in visualization and decision-making.

- As new equipment or components are added to the transit system, descriptions of those which might be used during emergencies should be made available to appropriate personnel.

- The availability and intelligibility of these materials to large numbers of personnel, in relation to the need and timing requirements of emergency preparedness, should be periodically evaluated.

2.7.3.4 Station and Vehicle Graphics - Signs indicating emergency equipment locations and emergency procedures can provide critical information for reacting to emergency situations.

- All graphics should meet the requirements of local regulatory authorities.

- All graphics containing station and vehicle emergency preparedness information should be evaluated periodically for number, placement, readabiaity, message content, intelligibility, and consistency with all other transit system standard operations documentation.

TABLE 2-2. EXAMPLES OF RAIL TRANSIT SYSTEM STANDARD OPERATIONS DOCUMENTATION USED DURING EMERGENCIES

1. Rule Books for All Operating Personnel
2. Standard Operating Procedures for All Operating Personnel Safety
3. Rules and Emergency Procedures for All Operating Personnel
4. Descriptions of Facilities and Equipment
5. Graphics in Stations and Vehicles for Passenger Awareness
6. Civil Defense or "Local Disaster Plans"

2.7.3.5 Training Materials - Training materials such as brochures, lesson plans, classroom presentations, incident scenarios, films, video tapes, and mock-ups should also be used in preparing for emergencies.

3. TRAINING

The transit personnel who respond to emergency situations are the most vital element of a transit system's emergency response capability. Proper training of these and other emergency response personnel is therefore essential. Only after adequate training can response personnel be expected to carry out an emergency plan in a timely and effective manner, while making optimum use of facilities, equipment, and vehicles.

The emergency procedures guidelines presented in this section address the following issues:

- Transit system personnel knowledge of the transit system emergency response plan, facilities, equipment and vehicles.

- Emergency response organization (Fire, Police, etc.) personnel knowledge of their own emergency response plan, and of transit system facilities, equipment and vehicles.

- Passenger awareness of transit system emergency preparedness procedures, facilities and equipment.

By and large, transit 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 equipment and facilities of the other group. Therefore, training improvements should focus on familiarizing fire and life safety personnel and transit system personnel with each other's facilities, equipment, operations, and supporting documentation.

Improvements in facilities and equipment associated with emergency preparedness tend to be more expensive and less frequent than operational changes, so that after the initial round of employee training, further review training in these areas need only occur periodically. On the other hand, operational documentation relating to emergency preparedness is less expensive, easier to improve, and more likely to change than existing facilities and equipment. Training sessions to implement documentation changes should, therefore, occur more frequently to keep abreast of such changes.

Passenger awareness with regard to emergency preparedness procedures deserves special consideration. Passenger behavioral response, as anticipated by the designers of emergency procedures, is crucial. Training of passengers, however, cannot be accomplished in a

classroom environment as it can with transit employees and emergency response personnel. Other methods of informing and guiding passengers should therefore be considered. These might include putting safety information posters in advertising spaces on trains and in stations, periodic train operator announcements of safety tips using the public address system, or perhaps distributing brochures at major terminals.

3.1 RAIL TRANSIT SYSTEM PERSONNEL TRAINING

The actions of most transit personnel (particularly train crews) are primarily associated with standard transit operations. Similarly, the largest percentage of initial training for train crews is usually devoted to standard operating procedures. However, this training usually includes preventive safety rules and emergency procedures. Although the majority of transit personnel may never be called upon to use many of these rules and procedures, they should nonetheless be familiar with them. It is recommended that the following training be provided at all transit systems:

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);

Refresher and/or retraining courses for both phase 1 and phase 2.

3.1.1 Initial Training

Rail transit systems should conduct an initial phase of training for their personnel. This training should include an overview of the rail transit system and should provide a means for employees to familiarize themselves with the operating rules, procedures, the layout of facilities, and the basic location, use and application of communication and emergency equipment as they relate to emergency preparedness. The following elements should be included:

A. Operating Rules

- All rail transit systems should provide employees with rule books. (Rule books should be of a type - e.g., looseleaf - which allows for addition or deletion of pages to reflect revisions.)

- Special rule notices, rule updates, and modifications should be disseminated in a variety of ways: provided by supervisors, posted on bulletin boards, and/or presented in training sessions.

- Rail transit systems should document that their personnel have received read, and understood new or revised information.

B. Standard Operating Procedures

- Standard operating procedures (SOPs) should establish guidelines for handling all normal, abnormal, and emergency rail transit operations.
- Initial training in emergency operating procedures should begin with discussions on what an emergency is and what occurrences, either on the train or trainway, could create an emergency situation endangering the safety of passengers and/or employees.

C. Layout of Facilities

- Rail transit systems should provide facility layout orientation through films or video tapes and/or walking tours of the facilities.
- Training should emphasize the location and operation of normal and emergency exit controls, communication equipment, and other safety features of the facilities.

D. Communication Equipment

- Transit system training should familiarize personnel with the location and proper use of communication equipment.
- Training programs should stress the communication of priority information as a means of minimizing transmission time and facilitating action.
- Rail transit training programs should provide operating personnel with specialized training in how to communicate with passengers.

E. Emergency Equipment

- Transit systems should train their personnel in the location and use of specialized emergency equipment associated with their assigned duties.
- Transit systems should train their operating and maintenance personnel, supervisors and inspectors to report lost, stolen, or vandalized equipment.

Appendix B contains a typical list of rail transit emergency equipment.

3.1.2 Specialized Emergency Training

Depending on their specific job responsibilities, rail transit employees should be given specialized training involving a variety of emergency situations.

- Transit systems should include elderly and handicapped (E&H) concerns in their training programs.
- Transit systems should provide separate training programs for emergency operating procedures.
- Training sessions should be designed to teach employees emergency procedures they will be expected to carry out.
- Emergency procedures documents should be used as a format for the training sessions.
- Transit systems should conduct drills which simulate emergency situations in a realistic manner.
- Emergency drills should include programs to teach personnel to identify the emergency and distinguish its unique demands, and to follow through with the appropriate responses.

Central Control is often the transit system organization that initiates the response to an emergency situation. Though remote from the emergency scene, well-trained Controllers have the capability of reducing the effects of an emergency situation. To be effective, a Central Controller should be:

- Familiar with the train operator's job and environment, as well as with the facilities that are available to him;
- Familiar with details of the fixed facilities; and
- Knowledgeable about the capabilities, limitations, and typical failure modes of vehicles, train control, power, and communications systems, etc.

Operating and supervisory personnel, maintenance personnel, and transit police should as a minimum be taught the characteristics of and appropriate response to the following emergency situations, depending on their specific job responsibilities:

- Fire/Smoke in Tunnel;
- Fire/Smoke in Train, or Under Train;
- Fire/Smoke on Trainway, or Adjacent to Trainway;
- Fire/Smoke at Station;

- Derailment, Collision, Structural Collapse;
- Passenger Evacuation from Train;
- Person on Trainway;
- Sick Passenger;
- Hostage Situation;
- Civil Disorder;
- Bomb Threat;
- Total Power Failure;
- Flood;
- Flammable/Combustible Liquid/Vapor Intrusion;
- Severe Weather (Snow, Ice, High Winds), Natural Disasters;
- Situations consisting of combined categories, such as:
  - Derailment, Collision, Passenger Evacuation from Train;
  - Derailment, Collision; Fire/Smoke in Tunnel; Passenger Evacuation from Train.

The remainder of this section focuses on specialized training in the following areas of emergency procedures: emergency tunnel evacuation, emergency tunnel ventilation, firefighting, emergency passenger care, crowd control and panic prevention, uncoupling of rail transit vehicles, and removal of traction power.

A. Emergency Evacuation

- Rail transit systems should provide special tunnel orientation activities, not only for their own personnel, but for emergency response personnel who may become involved in an emergency situation.
- Training should include visual aids depicting the tunnel environment and walking (or riding) tours for greater familiarization.
- Transit systems should conduct evacuation drills periodically both for their own petsonnel and for emergency response personnel.
- Transit systems should provide visual aids portraying a simulated emergency tunnel evacuation and demonstrating the appropriate application of emergency procedures by employees.

- Transit systems that use ladders, ramps, planks, and/or stretchers for emergency evacuation should ensure that their operating personnel know the location and use of these items.

B. Emergency Tunnel Ventilation

- Transit systems that have forced ventilation systems should provide specialized training for Central Control personnel, supervisors, and emergency response personnel in accordance with operations documentation for managing ventilation during emergencies.

- Transit systems that rely on train movement, natural air flow and/or grates between tunnel and surface to provide ventilation, should establish procedures and training in accordance with these limitations.

C. Firefighting

As a general rule, after reporting a fire situation, the first-priority action of transit personnel on the scene should be to assist passenger evacuation and to assist fire department personnel in gaining access to the fire. Many transit systems acknowledge 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 those transit personnel expected to perform such assistance duties, it is advisable to train them in the rudiments of firefighting. Such training will enable them to: make better decisions during fire emergency situations; fight small fires prior to the arrival of the fire department when it is prudent to do so; and devise improved methods of fire prevention while performing their regular duties. Such training may be developed and conducted in cooperation with local fire and rescue personnel. The firefighting training programs should address the following areas:

- Familiarity with use, application, and location of appropriate extinguishing equipment.

- Procedures for reporting used and missing fire extinguishers, in order that fire extinguishers can be promptly refilled or replaced if missing.

D. Passenger Emergency Care Training

Rail transit systems should provide emergency care training to appropriate employees. These emergency care training programs may involve the following:

- First aid treatment of hemorrhages, bruises, abrasions;
- Recognition and immobilization of passengers with head and back injuries; Cardio-pulmonary resuscitation (CPR); Treatment of respiratory blockages and convulsions.

E. Crowd Control and Panic Prevention

- When possible, training programs in crowd control and panic prevention techniques should be developed for use by rail transit operating personnel.

F. Emergency Uncoupling of Rail Cars

- Appropriate personnel should be provided with training in techniques for uncoupling rail cars in emergency situations.

G. Removal of Traction Power from Vehicle

- Rail transit systems should provide training in the emergency removal of traction power from the system.

3.1.3 Refresher/Retraining Programs

Refresher/retraining programs should be instituted to:

- Inform employees of changes in procedures and equipment;
- Ensure that employee skills remain at a level which enables them to execute their responsibilities in an effective manner;
- Reinforce a segment of the program for an individual who has not performed properly; and
- Recertify personnel in job positions (e.g., train operators).

A continuous cycle of specialized training, followed by periodic refresher training, etc., should be performed. Simulation drills, equipment and procedural changes, and employee skills should be reviewed on a regular basis to determine the need for refresher training. Employees should be made to understand the importance of training repetition.

3.1.4 Training Methods and Equipment

Rail transit systems should have formal methods for training train operators, Central Controllers and other personnel. These formal methods should include -but not be limited to - classroom instruction,

on-site familiarization, and emergency response training drills for rail transit and emergency response personnel, and the public.

- Regular training and review should be used to identify inconsistencies in operating rules, standard operating procedures, and crew duties. Elimination of such inconsistencies will help to avert future confusion.

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

A. Rulebooks, SOPs and Emergency Procedures

- Materials should be thoroughly discussed and examinations should be administered to appropriate personnel.

B. Audio-Visual Training Program

- Rail transit systems may utilize films, videotapes, and/or slide presentations to illustrate the emergency response and evacuation procedures to be used by Central Control supervisors, on-site supervisors, train operators, station attendants, transit police, the public, and fire/rescue personnel. These tools should also be used for ongoing refresher training courses.
- The audio-visual presentation should stress the importance of intradivisional teamwork and inter-organizational coordination, and the types of specific evacuation procedures to be followed by the train crew and responding units involved in an emergency evacuation.

C. Mock-ups

- When desirable, small scale mock-ups of particular types of equipment, such as operating cabs, signals, control center consoles, radios, and motor controllers may be utilized.

3.1.4.2 On-Site Familiarization - On-site familiarization for transit employees may be handled by transit systems in a variety of ways, including on-the-job training, walking (or riding) tours, demonstrations and/or hands-on practice sessions.

A. On-the-Job Training

- Following classroom instruction, transit systems should offer supervised on-the-job training that provides the trainee with hands-

on experience and an operational understanding of rules and procedures.

B. Walking Tours

- Walking tours of the facilities (stations, tunnels, emergency exits, etc.) should be required to further enhance the trainee's familiarization with the rail transit environment.

C. Demonstrations/Practice Sessions

- Actual hands-on practice sessions should follow videotape or film presentations of equipment and procedures to raise the skill level and lower the emergency response time of personnel.

3.1.4.3 Emergency Response Training Drills - Emergency response training in the form of drills should be carried out by rail transit systems. The drills may vary from full-scale emergency simulation drills involving both rail transit and emergency response organization personnel, to drills for rail transit personnel only or even for a particular employee (e.g., a train operator). More importantly, the simulation drills should serve as a means for evaluation of the overall emergency response capabilities of the system through careful selection of the time and location of drills, the location of monitors, and the performance of a simulation critique. Drills may be held during revenue service or non-revenue service periods (if they exist), or prior to the start-up phase operations on a new extension or a new rail transit system. The rail transit and emergency response organization drill participants will vary depending on the scope and objectives of the drill.

A. Simulation Drills

- Rail transit systems should conduct simulation drills to reinforce classroom training in emergency response and passenger evacuation for rail transit personnel, as well as for the emergency response team that would respond in the event of an emergency.
- These drills should serve as a mechanism for simultaneous testing and reinforcement of emergency operating procedures for track and tunnel fires, carborne fire, smoke removal, and passenger evacuation procedures.
- Drills should test the transit system's emergency communication capabilities, and the operability and effectiveness of other emergency equipment.
- Drills should test training and retraining procedures, response capability, and any changes in these areas.

The following aspects should be considered in planning and conducting simulation drills:

- Drills Prior to Start-Up. New rail transit systems should hold drills simulating various rail transit emergencies on new sections of the system that have not opened for revenue service. These drills should be held for rail transit personnel and emergency response organization personnel.
- Drills During Non-Revenue Service Period. If non-revenue service periods exist, transit systems should schedule emergency simulation drills during these periods.
- Drills During Revenue Service. Rail transit systems should drill such employees as operators, conductors, supervisors, and Central Control personnel on emergency operating procedures during revenue service by posing an emergency situation for the rail transit personnel to resolve, without actually interrupting revenue service or dispatching fire/rescue personnel to the scene of the hypothetical emergency. These may be general notice drills, employee notice drills or no notice drills, depending on how many transit employees, emergency response personnel, and passengers are informed beforehand.
- Location of Monitors. The selected monitor locations should allow monitors to view the following events:
    - The initial phase of communications between the train operator and Central Control,
    - The implementation of evacuation procedures by the train crew and responding units,
    - The passenger evacuation process,
    - Emergency medical technicians administering first aid to victims in the triage area,
    - Use of passenger evacuation equipment,
    - Emergency command post operations,
    - Firefighters' response efforts.

Performance of a Simulation Critique. The purpose of a critique is to review the reports of the monitors, to present comments or observations from sources other than the observers, 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. Videotaping the simulation drill provides observers and reviewers with an overview of the entire operation, and thus serves to enhance the critique.

B. Emergency Simulation Facilities

- Each rail transit system should have the ability to simulate emergency situations, either in areas of the rail yard set aside for drills (e.g., for training operating personnel how to use the end door emergency ladder for passenger evacuation) or areas located in portions of the transit system itself.

C. Drill Participants

Although drills are held primarily for transit personnel, other emergency simulation drills should include various emergency response organization personnel. Following is a list of possible rail transit and emergency response organization drill participants:

- Rail Trarisit Participants
    - Upper management staff (e.g., General Manager, Assistant General Managers and Directors of various rail operation departments),
    - Train operators/conductors ,
    - Central Control personnel,
    - Power dispatcher,
    - Line supervisory personnel,
    - Maintenance,
    - Rail transit police.

- Emergency Response Participants
    - Upper management fire staff (e.g., Deputy Chief, Assistant Chief, Chief, etc.),
    - Fire/Rescue personnel (e.g., firefighters, rescue personnel and midstaff personnel such as lieutenants, captains, battalion chief, etc.),
    - Fire alarm personnel,
    - Emergency medical service personnel,
    - Police,
    - Utility personnel (i.e., electric, water, gas and telephone),
    - Other relevant personnel.

3.1.5 Inter-Transit System Information Exchange

Rail transit systems should consider sending some of their employees to attend training programs at other rail transit systems. The sharing of ideas and perspectives regarding emergency response capabilities would be in the interest of all participating transit systems. Although this

approach is limited - because of the site-specific nature of equipment, local inter-organizational agreements and facility characteristics - attendance of personnel from other transit systems during a particular system's emergency simulation drills could afford valuable insights.

3.2 EMERGENCY RESPONSE ORGANIZATION PERSONNEL TRAINING

Rail transit systems should make training in emergency procedures available to firefighters, local police, ambulance personnel/paramedics, and other emergency response personnel, in accordance with "Inter-Organizational Emergency Procedures" operations documentation and the specific training identified in section 3.1.

Rail transit systems should provide the upper management staff of the fire department with information regarding the coordination of activities associated with rail transit emergency situations.

Rail transit systems should similarly make training available for fire alarm center personnel (fire/rescue dispatchers). Fire alarm center personnel perform an important role in the coordination of a rail transit emergency as the link between the rail transit Central Control operators and fire, police and rescue personnel.

The training programs for emergency response and fire alarm center personnel should encompass all or part of the following areas:

- Overview of the rail transit system including orientation and familiarization with facilities,equipment, and normal and emergency operating procedures.

- Orientation tours of stations and tunnels for emergency response personnel, to point out features described in formal presentations and to highlight the specific physical configuration of each segment of the system.

- Emergency situation drills involving all participating organizations to practice and reinforce the emergency response and evaluation procedures.

- Utilization of the various communication capabilities, including:

    - Telephone conference calls,
    - Radio links between the fire alarm center and firefighters at the scene of the fire or at Central Control,

- Direct phone line between Central Control and the fire alarm center,
- Wayside telephones or Private Automatic Branch Exchange (PABX) telephones, and
- Maintenance telephone system.

- Periodic training for emergency response personnel to cover shift assignment changes, area rotations, etc.

3.3 PUBLIC EDUCATION

Rail transit systems should employ the following methods to improve the public's ability to respond to emergency situations:

- Public involvement in simulation drills,

- Rail safety and emergency procedures for passengers publicized on posters in stations and vehicles,

- Safety brochures for public dissemination.

3.3.1 Passenger Awareness

Passenger education and training should be conducted to make passengers aware of emergency procedures and enable them to respond properly in the event of an emergency.

This should be accomplished primarily by the distribution of pamphlets, the posting of information in stations and transit vehicles, and broadcasts over the public address systems in the stations and transit vehicles. The information from these various sources must be consistent in content, sufficient for first-time users of the system (especially from posters), but not so overwhelming as to arouse undue concern.

Passenger emergency preparedness training should include information on:

- How to recognize and immediately report emergency situations to transit employees;

- How to recognize system hazards (e.g., third rail, other high voltage equipment, passage between cars, etc.);

- How to recognize and operate appropriate emergency-related facility features and equipment, such as:

    - Vehicle intercom to train operator,
    - Vehicle fire extinguishers,
    - On-board emergency stop devices,
    - Vehicle side doors,
    - Vehicle end doors,
    - Ladders, ramps, and planks for facilitating vehicle evacuation,
    - Devices for assisting evacuation and rescue of elderly and handicapped passengers,
    - Subway emergency exits, doors, grates, etc.,
    - Station emergency phones;

How to recognize and anticipate the potential special needs of fellow passengers (children, elderly, handicapped, etc.) during emergencies.

3.3.2 School Safety Program

Rail transit systems should conduct regular safety programs in the schools of the communities adjoining the rail transit system trainway. Such programs should be designed to highlight the numerous safety hazards on rail transit property, such as third rail power, and the dangers of throwing rocks, tampering with switches, placing objects on the tracks, etc. Such programs are especially important for transit systems in the process of developing a new system or extension, prior to initiating operations.

4. FACILITIES AND EQUIPMENT

The guidelines presented in this section are designed to help transit systems ensure that they possess the facilities and equipment needed to cope effectively with emergency situations. These guidelines are intended for use primarily in the planning of new systems, system extensions, and system rehabilitation.

The main elements of a rail transit system's facilities and equipment are passenger stations, trainway, and Central Control. Each of these areas and their respective components are considered in this section. In each instance, the guidelines presented here are of a general nature, allowing for the site-specific differences among transit systems. The guidelines have been developed from a variety of sources, including workshops, discussions with transit system personnel, and available literature sources including industry design guidelines, codes, and standards. These guidelines are performance-oriented, and are intended to reflect the best practices of the rail transit industry.

4.1 PASSENGER STATIONS

Rail transit passenger stations are located in four basic environments: underground, elevated, at grade, and open cut. Although rail transit 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. Additional information pertaining to specific station environments may be obtained from the sections describing trainway elements.

4.1.1 Construction

Transit station construction should provide for rapid patron evacuation and rapid emergency response personnel access for potential emergency scenarios. With this in mind, transit station construction should take the following into consideration:

- The system safety concept should be applied in the station planning phase to identify and resolve potential safety hazards associated with a transit system's emergency response capabilities.

- Critical station egress and access paths should be identified in the planning phase, and thereafter remain unobstructed.

- Concourses may or may not exist in rail transit stations, depending on station design. In any event, access/egress through department stores or other non-transit buildings should not be considered among the emergency exit requirements for stations.

4.1.2. Lighting

Lighting is an essential factor in many emergency situations, particularly in underground stations. It can also play an important role during hours of darkness at elevated, at grade, or open cut passenger stations.

- The minimum illumination level for emergency lighting should furnish sufficient visibility in passenger station areas - platforms, mezzanines, ticketing areas, passageways and entrances - to allow passenger evacuation from these areas.
- Emergency lighting fixtures and power sources should be protected from damage caused by accidents, water, maintenance to adjacent equipment, or vandalism.
- The emergency lighting should conform to the codes and regulations of authorities having proper jurisdiction.
- The emergency lighting system should be activated automatically upon loss of the normal lighting system and provide continuous operation for an amount of time specified by the individual transit system. This time-span should be determined by the amount of time necessary for safe evacuation of passengers from the station.
- Lighting fixtures in 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 towards the bottom of the walls of the station to provide visibility for passenger evacuation under smoke conditions. (Such fixtures should be vandal-proof.)

4.1.3 Access/Egress

The amount of available adequate access and egress is an important design consideration for rail transit passenger stations. The number and location of entrances and exits, as well as the arrangement of such facilities as concessions, station attendant kiosks, faregates, revolving gates, public stairways, escalators, and elevators within the passenger station, all determine the extent to which access/egress is judged to be adequate for evacuation during emergency situations.

Station exits are particularly important facilities during emergency situations because they provide the primary means of evacuating passengers from the system. They also provide an entry into the system for fire/rescue personnel.

- Each emergency exit should be identified by graphics and by a light of distinctive color, and provided with 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 issue onto a hazardous area such as a vehicle roadway or parking area, and should be kept free of such obstructions as vendor carts, trash dumpsters, etc.
- Emergency exits should have the capability of being readily opened from the outside by the fire department or other rescue personnel.
- The use of vertical ladders in emergency exits should be prohibited.
- All doors, ladders, etc., that do not provide egress capability should be clearly labeled "Not an Exit."
- The needs of passengers with special egress requirements (wheelchair, elderly, etc.) should be addressed. Faregate areas, exits, etc., should be evaluated for ease of evacuation by those passengers.
- Consideration should be given to developing a means of limiting access to station platforms when overcrowded conditions exist.

4.1.4 Communications

Passenger station communication systems make possible the reporting of emergencies and crimes, requests for assistance, announcements to passengers, visual surveillance, and coordination of fire/rescue efforts. The different types of equipment available for these uses are: radio, private automatic branch exchange (PABX), direct line telephones, maintenance line telephones, public add ress system (PA), intercoms, data transmission cables, and closed circuit television (CCTV).

- A communication system should be provided between all stations and Central Control to permit rapid and coordinated communication between passenger stations and Central Control.
- The P.A. system speakers should be installed in a manner which allows announcements made by a station attendant or Central Control to be clearly understood by passengers.
- The P.A. system should have an alternate source of power to permit use when the normal power system fails.

- P.A. system components should be protected from unauthorized use, vandalism, or other damage.
- The direct two-way line telephones should receive redundant power from an alternative power source.

4.1.5 Ventilation and Air Conditioning

Ventilation (and air conditioning) systems provide passenger comfort by dissipating heat from train and station operations, and by removing objectionable odors. Ventilation systems are also used to purge smoke and heat in the event of a fire. In addition, the proper operation of fans and dampers may play a critical role in confining the fire and smoke to a limited area. Proper design of ventilation systems is essential for emergency preparedness in rail transit stations.

- The local fan and damper controls should be clearly identified by lighting and/or graphics.
- Consideration should be given to providing a portable stand-by power source or other auxiliary power for ventilation system operation.
- Fans and dampers should be remotely controlled from Central Control.

4.1.6 Support Equipment and Systems

4.1.6.1 Fire Protection Equipment

A. Location of Detection and Alarm Boxes

- Fire and smoke detection devices should be located in non-public areas of rail transit stations. Ancillary and/or storage rooms located in stations are of particular importance.
- Manual alarm devices should be of a type to discourage activation except during an actual fire/smoke condition. It may be advisable to install them within the station attendants' line of vision.
- Graphics and lights on annunciator panels in passenger stations should indicate the geographical location of alarms.

B. Portable Fire Extinguishers

- The location of fire extinguishers and simple instructions for their use should be clearly identified with graphics within the rail transit station.
- Fire extinguishers should be protected from theft or vandalism.

C. Standpipe and Hose Systems

- If standpipe and hose systems are used, they should comply with the requirements of NFPA 130.

- When not located between the tracks in a station, standpipes should, when possible, be located on the side of the station platform opposite the third rail.

4.1.6.2 Rescue Equipment - Different types of rescue equipment may be stored at rail transit stations according to transit system requirements.

- Fire axes, crowbars, ladders, and stretchers are among the items which may be considered for storage in designated station areas (such as attendant kiosks or equipment rooms).

4.1.7 Flammable and-Combustible Liquid/Vapor Intrusion

Accidental flammable liquid or vapor intrusion can create the potential for a serious fire or explosion within the rail transit station. Extensive specifications to minimize emergency conditions which could result from such hazardous liquid or vapor intrusion are contained in Subsection 3.2.7 of NFPA 130.

4.1.8 Flood Protection

Rail transit passenger stations may in many areas be subject to water leaks. In addition, storm water drainage may enter at portals and shafts. Drainage and pumping stations for minimizing flooding in the rail transit station are presented in this section.

- Pumping stations should be provided at low points within the transit station.

- The drainage pumps should be of the proper size to handle water intrusion from weather, fire fighting operations, etc.

- There should be two separately powered alternate pumps at each location.

- Where the pumps operate automatically, local controls should be able to manually override the system.

4.1.9 Traction Power

The traction power system is an integral part of a transit system's emergency preparedness. The following items should therefore be taken into consideration when developing the traction power system:

- The capability of removing or reapplying power should be considered in the system safety analysis. Traction power requirements should be carefully evaluated for all emergency scenarios. Such requirements might include redundant power supplies or specific system design features to meet system needs.

- A means for locally removing power from specific sections of the third rail or catenary should be provided. (This could be accomplished by local emergency trip stations.) Central Control should also have the ability to remove power from specific sections of rail or catenary.

- When appropriate, devices for verifying that power has been removed from third rail sections should be incorporated into the system.

4.1.10 Graphics

Graphics are defined as the informational symbols indicating the location and use of crucial passenger station facilities and equipment. They are essential in identifying exits, exit paths, emergency exits, fire extinguishers, etc.

This section addresses guidelines for graphics used in passenger transit stations.

- Consideration should be given to using bilingual and/or pictograph signs.
- Standardized emergency graphics should be used. 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 occurences and procedures for emergency evacuation.
- Location signs and instructions for operation of emergency exits, fire extinguishers and emergency intercom or alarm should also be provided.

4.1.11 Emergency Power

In order to ensure the continued operation of such vital components as lighting and emergency ventilation systems and pumping stations, it is necessary to consider two options for furnishing uninterruptible power. One option involves the use of dual controls, feeder cables, etc., to provide redundancy should failure in one component occur. The second option is to provide an alternative power source in case the normal power source becomes unavailable.

The following station components should be considered for connection to alternative power systems:

- Station emergency lighting,
- All illuminated exit signs,
- Selected signs,
- Ventilation system (subway),
- Radio and telephone systems,
- Public address system,
- Fire alarm system,
- Pumps (subway).

4.2 TRAINWAY

Although the preferred method of evacuating passengers under emergency conditions is to move all or part of the train to the nearest station, in some cases it may be necessary for passengers to exit from the train while it is located between stations, in order to walk to another train or to the closest station or emergency exit. The trainway environment and available equipment can thus have a large effect on passenger evacuation in emergency situations.

The three basic types of trainway are underground (tunnels and underwater tubes), elevated, and surface (at-grade and open cut).

4.2.1 Construction

The typical rail transit trainway consists of ties, rail, and road bed of ballast and/or a steel or concrete structure. This trainway may be located in a subway tunnel or underwater tube; on an aerial structure;

on the same general ground level as other vehicle roadways (at grade); or in an uncovered .depression (open cut).

Trainway construction should be of such a design as to facilitate passenger evacuation and emergency response personnel access for potential emergency scenarios. With this in mind, trainway construction should incorporate the following:

The system safety concept should be applied in the trainway design phase to identify and address prospective safety hazards associated with the transit system's emergency response capabilities.

Critical egress paths should be identified in the system design phase and remain unobstructed.

4.2.2 Lighting

4.2.2.1 Underground - An adequate level of lighting in tunnels and underwater tubes is critical for successful passenger evacuation under emergency conditions. In addition, fire/rescue personnel depend on sufficient lighting for visibility during fire suppression and/or rescue operations.

The recommended guidelines contained in Section 4.1.3 should be followed with the following modifications:

- Consideration should be given to locating a designated number of lighting fixtures toward the bottom wall of the tunnel or tube (near the top of the rail) to provide for visibility under smoke conditions.
- The minimum illumination level for emergency lighting should furnish a sufficient amount of visibility to enable passenger evacuation from the tube or tunnel to a place of safety.

4.2.2.2 Surface - In general, emergency lighting has not been provided along the surface portions of the tail transit trainway. The belief has been that because of daylight and the less confined environment (in contrast to the dark and constricted area within the underground trainway), emergency lighting is not necessary. However, all systems operate trains during hours of darkness, and thus similar problems of insufficient visibility could arise during emergency situations. 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 trainway in emergency situations.

4.2.3 Access/Egress

Emergency exits provide the means for transit passengers to exit from emergency conditions within the trainway to a point of safety.

4.2.3.1 Underground - There are two basic types of emergency exits typically provided along the underground trainway. Tunnels constructed using the cut and cover method are usually located just below street level. Their relatively shallow depth facilitates the 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, deep bore tunnels and sunken caissons (underwater tubes) possess limited exit capability directly to the surface level. For this reason, underground trainways utilizing these methods of construction must provide alternative types of emergency exits. Options used have included cross passages and/or fire doors leading to the opposite track-way area, or a separate center passageway between the adjacent track-way areas.

Recommended guidelines applicable for emergency exits from underground trainways are contained in Section 4.1.4.

4.2.3.2 Elevated - Emergency exits, so vital for underground trainways, have rarely been provided along elevated trainways. Although the height of the aerial structure presents a condition of confinement similar to that of an underground tunnel, an important difference exists. The complete availability of open air minimizes the degree of danger in comparison to poor tunnel ventilation. As in all cases of passenger evacuation, the preferred methods of moving passengers to safety involve moving all or part of the train to the nearest station, or moving a rescue train up to the front or rear, or alongside, for passenger transfer. However, in some cases, the only alternative has been for passengers to leave the trainway by means of fire department ladder trucks, an extremely slow and time-consuming process. Walkways have been used as an alternative means of teaching a point of refuge (i.e., the next station); these are discussed in Section 4.2.4 of this document.

4.2.3.3 At Grade/Open Cut - Emergency exits are not usually provided along surface trainways unless the trainways are fenced. It is common to provide emergency access gates which can be opened by transit personnel or rescue crews.

With the exception of the third rail hazard, the dangers inherent in a confined tunnel or aerial structure are not present during passenger evacuation from a disabled train on a surface trainway. In most instances, passengers ate able to simply leave the vehicle via a short ladder and walk directly to a point of safety. However, difficulties in

proceeding to a point of safety may exist when the trainway is shared with highways or railroad tracks. In addition, certain sections of the surface trainway may be protected by fencing or other restraining material.

- The access gates should be 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.

- Caps in the third rail and crosswalks should be provided at access gate locations.

- When the surface trainway is shared with highways or railroads, provisions should be made for some means of exit which does not require passengers to face other moving traffic when evacuating a rail transit train.

4.2.4 Walkways

4.2.4.1 Underground - Walkways, when they exist within the underground trainway, may consist of a flat surface located at track level or on a ledge located preferably at the floor height of vehicle doors. In either case, walkways may serve as a direct, high capacity exit route through the side doors of the vehicle. However, a major disadvantage is the narrowness of the walkways, which tends to restrict the movement of passengers once they exit from the vehicle.

- When walkways exist in the underground trainway, it is recommended that they be located on the side of the track opposite the third rail, and that they be of a width deemed suitable by the transit system.

- When walkways are used, they should, whenever possible, be of vehicle floor height.

- When walkways exist, consideration should be given to the use of a fixed railing to assist passengers.

- The walkway should have a flat, non-slippery surface.

- Emergency exit paths should not require passengers to step over the third rail.

4.2.4.2 Elevated - A walkway located along one side or in the center of an aerial structure would provide an alternative means of moving passengers from the vehicle to a point of safety (i.e., the next station).

- The walkway should be of sufficient width for passengers to avoid contact with the third rail or other power sources.

- Walkways located along the side of the aerial structure should be equipped with a fixed railing or other restraint to help passengers maintain their balance.

- The walkway should be located on the side of the track opposite the third rail.

- Emergency exit paths should not require passengers to step over the third rail.

4.2.5 Communications

Effective on-the-scene communications are vital during emergency situations and provide the major source of information for coordinating rescue/fire suppression efforts within trainway areas. Examples of various kinds of communications equipment are direct line emergency telephones connecting directly with Central Control, maintenance telephones, and mobile radio units,

A means of voice communication should be installed at all emergency exits and at selected locations along the trainway, and be conspiciously identified with graphics and lighting.

4.2.6 Ventilation

Ventilation systems can be used in the event of a fire to control smoke and heat, and provide visibility and fresh air to passengers and rescue/fire suppression teams. They are therefore considered essential components in the underground trainway. In addition, the proper operation of fans and dampers may play a critical role in confining the fire and smoke to a limited area.

- Manual fan and damper controls should be clearly identified by lighting and/or graphics.

- Fans and dampers should be remotely controlled from Central Control.

4.2.7 Support Equipment and Systems

4.2.7.1 Fire Protection Equipment

A. Fire Detection

- When trains are parked in isolated underground storage areas not immediately visible to or frequented by transit personnel, some means of fire detection which activates an audible or visible signal at Central Control or other supervising station should be provided.

B. Fire Extinguishers

- The location and user instructions for fire extinguishers should be clearly marked.

C. Standpipe/Hydrant and Hose System

- Where the standpipe and hose systems are used, they should comply with the requirements of NFPA 130.

- Standpipes should be located whenever possible on the side of the trainway opposite the third rail.

4.2.7.2 Other Support Equipment

Third rail power "testing" devices should be available for ensuring that the power is indeed cut off when requested.

4.2.8 Intrusion Alarm

In many cases, rail transit systems operate trains along a shared corridor. The rail transit track may be located adjacent to highways, along the center median of highways, or adjacent to freight/passenger railroads. Motor vehicle accidents or train derailments may thus intrude on the transit track area and present serious hazards to train operators unaware that any problem exists.

It is essential that both train operators and Central Control become immediately alerted when accidents cause intrusion into the transit track area. Consideration should be given to protection of the trainway by physical barriers or by some type of detection and alarm system.

4.2.9 Flammable and Combustible Liquid/Vapor Intrusion

Accidental flammable liquid or vapor intrusion creates the potential for a serious fire or explosion resulting in damage to the trainway and/or injury to transit passengers and personnel. Extensive specifications to minimize the hazards of such liquid or vapor intrusion are presented in Subsection 3.2.7 of NFPA 130.

4.2.10 Flood Protection

The underground and surface trainway in many areas may be subject to water intrusion. In addition, storm water drainage may enter at portals and shafts. Drainage and pumping station components to reduce flooding should comply with the guidelines presented in Section 4.1.9, with the following modifications:

- Primary drainage should be achieved through the use of proper road-bed design and construction. Excessive water should drain into grates, to be carried in culverts to a pump pit.
- Pumping stations should be provided at low points throughout the trainway.

4.2.11 Traction Power

See the guidelines contained in Section 4.1.10.

4.2.12 Graphics

Graphics are defined as the informational symbols indicating the location and use of crucial trainway facilities and equipment. They are essential in identifying emergency exits and routes, fire extinguishers, etc. This section presents guidelines for graphics used in and along the trainway.

- Location marker signs should be posted along the trainway which are highly visible to the train operator.
- Signs indicating the distance to and direction of the closest passenger station and emergency exits should be posted, especially in underground sections.
- Each emergency exit should be identified by a sign and a light, and include instructions for use.
- Consideration should be given to providing bilingual and/or pictograph signs as appropriate.
- Standardized emergency graphics should be used.

- Information signs should be located at decision points for maximum visibility.

4.2.13 Emergency Power

In order to ensure the continued operation of such vital components as lighting, ventilation systems and pumping stations, two options for furnishing uninterruptable power must be considered. One of these entails the use of dual controls, feeder cables, etc., to provide redundancy in case of failure in one component. The second option is to provide an alternate power source should the normal power source become unavailable.

The following trainway components should be considered for connection to alternative power systems:

- Tunnel emergency lighting,
- All illuminated exit signs,
- Selected signs,
- Ventilation systeln (subway),
- Public address system,
- Fire alarm system.

Emergency power system components should be located so as to be protected frorn damage by water or by normal maintenance to adjacent equipment.

4.3 CENTRAL CONTROL.

Train operations within most rail transit systems are controlled from a centralfacility. This headquarters (Central Control) contains the personnel, offices and equipment necessary to maintain normal train operations, control power, and maintain communications throughout the system. In addition to these functions, Central Control becomes the command center for coordinating responses to emergency situations through the use of such equipment as transit radio systems, direct "hot" line telephones, traction power cut-off controls and ventilation controls.

The guidelines in this section are intended to assist Central Control in responding to emergency situations occurring within the station and trainway sections of the system.

4.3.1 Emergency Exits

Diagrams indicating the exact location of every emergency exit within stations and along the trainway should be available in Central Control.

4.3.2 Communications

Central Control should possess the following minimum communication capabilities:

- Audible and visible alarms located in Central Control should indicate when critical equipment commands fail.

- If intrusion alarms are installed, they should communicate directly with Central Control. Central Control should be able to directly and immediately notify the appropriate railroad control center in the event that intrusion occurs from railroads into the transit trainway or vice versa.

- Central Control should have a plan for reacting to train control failures.

4.3.3 Ventilation Equipment Controls

Consideration should be given to the implementation of a series of predetermined ventilation control system scenarios which may be employed in responding to various emergency situations.

4.3.4 Traction Power Removal

Central Control should have the capability of remotely removing third rail or catenary power from any location for which Central Control is responsible.

4.3.5 Graphics

Some means of clearly indicating the location of every emergency exit, standpipe connection, pump station, ventilation fan, emergency telephone, traction power sub-station, power cut-off switch, and alarm should be available in Central Control.

5. VEHICLES

The purpose of the guidelines presented in this section is to identify those vehicle features which can minimize the consequences of an emergency situation. These vehicle guidelines are meant for use primarily in the procurement of new vehicles. For the purposes of this section, "vehicles" are considered to be of two general types: passenger rail vehicles, and rail vehicles used for emergencies.

The guidelines address transit vehicle construction, lighting, access/egress, communications, ventilation, electrical equipment and wiring, on-board support equipment, mechanical equipment, graphics, and emergency power. Whenever possible, the guidelines are general enough to allow for the site-specific differences between rail transit systems. The guidelines have been developed from a variety of sources including workshops, discussions with transit personnel, and available literature sources such as industry design guidelines, codes and standards. These performance-oriented guidelines are intended to reflect the best practices of the rail transit industry.

5.1 PASSENGER RAIL VEHICLES

The rail transit vehicle is (with the transit station) one of two environments with which passengers normally come in contact when using rail transit systems. However, the passenger rail vehicle is unique in that it is a dynamic, confined
"envelope", with movement and access/egress controlled by the train crew. moreover, the vehicle represents both a potential safety hazard (e.g., burning interior materials) and an area of refuge from such a hazard (by the movement of passengers to other unaffected cars of the train).

The guidelines in this section are intended to provide for rapid patron evacuation and rapid emergency response personnel access for all possible emergency scenarios.

5.1.1 Construction

Transit vehicle construction should incorporate the following:

A. General

- The system safety concept should be applied in the vehicle design phase to identify and resolve all prospective safety hazards associated with a transit system's emergency response capability.
- Critical vehicle/system egress and access paths should be identified and remain unobstructed throughout the system design.

B. Exterior

- The transit vehicle structure should permit the vertical jacking of the vehicle in an emergency without affecting structural integrity.
- The vehicle should be constructed so as to allow emergency access from the exterior.

C. Interior

- The seats and other interior components should be securely attached to the vehicle.
- The seating arrangement within the vehicle should be designed so as to minimize congestion around doors.
- A sufficient number of grabrails and stanchions should be installed within the vehicle to provide stability for standing passengers.
- Design of the vehicle interior should limit the presence of sharp corners and edges.

5.1.2 Lighting

Emergency lighting is a crucial factor which contributes to the level of visibility needed to evacuate passengers successfully.

- Emergency lighting should be provided at all door locations.
- Vehicle marker lights should be connected to the emergency power system.
- Consideration should be given to locating emergency lighting fixtures toward the bottom sidewall and door vestibules of the rail transit vehicle.
- Emergency lighting fixtures, circuits, etc., should be protected to ensure that the emergency lighting will perform when necessary.

- Lighting circuits within the normal power system are considered to be emergency lighting if a'designated number of the fixtures are connected to a separate, independent power source.
- 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 passengers to enter and exit a rail transit vehicle is at a station platform through doors located on the side of the train. When a disabled train cannot be moved to the nearest station, alternative methods of evacuating passengers must be used. Passengers may be moved through the end door(s) from a cat containing a fire to a point of safety within an adjacent unaffected vehicle. Other emergency situations involve the transfer of passengers from an entire disabled train to a rescue train. In this instance, the train side doors of the two trains are aligned and passengers are transferred directly to a rescue train.

5.1.3.1 End Doors

- An emergency door opening control requiring no electrical power should be located on the exterior of the vehicle.
- A means should be provided that allows passengers to move from one car to another in an emergency.
- Locking of the end doors is to be discouraged unless an interior emergency door release is provided.
- Emergency door release controls for the end doors requiring no electrical power should be located within the interior passenger com part ment.
- The location and operating instructions for the emergency door release controls should be clearly indicated by graphics. Provisions should be made for discouraging unnecessary operation of the release.

5.1.3.2 Side Doors

- An interlocking door control should be located in each train operator cab to permit the opening of all doors on either side of the train.
- An emergency door unlocking device for side doors requiring no electrical power should be located both in the interior and on the exterior of the vehicle.

- An attempt should be made to locate side doors in an area of the car not directly over the current collector assemblies.
- Vehicle side doors should be of sufficient width to permit the passage of two people, side by side.
- The location and operating instructions for the emergency door release controls should be clearly indicated by graphics.

5.1.4 Communications

A variety of mutual communication needs exists within the environment of the rail transit vehicle. These include: train operator to passengers, passengers to train operator, and Central Control to train operator.

- All vehicle communication systems should be connected to a source of emergency power.

5.1.5 Ventilation

A critical element of emergency preparedness is the ability to provide fresh air in the vehicle interior, or to prevent smoke from entering the interior, prior to or during emergency situations.

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

- Controls which allow the shutoff of the ventilation system should be provided in the train operator cab.

5.1.6 On-Board Support Equipment

5.1.6.1 Fire Extinguishers

- Fire extinguishers should be provided at a designated location in all transit vehicles.

5.1.6.2 Rescue Equipment

- Ladders should be provided in each rail transit vehicle.
- Flashlights should be provided for the use of train operating personnel.

- Critical evacuation equipment for use in emergency situations should be readily available.

5.1.7 Special Mechanical Equipment

The rail transit vehicle should be equipped with certain types of mechanical equipment, including but not limited to emergency brakes, current collector shoe lifts, car uncoupling controls, etc. Guidelines for this equipment ate listed below.

5.1.7.1 Emergency Brakes

- Each rail transit vehicle should be equipped with a fail-safe friction brake to provide manually activated braking.

- Emergency braking independent of the train operator should be activated in the event of unintentional uncoupling of any car within a train.

5.1.7.2 Current Collector Isolation

- A means should be provided for removal of power from the current collector.

5.1.7.3 Couplers

- Consideration should be given to a vehicle uncoupling system which allows the train operator to uncouple cars without leaving the train.

5.1.8 Graphics

Graphics are the informational symbols indicating the location and operation of such crucial vehicle components as doors, intercoms, etc.

- Consideration should be given to using bilingual and/or pictographic signs.

- Standardized emergency graphics should be used.

- Location signs and instructions should be provided within the vehicle for intercom operation, window and door emergency exits, fire extinguishers, etc.

- Vehicle number identification should be displayed within the interior and on the exterior of the transit vehicle.

5.1.9 Emergency Power

The following components in each vehicle should be connected to an emergency power system:

- Selected lighting fixtures in the passenger area, particularly those adjacent to doors;
- The communication system, including the P.A., radio, and intercom systems;
- Lighting in the train operator cab;
- Exterior market lights.

5.2 VEHICLES USED IN EMERGENCIES

Various types of rail vehicles are used to respond to rail transit emergencies. Depending on the situation, diesel rail engines, work equipment, empty passenger trains, and road/rail vehicles may be utilized. This section focuses on the "transit emergency response vehicle" which possesses unique capabilities directed at emergencies occurring in the confined area of the trainway.

- Vehicles should be stored at locations offering ready access to the trainway.
- Vehicles should possess a motive power source independent of the traction power.
- 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 Central Control.
- Any auxiliary rail vehicle to be used in an emergency should have compatible coupling available.
- Such a vehicle (locomotive) should be capable of moving maximum length trains up the maximum grade of the trainway.

APPENDIX A

INTER-ORGANIZATIONAL AGREEMENTS

The content of inter-organizational agreements should encompass the following elements for each of these suggested organizations:

A. Fire Departments

- Establish appropriate fire department jurisdiction.
- Establish level of service (equipment, personnel, etc.) to be delivered in response to various types and degrees of transit emergencies.
- Specify level of notification, 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 rail transit facilities, access/egress, equipment, procedures, passenger behavior, etc.
- Specify use of tools, handling of transit equipment, use of transit personnel, power removal and restoration, use of support personnel, etc., to assist fire fighting 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 for emergency work in the transit system.

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 transit emergencies.
- Establish appropriate methods of communication for continuous coordination during a response.
- Familiarize EMS personnel with the rail transit facilities,
- Conduct periodic drills involving participation by EMS personnel.

C. Police Departments

- Establish a full understanding of jurisdictional responsibilities between any internal transit security group and the local police department(s).

- Establish level of service (equipment, personnel, etc.) to be delivered in response to various types of transit 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, etc.)

D. 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

- Rail transit systems should 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 transit system facilities and trainway.
- 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/Federal Government

System-specific agreements with one or more of the following government agencies might be appropriate: Public Utilities Commission, Civil Defense, Highway and Rail Departments, National Guard, and 1Mayor's Emergency Action Center. In the event of emergency incidents that may require investigation, coordination with the appropriate representatives of these agencies (e.g., NTSB) for reporting serious problems, or for requesting support when needed, should be established.

APPENDIX B

EMERGENCY EQUIPMENT

The following is a list of specialized emergency equipment. Appropriate transit employees should be provided with specialized training in the use of equipment pertinent to their assigned duties.

- Air bag rescue and lifting system with the power to lift, move or shift weights of up to 146,000 pounds
- Axes
- Bolt Cutters
- Emergency Evacuation Cart
- Evacuation Ladders and Planks
- Fire Extinguishers of Various Types
- Fire Hose and Nozzles
- First Aid Kits
- Flood Lights
- Hand Lights
- Hand Tools (hammers, wrenches, saws, etc.)
- Hydraulic Jacks
- Hydraulic tools used to pry, pinch, push, bend, tear, shear and force metal masonry and timber, to gain access to or release for trapped people.
- Insulating aprons, mats, blankets, gloves to provide protection from electrical shock
- Jumpers or Stingers for Third Rail Power
- Maintenance Phone Headsets
- Pry Bars

- Radios
- Self-Contained Breathing Apparatus (SCBA)
- Shoe Lifts (to inhibit traction power collection on a vehicle)
- Spare Air Bottles for SCBA
- Stretchers (Stokes Baskets, Reeves Stretchers, etc.)