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Bus and Passenger Accident Prevention

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PREFACE

Mass transportation systems and specifically bus systems are a key element of the transportation network. While the safety record of bus transit operations has been very good, accidents still continue to occur. The resulting injuries, fatalities and property damage often result in the expenditure of funds which are becoming more scarce in today's society. This document, along with the Bus and Passenger Accident Prevention Seminar, provides guidance on how to prevent accidents through the development and implementation of an accident prevention program. Comprehensive accident prevention programs should save urban, rural and specialized transit systems considerable resources.

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1. INTRODUCTION

A fundamental goal of each transit system is to provide passengers and employees with the highest level of safety that is practical and consistent with the mission of the transit system. Accomplishing this goal with any degree of efficiency requires a transit system to develop and implement a comprehensive safety program. This program should address the three primary safety functions of a transit system, which are as follows: to prevent the occurrence of accidents, to respond to and recover from accidents, and to learn from accidents that have and do occur. This document, prepared under the sponsorship of The Federal Transit Administration (FTA), provides guidance on how to develop and implement an accident prevention program for urban, rural, and specialized transit systems.

1.1 PURPOSE AND SCOPE

This report, prepared in conjunction with the Bus and Passenger Accident Prevention Seminar, is intended to serve as a resource to urban, rural and specialized transit operators. It identifies safety issues that must be addressed and resolved in order to provide passengers, employees, and the general public with the highest degree of safety that is practical. Included in this document is guidance on the following safety issues:

1. Development and implementation of an accident prevention program

2. Selection, training, evaluation and, if necessary, termination of transit system employees

3. Promotion of patron safety/awareness

4. Design options available in the vehicle procurement phase that will prevent accidents

5. Development of safety policies and procedures

This guidance is intended for those managers, safety directors, operations staff, board members, and state and local officials who are responsible for planning, procuring, equipping, and operating transit systems.

It is important to emphasize that this document does not attempt to prescribe criteria for vehicle purchases, but rather to provide guidelines for the development of a process for discussion of the alternatives available to decision makers. Each decision must be carefully weighed and take into consideration the system's goals, the safety of the system and its passengers, and the availability of limited financial resources. One must realize that accident prevention need not cost additional dollars. The system is already spending "safety dollars" in other areas such as accident claim payments, down-time, worker's compensation, insurance premiums, property damage, and lost ridership dollars.

1.2 BACKGROUND

While the safety record of urban, rural, and specialized bus transit operations, in general, has been very good, accidents that result in fatalities, injuries, and property damage continue to occur. Transit systems utilize scarce funds for costs associated with liability claims; property and equipment damage; the replacement of service, equipment and employees; and the administration of risk management. In addition to these costs, many transit systems also pay insurance premiums and provide a safety and training program. With exception of the safety and training program, the costs associated with accidents utilize funds that could be used to.provide safe and efficient transportation to the transit system passengers and employees.

From the data presented in Reference 1, it can be seen that in 1991 vehicle accidents caused over $26.7 million in property damage to buses and facilities. Furthermore, it is estimated in Reference 2 that in 1991 accidents cost the mass transit industry a minimum of $1 billion.

The implementation of a comprehensive accident prevention program will result in a reduction in accidents, and therefore, a reduction incasualty claim costs, vehicle repair costs, and the cost of insurance premiums. In addition, it will also reduce the number of employee and passenger injuries. A properly designed accident prevention program, after development and implementation, will NOT cost money but save money. At a time when many transit systems are spending approximately five percent of their operating budgets (Reference 3) to pay for related accident costs, a portion of the money saved should be applied to fundinga comprehensive cost-effective safety program and the safety organization necessary to implement it. Such a program can result in vastly improved customer relations by informing customers about steps being taken to improve their safety.

2. DEVELOPING AN ACCIDENT PREVENTION PROGRAM

In some transit systems, the concern for safety and the desire to develop and implement an accident prevention program occurs only in response to an accident. This type of reactive concern is limited in its effectiveness. A more efficient, successful approach to the prevention of accidents involves the establishment of a pro-active safety program that includes the systematic identification of potential accidents and the implementation of preventive actions. Preventing the occurrence of accidents requires the identification and resolution of hazards and potentially unsafe conditions. This can be achieved through the adoption and implementation of the system safety concept.

An effective response to accidents can be accomplished through the adoption and implementation of the emergency preparedness concept. Reference 4 provides a detailed discussion of the emergency preparedness concept and instruction on how to develop and implement an emergency plan. The function of recovery from the accident is partially addressed in the emergency response.

Learning from the accident is accomplished through the accident investigation process. At the completion of the investigation, that which has been learned should be integrated into the safety and training program to ensure that the accident does not occur again. The following sections discuss the development and implementation of the system safety concept and program and their important roles in an accident prevention program.

2.1 ACCIDENT PREVENTION THROUGH SYSTEM SAFETY

As stated, a safety program must be proactive, and safety hazards must be identified and resolved prior to the occurrence of accidents. Establishing a proactive safety program can be accomplished through the adoption and introduction of the system safety concept. System safety is defined as the application of special technical and managerial skills to the systematic, forward-looking identification and control of hazards throughout the life cycle of a project, program, or activity (Reference 5). This process spans the entire system life cycle and begins during the acquisition (concept definition, design, construction, and inspection/testing/certification) and operation (operation, training, maintenance, modification, and disposal) phase of the system life cycle.

The advantage of applying the system safety approach is that it provides the opportunity to identify hazards early in the bus system life cycle and then to recommend design and operational modifications necessary to ensure safety. It is significantly less expensive for a bus system to change a specification, design or procedure than it is for that system to modify already constructed facilities or to retrofit vehicles. Doing this prior to system development, construction, and operation will serve to enhance safety and minimize cost.

As applied to transit systems, the focus at this early, pre-production stage is on the *prevention* of accidents by eliminating and/or controlling safety hazards in a systematic manner. This preventive approach, through the most effective use of resources, will serve to reduce the risks from system hazards to the lowest practical level. Hazards are not accidents. *A hazard is any real or potential condition that CAN lead to or cause injury or death; damage to or loss of equipment or property.*

It should be noted at the outset that a **System Safety Analysis** is not the same as **Failure Analysis**. This distinction is important because a *hazard* involves the risk of loss or harm, while a *failure* does not always result in loss or harm.

2.2 IMPLEMENTATION OF A SYSTEM SAFETY PROGRAM

Preventing accidents is the responsibility of all transit system personnel, up to and including the board of directors. The fundamental aim of system safety is to ensure that all transit personnel practice a proactive approach to safety. The system safety programs are established and documented in order to ensure that the safety program is proactive and that all personnel understand and respond appropriately.

The first step in the establishment of the system safety program is obtaining the commitment of the top management of the transit system, beginning with the board of directors. Without the commitment of top management (e.g., the directors and general manager, executive director or president, etc.) such a program cannot be successfully implemented.

Once management commitment is obtained, the safety manager or staff person responsible for coordinating, developing, and implementing the safety program should ensure that it clearly recognizes the safety role and responsibilities of each employee of the transit system. The purpose of the program is to provide the transit system patrons and employees the highest degree of safety possible by minimizing the risks to which they and the equipment are exposed. The safety staff should emphasize this purpose when explaining and justifying to other transit departments their involvement in the system safety program.

When developing and implementing a system safety program, keep in mind that it should accomplish the following:

- Address all departments within the transit system (safety, operations, maintenance, etc.).
- Include both patrons and employees in the plan development.
- Address all of the safety issues associated with the transit system.
- Provide for and maintain top management and board of directors approval in the form of a signed policy and the allocation of adequate resources.
- Ensure that the safety director/officer has direct access to top management.
- Designate one individual as the responsible safety authority for the system.
- Clearly identify the roles and responsibilities of the safety director/officer and the safety department.
- Clearly identify the safety roles and responsibilities of all other transit system departments.

- Establish a proactive safety program with the process and procedures necessary to identify and resolve hazards prior to their resulting in accidents.

- Include a mechanism for ensuring that all employees are accountable for safety. This must include a disciplinary process.

- Provide a mechanism for cooperation (including the resolution of differences) between the individual transit system departments and external agencies that support the transit system.

- Include the establishment and review of data bases to assist in the continuous monitoring of the system safety program to ensure that it is providing the results expected.

- Prepare a fully documented system safety program plan.

Only if the above items are included in the system safety program can it be expected to provide transit system patrons and employees with the highest degree of safety practicable.

2.2.1 System Safety Policy

The system safety policy statement is the document that the top management of the transit system may use to formally state their commitment to safety. It should be a brief statement of the safety goals and objectives of the transit system. The policy should clearly state that all employees are responsible for the safety of the transit system's patrons and employees, i.e., "SAFETY IS MY RESPONSIBILITY." It should identify one person or position that is ultimately responsible for ensuring that the safety policy and program are implemented. Furthermore, that individual should report to the top management officer. A sample system safety policy is contained in Appendix

To reinforce management commitment, the policy should be signed by the top management officer in the system (e.g., General Manager, Executive Director, Board of Directors, etc.). It should then be distributed to all employees and posted in visible locations throughout the system.

2.2.2 System Safety Program Plan

The system safety program plan is the written plan that documents the implementation and operation of the system safety program. It is intended to guide the implementation of the program and to document the roles and responsibilities of all individuals and departments within the transit system. Included in this document are the internal and external safety reporting requirements for the transit system.

The system safety program plan should be a dynamic document that is continually referred to and revised as the program is modified. To accomplish this, the plan should be brief and to the point. A long tedious document will not be of assistance to the transit system as people tend not to utilize it after development. An example of the table of contents of a system safety program plan is as follows:

- Policy and introduction.

- Brief description of the system.
- Safety roles and responsibilities of all transit system personnel.
- Detailed discussion of the role and responsibility of the safety officer and/or department.
- Process that is employed to be proactive in identifying and resolving hazards.
- Process for monitoring and revising the system safety program. This should include a schedule for the implementation.

2.3 THE PROACTIVE PROCESS

The identification of hazards and potential accidents is the responsibility of all transit system employees. The mechanism by which potential accidents are identified will, however, differ depending on the roles and responsibilities dedicated to system safety. The safety officer or safety staff should have the primary responsibility and work with other transit system personnel to continually identify and resolve hazards and potential accident conditions.

There are four basic alternative methods of identification that may be employed to identify hazards and potential accidents. These methods are:

- Examination of data from previous accidents, incidents or operating experience Review of generic hazard checklists
- Judgement of knowledgeable individuals, i.e., transit personnel, outside experts, etc.; case studies of accidents; scenarios
- Formal hazard analysis techniques

With the exception of the checklists, the initial step in identifying the hazards in each of these methods is to identify the accident that may result if the hazard(s) is not eliminated or controlled. For the purposes of this discussion, the identified accident events are the safety issues that must

be resolved to provide the passengers, employees, and general public with the highest level of safety practical.

2.3.1 Data From Previous Accidents or Incidents

Examination of previous accident/incident experience can provide insight into what has happened in the past. Each transit system should investigate each accident and periodically conduct a detailed examination of their operating experience and accident data. This examination will serve to identify the hazards that led to the accidents and how those hazards may be resolved; thus, preventing future accidents. Failure to review accident history and learn from it will result in a reoccurrence of those accidents. In addition to reviewing the data from your system, you should contact other transit systems to learn from their accident experience.

Identification of hazards through a review of previous accident data or experience is an important step in the resolution of potential safety hazards. However, a review of past accident data does not

provide a complete analysis of hazard identification, because the hazards identified will be limited only to those that caused previous accidents. New and potential hazards will not be identified. Furthermore, in the reporting and investigation of accidents, if the pertinent information isn't collected and the incident isn't classified by type and the details of its occurrence, it will not be possible to use the results to improve vehicle procurement, employee selection, operations, or transit safety nationally.

Transit systems should also review their data on "near-misses" and other incidents that did not result in accidents, but easily could have. Research on transit accidents has demonstrated that, for almost every type of accident, there is a recognizable pattern or chain of events leading up to its occurrence. For example, a bus operator with a drinking problem will probably have several "near-misses," minor collisions or other infractions on his/her driving record that suggest the nature of his/her problem. If these records are reviewed, this employee can be identified before a major accident occurs. Likewise, mechanical difficulties, such as failure of a brake light or turn signal, can be discovered during an investigation of a "near-miss" before they cause an accident. If a transit system can recognize and respond to these difficulties quickly and efficiently, they can prevent accidents.

The following Table 2-1 lists the types of accidents that were reported in the 1991 Section 15 data (Reference 1).

2.3.2 Judgement by Knowledgeable Individuals

Safety issues and hazards can be identified by transit system personnel and users of the system. Many transit system personnel such as the managers, drivers, supervisors, and dispatchers, as well as transit system patrons, are well aware of existing situations that will result in the occurrence of accidents if not addressed.

TABLE 2-1. TYPES OF ACCIDENTS

Another means of ensuring safety is to have knowledgeable individuals identify accidents that may occur. This will provide a starting point for the identification of the types of "accident events" and emergency situations which can occur. Once these types have been identified, hazard scenarios can be developed to assist in understanding the mechanism by which these accidents occur. The scenarios will provide insight into the chain of events that result in such an accident. Understanding this chain of events will enable the transit system to identify measures they may take to interrupt the chain and prevent the occurrence of the accident.

Also, with some preparation, the transit system can prepare analysis and emergency guidelines for transit personnel and emergency responders in order to minimize in-house work and maximize the use of supplier experts.

2.3.3 Generic Checklists

Checklists are an excellent means to identify potential hazards and, thereby, potential accidents. With this approach, the depth of detail and applicability of the hazard checklists have an impact

on the quality and quantity of hazards identified. Appendix B contains a detailed checklist that may be used to develop an inspection and maintenance checklist and procedure. Appendix C contains a checklist that groups hazards within the categories of basic design deficiencies, inherent hazards, malfunctions, maintenance hazards, environmental hazards, and human factors. This checklist will, as the system design evolves, provide additional insight into the safety hazards that may be present in the system.

2.4.4 FormalAnalssis

Several formal analysis methods are available for use in identifying hazards and potential accidents. Transit system operators may require the transit system suppliers/vendors to conduct these analyses on the facilities and equipment they provide. Additionally, most insurance carriers have loss control personnel available to provide assistance, as do many universities, trade groups, and RTAP. Some of the safety analysis techniques that may be used include:

- Preliminary hazard analysis
- Subsystem hazard analysis
- System hazard analysis
- Operating hazard analysis
- Fault tree analysis

A thorough discussion of the above analysis methods is contained in Reference 5.