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**Federal Railroad
Administration**

EVALUATION OF OPTIONS FOR IMPROVING AMTRAK'S PASSENGER ACCOUNTABILITY SYSTEM

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In investigating the derailment of Amtrak's Auto Train on April 18, 2002, the National Transportation Safety Board (NTSB) reported that an accurate count of persons on the train at the time of the accident was not available at the accident scene. NTSB noted that emergency response would be improved with accurate count data at the accident scene and issued a Safety Recommendation to the Federal Railroad Administration (FRA) that it develop and implement an accurate passenger and crew accountability system. This report assesses the weaknesses in Amtrak's passenger accounting system, the costs of improving it, and the potential safety and business benefits of an improved system. It finds that while technically feasible, the recommendation is impractical given Amtrak's business model and would not provide the desired safety benefits. It also identifies alternative improvements to Amtrak's passenger accounting system that can be the basis for future cost-effective Amtrak initiatives.

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1 inch (in) = 2.5 centimeters (cm)	1 millimeter (mm) = 0.04 inch (in)
1 foot (ft) = 30 centimeters (cm)	1 centimeter (cm) = 0.4 inch (in)
1 yard (yd) = 0.9 meter (m)	1 meter (m) = 3.3 feet (ft)
1 mile (mi) = 1.6 kilometers (km)	1 meter (m) = 1.1 yards (yd)
	1 kilometer (km) = 0.6 mile (mi)
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1 square inch (sq in, in^2) = 6.5 square centimeters (cm^2)	1 square centimeter (cm^2) = 0.16 square inch (sq in, in^2)
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1 square yard (sq yd, yd^2) = 0.8 square meter (m^2)	1 square kilometer (km^2) = 0.4 square mile (sq mi, mi^2)
1 square mile (sq mi, mi^2) = 2.6 square kilometers (km^2)	10,000 square meters (m^2) = 1 hectare (ha) = 2.5 acres
1 acre = 0.4 hectare (he) = 4,000 square meters (m^2)	
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1 short ton = 2,000 pounds (lb) = 0.9 tonne (t)	1 tonne (t) = 1,000 kilograms (kg)
	= 1.1 short tons
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1 cubic foot (cu ft, ft^3) = 0.03 cubic meter (m^3)	1 cubic meter (m^3) = 36 cubic feet (cu ft, ft^3)
1 cubic yard (cu yd, yd^3) = 0.76 cubic meter (m^3)	1 cubic meter (m^3) = 1.3 cubic yards (cu yd, yd^3)
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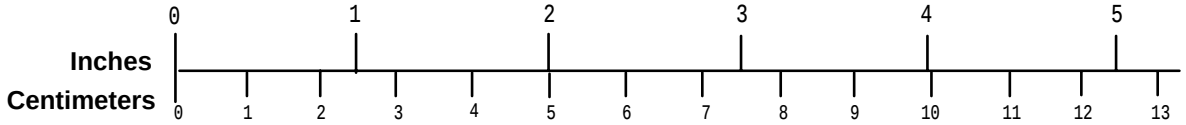

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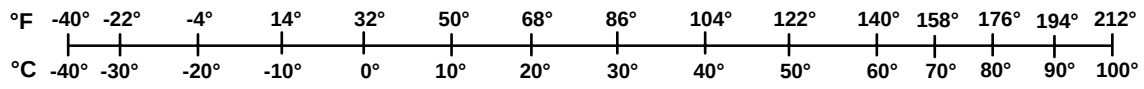

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Executive Summary

Background

In investigating the derailment of Amtrak's Auto Train on April 18, 2002, near Crescent City, Florida, the National Transportation Safety Board (NTSB) observed that an accurate count of persons on the train at the time of the accident was not available at the accident scene. It took NTSB almost 5 months to develop such a count. NTSB noted that emergency response may be improved with accurate passenger- and crew-count data at the accident scene and thus on August 15, 2003, issued the following Safety Recommendation, R-03-12, to the Federal Railroad Administration (FRA):

> In cooperation with the Transportation Security Administration, develop and implement an accurate passenger and crew accountability system for all long-distance, overnight, and reserved passenger trains that will immediately provide an accurate count and identity of the people on board the train in case of an emergency at any time during the trip.

NTSB also issued similar, concurrent recommendations to the Transportation Security Administration (TSA) (R-03-13), and to Amtrak (R-03-10).

FRA must assess the feasibility of implementing this recommendation, and develop a response to the NTSB. FRA has requested that the John A. Volpe National Transportation Systems Center (Volpe Center) undertake an effort to define options for such an accountability system and assess the feasibility of implementing them.

Objectives

This study has two objectives: (1) to define one or more options for a real time manifest[1] system for passengers and crew aboard Amtrak long-distance, overnight, and reserved trains; and (2) to assess the feasibility of developing and implementing such system(s).

The improved system should be capable of providing an accurate listing of all persons on board at all times, including limited personal information to be used as part of an emergency response (i.e., name, and perhaps also age or age category, gender, and contact person/number).

[1] In this report a passenger manifest is a list of the number and names of the passengers on board a train and could include other persons (crew). Under current practices, Amtrak's "manifest" provides the names of first class and sleeper passengers holding reservations. However, it only has a count (without names) of coach reservations and is not checked against the number and names of passengers actually on board. Thus it is not a comprehensive passenger accounting system (manifest) as envisioned by NTSB.

The feasibility assessment includes information on the required institutional changes, constraints, implementation costs, and the expected benefits in an emergency situation, including the system's expected reliability and effectiveness.

The system options considered do not include security functions such as options for linkages to other security databases for passenger screening, which may be the subject of a follow-on study.

The following tasks were performed to meet the study objectives:

1. Describe the existing Amtrak operations and passenger processing systems.

2. Identify Amtrak's past or planned initiatives to create or improve passenger processing procedures and systems, especially regarding manifests.

3. Describe passenger reservation, ticketing, and control processes for a small sample of foreign passenger rail systems.

4. Describe the role of passenger count and identification information in a rail accident and emergency response environment, and the expected benefits of the improved system.

5. Describe options for an improved passenger accountability system and estimate their development, capital, and operating costs, and assess the feasibility of implementing an improved system.

Conclusions in Brief

- Rail passenger accidents in which passenger accountability could be an issue are rare events.

- Amtrak's current passenger accountability system does not and cannot meet the NTSB's requirement for accurately knowing the number and identity of passengers on reserved trains at all times.

- Amtrak's business model includes open access to its trains. To meet NTSB requirements, Amtrak would need to make a fundamental change from an open to a controlled access business model. The changes include the following:

    - Elimination of onboard sales and replacement by one or more of the following:

        - Installation of ticket machines at unstaffed stations

        - Establishment of non-Amtrak sales outlets

        - Elimination of service at unstaffed stations (almost 10 percent of passengers currently board at unstaffed stations)

- Validation/verification of all tickets before or during passenger boarding
- Validation/verification of all tickets when passengers depart the train
- Transfer of accurate manifest information from the train to a central database before departing each station

- While the technology exists to implement a new business model meeting NTSB requirements, it may prove too costly and be viewed as inconsistent with the traditional business model and practices for intercity rail passenger service.

- Potential benefits for passenger accounting system improvements include possible cost savings in the automation of the paper-based revenue accounting process, a change in emphasis in the role of the conductor from revenue collection to customer service and safety, improved ridership data, and more timely resolution of passenger train emergencies.

- Although having an accurate passenger manifest can be useful, the development and implementation costs associated with such a system would likely be substantial and there is no significant safety benefit in having an accurate passenger manifest immediately available at the accident scene.

Detailed Findings and Supporting Information

Amtrak's passenger accounting system involves a complex set of subsystems and procedures that reflect its operating environment and business model. The following provides a summary of its main features and their impact on accuracy, an assessment of the value (safety benefits) of accurate passenger accounting, and a discussion of potential improvements based on the perspective of past initiatives, experiences in other passenger transport environments, and available technologies.

Amtrak's Existing Passenger Accountability Systems

- Amtrak's existing passenger accountability system is based on two components:
  - A printed manifest based on its Arrow computerized reservation system
  - The conductor's ticket pouch

- Amtrak's passenger accountability system has significant shortcomings in both its design and actual use.

Amtrak's Reservation System-Based Printed Train Manifest

- The conductor's printed manifest does not provide a reliable basis for knowing the number of persons on board because it will generally include persons not on board and exclude other persons who are on board. It should not be used to provide passenger count information after an accident.

- The reservation-based manifest information changes in real time while the train travels from origin to destination because additional tickets are purchased at downstream stations and on board trains.

- Serious deficiencies exist in the procedures for transmitting information needed to update the reservation system and manifest for transactions occurring postdeparture.

- An updated manifest suffers from the same weaknesses that make the original departure manifest unreliable.

The conductor's manifest is printed about 30 minutes before a train's departure. The current manifest provides an estimate of passenger loads and other information of value to the train crew, but not a full list with passenger names. Thus, no way exists of comparing whom actually got on the train with the information provided on the typical manifest.

The onboard manifest is inaccurate to the extent that it includes some persons not on the train and excludes some persons who are on board. It may incorrectly include persons not on the train, mainly no-shows[2] and persons departing the train before the ticket destination. If a ticket is issued, Amtrak's Arrow reservation system assumes it is used and that the passenger remains on the train until his or her scheduled destinations, even though it is known and expected that some passengers leave the train both before and after their scheduled destination. Because updates are often not sufficiently frequent and complete, generally the printed manifest excludes both passengers who board and purchase tickets on the train[3] and other non-revenue riders.

The update process for Arrow and the printed manifest involves dropping off at staffed stations the records of persons boarding without tickets, and having this information entered later into Arrow. The update process does not include information about persons boarding at the current station stop, so the Arrow system is always at least one station behind. Since no-shows are not identified, no correction can occur for them, and the update process is not consistently executed since exceptions to proper recordkeeping and the drop-off process occur.

Conductor's Ticket Pouch

- The conductor's ticket pouch, if managed properly, is a more accurate source of the number of passengers on board at a given time than the Amtrak manifest.

- A system based on the conductor's recordkeeping will not be perfectly reliable in accounting for all passengers on board at all times. For example, records for infants and other non-ticket riders can be incomplete.

[2] People who have purchased and picked up a ticket but do not actually board the train.

[3] Except at a few major stations, it is possible to get on a reserved train without a ticket and without a reservation. Most staffed and unstaffed stations have open platform access.

- Deficiencies in ticket pouch recordkeeping are most likely to result in ridership undercounts.

- The pouch itself can easily be misplaced or destroyed in the event of an accident, and its information lost.

Even if Amtrak policies are followed, the ticket pouch is not a perfect passenger accounting system since: (1) there is a time lag to "sweep" the train and gather the records during which the pouch does not contain complete records of persons on board; (2) the conductor could miss someone when collecting tickets; (3) a passenger could leave the train before his or her scheduled stop without notifying the conductor either because of a personal emergency or last minute change in travel plans; and (4) the pouch could be destroyed or otherwise become unavailable in an accident.

In actual practice, the ticket pouch records are not likely to be a very accurate basis for passenger accounting due to the failure to consistently record the presence of persons without pre-purchased tickets on Form 3085, which is designed for this purpose. Exceptions to the use of Form 3085 are permitted on some reserved trains in the Northeast Corridor (NEC). Furthermore, given their limited perceived value and importance relative to other conductor records and responsibilities, lapses in other situations seem likely. To the extent this occurs, ridership counts based on the ticket pouch records will understate the number of persons on board.

Regarding passenger identification, since the cash fare receipts lack passenger name information for multi-person groups traveling together, unless the conductor also fills out a Form 3085 for each individual (and, as noted, this process is not uniformly followed), incomplete records of individual names will exist. The same is true of the "Record of Tickets Honored but not Lifted" as it is applied to revenue pass holders (i.e., any failure to record information appropriately on Form 3085 results in missing passenger names).

No designated or especially designed safe place exists on board for the ticket pouch. Given the possibility that the pouch could be destroyed or become lost in the aftermath of serious accidents (and it is mainly the serious accidents for which accurate passenger accounting is needed), the ticket pouch is not a reliable source by itself. Since no reliable and timely means of transmitting all of the information in the pouch to a safe repository off the train exists, the Arrow computerized reservation system does not provide a reliable backup capability for the ticket pouch information regarding the number of actual boardings by station or a name list of passengers on board at any given time.

It is also notable that there do not appear to be any standard procedures in place for ticket pouch management, such as, sorting all tickets and forms by origin/destination or summarizing ons and offs after each station stop. This means that while the pouch may contain most of the information needed to determine the number of passengers on board, (1) the work involved in sorting through the individual pieces of paper after an accident precludes determining an accurate count of passengers on board in a timely manner; (2) it would be a daunting task for someone unfamiliar with the various forms and their uses to perform in the event that the conductor was unavailable (e.g., if the conductor were injured in a serious accident).

Amtrak Routes and Services

- Over three fourths of Amtrak routes involve reserved/sleeper trains, and slightly less than half of Amtrak passengers ride reserved/sleeper trains.[4]

The envisioned manifest system would apply to the routes having sleeper service and all reserved trains. It would not apply to unreserved trains. The manifest system would thus cover about 51 percent of Amtrak's passengers, 91 percent of its routes, and 51 percent of trains operated.

- Passengers boarding at unstaffed stations are not required to pick up tickets in advance.

- About 60 percent of the 495 unique stations served by reserved trains are unstaffed.

- Almost 10 percent of passengers on reserved trains board at unstaffed stations.

Amtrak provides service at 495 unique[5] stations on its routes served by sleeper, reserved, and partially reserved trains. Of these stations, 206 (42 percent) are staffed, and 289 (58 percent) are unstaffed.

Passenger boardings at unstaffed stations have potential negative implications for the passenger accountability system since passengers boarding at those stations cannot pick up their ticket at the station before boarding. Amtrak does offer the provision of sending tickets to customers via FEDEX, but it is believed this service is not used very often.

For Amtrak's 16 routes having sleeper service, 91 percent of passengers board at staffed stations. For Amtrak's 18 routes having reserved trains, 92 percent of passengers board at staffed stations.

- Spacing between staffed stations is a critical component determining the accuracy of passenger manifests under the current passenger accountability system.

- Large numbers of unstaffed stations between staffed stations implies large gaps between manifest updates under the current system.

The spacing between staffed stations is a critical component of Amtrak's current passenger accountability system. Large gaps on a route between staffed stations detract from the usefulness of such a system because as the time between updates increases, the value of the updates in terms of their currency decreases (i.e., the updated information becomes obsolete).

Many cases of long spacings between staffed stations in the Amtrak system exist. The average distance between staffed stations for sleeper routes varies from about 24 miles on the Federal to

[4] Data on reserved trains reflect Amtrak's schedule of 2004. Amtrak continues to make changes in its policies regarding the need for reservations but the basic points in this section are still valid.

[5] Many stations are served by more than one route.

about 345 miles on the Sunset Limited. The maximum station spacing between staffed stations for reserved routes varies from 69 miles on the Acela Express to 283 miles on the Kansas City-St. Louis trains.

Amtrak Initiatives to Improve Passenger Accounting

Amtrak's past approach to improving the passenger accountability system appears to have been an attempt to automate the ticket collection process. Due to technology limitations and cost or other practical considerations, these automation initiatives were never implemented.

Amtrak currently has an initiative that will improve its passenger accounting capabilities to a certain extent if developed and implemented as planned. Significant business practice, cost, and technology challenges will need to be overcome, and uncertainty exists regarding details that affect the timeliness and accuracy of its passenger accounting capability. The current initiative seems to be aimed at automating Amtrak's existing ticket lift system and communication of updates to Arrow. Its other inherent flaws will remain as imperfections even if a more automated system is implemented and used consistently. A more automated system will likely have the same basic deficiencies as the existing system, namely: (1) not being able to determine exactly who has boarded until after a sweep is completed after each stop; (2) uncertainty regarding whether anyone is missed in the train sweep; and (3) uncertainty regarding whether anyone has departed before his or her ticketed destination.

Passenger Accounting on Foreign Passenger Rail Systems

- Two examples of alternative closed models for improved passenger accountability were identified (though most foreign systems are open).

- The closed approach, in place to varying degrees on Japan railways and Eurostar trains, requires all passengers to possess a ticket before entering a station's boarding platform and requires a second use of the ticket to exit the system.

Generally, even among the relatively sophisticated foreign passenger rail systems examined, most seem incapable of providing a very accurate accounting of passengers on board. Foreign systems are focused more on accurate fare collection. The Japanese have the only system that requires electronic verification at both boarding and departing stations, though Volpe Center staff did not ascertain whether this information is captured by a database system. The more common foreign business models have features that are inconsistent with accurate passenger accounting practices, namely open access to and egress from trains, trains with at least some unreserved cars, and onboard ticket inspection done using train sweeps by conductors. It is likely these practices exist for cost and passenger convenience reasons.

Amtrak Accident History

- Passenger accountability is not an issue in most Amtrak accidents because few result in casualties to train occupants.

- Only 92 of 881 (10.4 percent) of reportable accidents involving Amtrak passenger trains resulted in passenger casualties (injuries or fatalities) over the period 1993 to 2003, and only 5 (0.6 percent) resulted in at least one passenger fatality.

- Only 32.2 percent of reported injuries to Amtrak passengers resulted from a reportable accident.

Although Amtrak averages about 80 accidents per year, only about a third involve passenger casualties, and very few (5 over an 11-year period) involved fatalities.

The proposed manifest system would apply to sleeper trains and reserved trains not having sleeper service. These two types of trains combined accounted for 89.2 percent of accidents, 100 percent of passenger fatalities, and 94.9 percent of passenger injuries.

Value of an Accurate Passenger Accountability System

- In the five Amtrak accidents resulting in passenger fatalities between 1993 and 2003, a perfectly accurate passenger manifest would not have contributed to a passenger's life being saved.

- From the perspective of first responders, the principal value of the manifest is in allowing them to determine that all persons have been accounted for, and that no one has been left behind.

- Determining passenger names, as well as the number of passengers is an important part of the responders' passenger accountability procedures.

- In reporting an accident to an emergency response organization, providing an approximate number of passengers is useful in planning their response and marshalling the appropriate resources, but an exact count is not essential for this purpose.

In one example of its criticism of Amtrak's passenger accountability system, NTSB has noted that:

> The survival of passengers and crewmembers might well depend on emergency responders, who in turn depend on a complete and accurate accounting of all people on the train to ensure that they locate, evacuate, and treat (if necessary) all those on board. If the passenger list does not include every passenger on the train, emergency responders may leave passengers behind. If the passenger list includes people not on the train, emergency responders may be needlessly exposed to prolonged risks as they search for nonexistent passengers.[6]

[6] Derailment of Amtrak Auto Train on the CST Railroad Near Crescent City, Florida, April 18, 2002, NTSB Report Number RAR-03-02, adopted on 8/5/2003.

In none of the accidents that were the subject of an NTSB report, however, has the NTSB explicitly cited an instance where a surviving passenger had unknowingly been left behind nor an instance where emergency responders had spent time searching for nonexistent passengers.

Given the sparse data available it is difficult to draw sweeping general conclusions. Based on the cases available (including the two involving commuter rail fatalities), however, it seems that the availability of a perfectly accurate passenger manifest would not have resulted in a passenger's life being saved or the degree of injury reduced. No examples have been found in which promptly accounting for passengers and crew has affected survivability or severity of injury.

Moreover, an accurate manifest is only one part of the solution to the passenger accountability problem. Matching known passengers to a list either by means of a simple head count, or taking attendance (a head count with associated names), as soon as possible after the accident is the other necessary part of the solution. In the Amtrak accident at Syracuse, New York, it took about 1 hour for first responders to count 100 passengers. In the Amtrak accident at Nodaway, Iowa, it took first responders between 3 and 4 hours to count 241 passengers. Of the accidents involving Amtrak trains that occurred between 1993 and 2003 and documented by NTSB, the number of Amtrak passengers has varied from 83 (Intercession City, Florida) to 413 (Crescent City, Florida).

When serious Amtrak accidents occur, having a count of the number of persons on board has three main uses.

- If an estimate is provided as part of the accident reporting process, first responders will be able to better gauge the need for resources.

- As the search and rescue process proceeds, an accurate list to compare with persons evacuated can be used to determine whether persons may still be missing or that all persons are accounted for.

- A list containing names and other personal information will also be of subsequent use to Amtrak for purposes such as notifying next of kin, and in dealing with legal liability matters.

The NTSB recommendation that an accurate accounting system be developed and implemented implicitly assumes it would have a meaningful safety benefit. It is thus necessary to assess the value of such a system in terms that can be compared to the costs of implementation. Each of the identified uses is examined below to determine its effect on safety and indicate a measure of the likely impacts.

Gauging Resources Required for an Accident Response

To gauge the amount of resources to dispatch to a rail accident, responders need information about the type and size of the accident and the number of casualties requiring emergency medical

care and transportation. Amtrak crews are trained to quickly assess the situation and include this information in reporting the accident. Exact counts are not essential for this purpose.

Indicating the Possibility of Missing Persons

Emergency response teams are trained to perform systematic searches of accident and disaster sites to locate all victims. Part of this standard practice is to count rescued persons and collect personal information about these individuals. Comparing this on-site accident response information to records of persons on board could aid in the accounting of persons. This process takes time, however, and is not the first priority of emergency responders.

Emergency responders will normally perform careful searches irrespective of any indication of missing persons. Inaccurate records of persons on board might cause some continuation of search and rescue operations that might otherwise have ceased, but only if the error was to list more persons than were actually on board. It is more likely that imperfections in Amtrak's passenger accounting system would result in undercounts rather than overcounts of persons on board and thus would not cause unnecessary searches. The added costs of extending the search period could be extra pay for those searching, but this might be performed within regularly scheduled duty time. Given the potential for undercounting, emergency responders will likely continue the search for passengers even after all those listed on the manifest are accounted for.

Providing Information for Post-Accident Notification and Records

As a common carrier, Amtrak has post-accident responsibilities that require information concerning persons on board. Pre-accident data will always be compared, verified, and supplemented by information collected during the emergency response. Accurate pre-accident information would facilitate this process, but has no significant safety benefit or notable cost saving other than potentially reducing fraudulent liability claims.

Potential Costs and Benefits of an Improved Passenger Accountability System

- Amtrak's passenger accountability system can be improved but will require changes to its operating practices and increases in capital and operating costs.

- Detailed analysis of the costs of Amtrak's existing and improved systems for ticket reservations, sales, collection, and revenue accounting would be required to decide what end-state system Amtrak should select and integrate into the long run planning of all its system modernization acquisitions and improvements.

- Estimated capital costs for new equipment considered in this study range from about $17 million to over $200 million, and a system that meets NTSB requirements would cost at least $40 million. Additional one-time development costs would exist for changes to computer systems that would likely be substantial.

- Incremental operating costs for materials and maintenance of the new systems would range from $2 million to $21 million annually, and meeting NTSB requirements would cost at least $7 million per year. Staffing changes at stations and on board trains would result in additional operating costs.

- Non-safety business benefits may exist to improving Amtrak's passenger processing system; these should be considered in decisions regarding future system improvements.

1. Background and Purpose

1.1 Background

In investigating the derailment of Amtrak's Auto Train on April 18, 2002, the National Transportation Safety Board (NTSB) observed that an accurate count of persons on the train at the time of the accident was not available at the accident scene; this took NTSB almost 5 months to develop. NTSB noted that emergency response would be improved with accurate passenger- and crew-count data at the accident scene and thus on August 15, 2003, issued the following Safety Recommendation, R-03-12, to the Federal Railroad Administration (FRA):

> In cooperation with the Transportation Security Administration, develop and implement an accurate passenger and crew accountability system for all long-distance, overnight, and reserved passenger trains that will immediately provide an accurate count and identity of the people on board the train in case of an emergency at any time during the trip.

FRA must assess the feasibility of implementing this recommendation and, consistent with its authority and Amtrak's capability to implement the recommendation, develop a response to the NTSB. FRA requested that the John A. Volpe National Transportation Systems Center (Volpe Center) undertake an effort to define options for such an accountability system and assess the feasibility of implementing them.

1.2 Objective

This study has two objectives: (1) to define one or more options for a real time manifest[7] system for passengers and crew aboard Amtrak long-distance, overnight, and reserved trains, and (2) to assess the feasibility of developing and implementing such a system.

The improved manifest system would provide an accurate listing of all persons on board, including limited personal information to be used as part of an emergency response (i.e., name, and perhaps age or age category, gender, and contact person/number).

The feasibility assessment will include information on the required institutional changes, constraints, implementation costs, and the expected benefits in an emergency situation, including the system's expected reliability and effectiveness.

[7] In this report, a passenger manifest is a list of the number and names of the passengers actually on board a train and could include other persons (crew). Under current practices, Amtrak's printed "manifest" provides the names of first class and sleeper passengers holding reservations. However, it only has a count (without names) of coach reservations and is not checked against the number and names of passengers actually on board. Thus, it is not a comprehensive passenger accounting system (manifest) as envisioned by NTSB.

The system will not include security functions. This study will not consider options for linkages to other security databases for passenger screening, but these may be the subject of a follow-on study.

The following tasks were performed to meet the study objectives:

1. Describe the existing Amtrak operations and passenger processing systems.

2. Identify Amtrak's past or planned initiatives to create or improve passenger processing procedures and systems, especially regarding manifests. The efforts identified will be described, including the technical nature of the system and what is known about its implementation and status.

3. Describe passenger reservation, ticketing, and control processes for a small sample of foreign passenger rail systems.

4. Describe the role of passenger count and identification information in a rail accident and emergency response environment, and the expected benefits of the improved system. A key issue in this task is to determine how an accurate manifest would make the emergency responders' efforts more successful and the likelihood that it would be effective in typical accident situations.

5. Describe options for an improved passenger accountability system; estimate their development, capital, and operating costs; and assess the feasibility of implementing an improved system.

2. Types of Amtrak Routes

In its report documenting the investigation of the Auto Train derailment,[8] the NTSB noted that Amtrak uses the same paper record system that performed so poorly on the Auto Train for all its long-distance, overnight, and reserved trains. NTSB noted that Amtrak operates the following trains that fall into one or more of these categories:

Sunset Limited
Southwest Chief
California Zephyr
Empire Builder
Coast Starlight
Crescent
Texas Eagle
Capitol Limited
Three Rivers
Lake Shore Limited
Cardinal
Auto Train
City of New Orleans
Silver Palm
Silver Star
Silver Meteor
Acela Express
Metroliner
Empire Service

This list appears to have been taken directly from Amtrak's *Service Standards Manual for Management Employees*[9] then in effect. Unfortunately, the manual does not define long-distance, overnight, and reserved trains other than giving examples of trains that would fall within those categories. The NTSB list from Amtrak's manual includes all sleeper trains, three reserved non-sleeper services, and one service (Empire Service) that does not require reservations of all passengers. Many trains not on this list exist that also require reservations, and it is assumed that they fall within the intent of the NTSB recommendation.

In considering the question of where a manifest system would be applicable, an examination of the 2003 Amtrak timetable indicates that the long-distance distinction has little relevance, and no purpose would be served by treating it as a separate category in this report. All trains with sleeper service are reserved, and most of the corridor trains are reserved either completely or on a portion of their route. A few cases of overnight non-sleeper trains in the reserved service list exist. The current classification (based on the 2003 timetable) is indicated below and is used in the reminder of this report.

[8] Derailment of Amtrak Auto Train on the CSXT Railroad Near Crescent City, Florida, April 18, 2002, NTSB Report Number RAR-03-02, adopted on 8/5/2003, pp. 57, 58.

[9] Service Standards Reference Manual for Management Employees, Chapter 16 "Train Service Crew Functions and Accountabilities," Part D, "Passenger On-Board Record Procedures," reissued November 2002.

Sleeper

Federal (Twilight Shoreliner)[10]
Silver Star
Three Rivers
Cardinal
Silver Meteor
Empire Builder
Capitol Limited
California Zephyr
Southwest Chief
City of New Orleans
Texas Eagle
Sunset Limited
Coast Starlight
Lake Shore Limited
Crescent
Auto Train

Reserved

Metroliner/Acela Express
Vermonter
Downeaster
Chicago-St. Louis
Chicago-Pontiac
Illini
Illinois Zephyr
Heartland Flyer
Cascades
San Joaquins
Adirondack
International
Palmetto (Silver Palm)
Hoosier State (Kentucky Cardinal)
Kansas City-St. Louis
Pere Marquette
Carolinian
Piedmont

[10] In 2004, the Federal was replaced by an all reserved Regional without sleeper service.

Partially Reserved[11]

Ethan Allen Express
NE Direct/Acela Regional
Maple Leaf
Empire Service

Unreserved

Clocker Service
Keystone
Hiawathas
Pacific Surfliner
Capitols
Pennsylvanian

[11] The Ethan Allen Express is reserved north of Albany. The Maple Leaf is reserved west of Albany. The Empire Service is reserved west of Albany. NE Direct/Acela Regional operates a mix of reserved/unreserved trains. In 2003 18 percent of the Regionals were reserved.

3. Amtrak Route Characteristics

Amtrak's passenger accounting systems, including their weaknesses and potential improvements, are best discussed in the context of the route characteristics described in the following subsections.

3.1 Service Characteristics and Ridership

Some characteristics of Amtrak services are listed in Table 1. An improved passenger accounting system would apply to the routes having sleeper service and all-reserved trains. It would not apply to unreserved trains. Most of the ridership and trains in the mixed category are unreserved Empire and Northeast Corridor (NEC) trains. Thus the passenger accounting system would cover about 45 percent of Amtrak's passengers, 77 percent of its routes, and 46 percent of the trains operated.

Characteristics of Amtrak services for each route are listed in the tables of Appendix G.

Table 1. Selected Characteristics: Amtrak Routes

Route Type	Ridership	Percent	Number of Routes in Category	Percent	Trains/Week (Both Ways)	Percent
Sleeper	3,928,477	16.7%	16	36.4%	208	11.4%
Reserved Non Sleeper	6,723,144	28.7%	18	40.9%	628	34.5%
Unreserved	5,795,352	24.7%	6	13.6%	570	31.3%
Mixed: Reserved/Unreserved	7,009,731	29.9%	4	9.1%	415	22.8%
Total	23,456,704	100.0%	44	100.0%	1,821	100.0%

All data are for 2003

3.2 Stations

3.2.1 Station Staffing

Passenger boardings at unstaffed stations have potential implications for Amtrak's passenger accounting systems because passengers are not required to pick up their ticket before boarding at these unstaffed stations. Amtrak does offer the provision of sending tickets to customers via FEDEX, but this service is not used very often.[12] Unticketed passengers detract from the usefulness of the printed manifest the conductors receive before departure and at crew change points.

[12] Telephone conversation with Rich Reccardi, Amtrak Human Resources Officer, March 25, 2004.

Amtrak provides service at 495 unique[13] stations on its routes served by sleeper, reserved, and partially reserved trains. Table 2 illustrates the mix of staffed and unstaffed stations by route type. Of stations serving reserved routes, 206 (42 percent) are staffed, and 289 (58 percent) are unstaffed. Of the 340 unique stations served by Amtrak's 16 routes having sleeper service, 159 (47 percent) are staffed and 181 (53 percent) are unstaffed. Of the 215 unique stations served by Amtrak's 18 routes having reserved trains, 101 (47 percent) are staffed, and 114 (53 percent) are unstaffed. Of the 60 unique stations served by Amtrak's 4 routes having trains reserved over a portion of the route or a mix of reserved and unreserved trains, 44 (73 percent) are staffed and 16 (27 percent) are unstaffed. It is apparent from these data that unstaffed stations are a major element in Amtrak's operations and business model, and permitting passengers to board without tickets from such stations is a long-standing policy and practice. The tables in Appendix G show the breakdown of staffed and unstaffed stations within each type of service.

Table 2. Station Staffing by Type of Route

	Unique Stations Served				
Route Type	**Total**	**Staffed**	**Percent**	**Unstaffed**	**Percent**
Sleeper	340	159	47%	181	53%
Reserved	215	101	47%	114	53%
Partially Reserved	60	44	73%	16	27%
Total Manifest Trains	495	206	42%	289	58%

3.2.2 Passenger Boardings

An examination of passenger boardings at all stations served by Amtrak's reserved trains indicates that 94 percent of passengers board at staffed stations (see Table 3). For Amtrak's 16 routes having sleeper service, 91 percent of passengers boarded at staffed stations. For Amtrak's 18 routes having reserved trains, 92 percent of passengers boarded at staffed stations, and for Amtrak's 4 routes having trains reserved over a portion of the route or a mix of reserved and unreserved trains, 98 percent of passengers boarded at staffed stations. The tables in Appendix G show the breakdown of passenger boardings for staffed and unstaffed stations within each type of service.

[13] Many stations are served by more than one route.

Table 3. Passenger Boardings by Station Type by Route

Type	Passenger Boardings				
	Total	Staffed	Percent	Unstaffed	Percent
Sleeper	3,928,477	3,561,965	91%	366,512	9%
Reserved	6,723,144	6,188,464	92%	534,680	8%
Partially Reserved	7,009,731	6,882,310	98%	127,421	2%
Total Manifest Trains	17,661,352	16,632,739	94%	1,028,613	6%

3.2.3 Station Intervals

The spacing between staffed stations is a critical component of Amtrak's current passenger accountability system. Ideally, under the current system, conductors drop off hand-generated updates to the manifest at each staffed station so that the data can be entered into the computerized reservation system. The conductors then pick up an updated version of the train manifest at the next staffed station downstream. Large gaps on a route between staffed stations detract from the usefulness of such a system in two ways. First, as the time between updates increases, the value of the updates in terms of their currency decreases (i.e., the updated information becomes obsolete). Secondly, in terms of accident theory, as the distance between stations is increasing, all other things being equal, accident exposure (the likelihood that an accident will happen) is also increasing.

The tables in Appendix G show station spacing by route. When all stations on a sleeper route are considered, the average distance between stations varies from about 24 miles on the Federal[14] to about 73 miles on the Southwest Chief. (The Auto Train is a special case serving a single origin-destination pair 855 miles apart.) The maximum station spacing varies from 69 miles on the Federal to 263 miles on the California Zephyr. When only staffed stations on a route are considered, the average distance between stations generally increases. It varies from about 24 miles on the Federal (all stations served are staffed stations) to about 345 miles on the Sunset Limited. The maximum station spacing varies from 69 miles on the Federal to 622 miles on the Sunset Limited.

Distances between stations for reserved or partially reserved non-sleeper routes are shorter but still substantial. For example, the maximum spacing between staffed stations varies from 69 miles on the Acela Express to 283 miles on the Kansas City-St. Louis trains.

Thus, there are many cases of long spacings between staffed stations in the Amtrak system. Because staffed stations are used in updating Amtrak's passenger counts, these spacings are a factor that must be considered in assessing the design and reliability of their passenger accounting systems.

[14] In 2004, the Federal was replaced by an all reserved Regional without sleeper service.

4. Rail Passenger Accountability Systems

4.1 Amtrak's Existing System

Amtrak's existing passenger accounting process involves its computerized reservation system (Arrow) and onboard records and procedures.

4.1.1 Introduction

Amtrak's existing approach to accountability of passengers on board reserved trains is based on two systems, a manifest (as that term is used by Amtrak) and the conductor's ticket pouch. On unreserved trains, which in most cases can be viewed as up-scale commuter railroads, although passenger tickets or other authorizing documents are collected or checked, no attempt is made to keep a count of the number of passengers on board at any time.

Currently, Amtrak manifests are produced by Amtrak's computerized reservation system (CRS), known as Arrow, and are based on its reservations and ticket sales. As the name implies, the conductor's ticket pouch is based on tickets. It should be noted that, because of no-shows, in any common carrier passenger service the advance reservations do not necessarily equal tickets purchased, which, in turn, do not necessarily equal tickets used (i.e., passenger boardings). This basic fact is one key reason for the inconsistencies noted by NTSB in its criticism of Amtrak's past inability to provide an accurate accounting of passengers following a train accident, but there are also other Amtrak policies and business practices that inhibit timely and accurate passenger accounting.

An ideal passenger accountability system would provide an accurate count of passengers on board the train at any given time, their location on the train (per comment of emergency responders), and basic information on each passenger, such as name, emergency contact person/phone number, age or age category, and gender. The information would be available as a printed manifest on board the train and in a computer database located elsewhere to provide redundancy in case the onboard manifest is destroyed or cannot be located after an accident.

4.1.2 Types of Train Riders and Ticketing Procedures

The Arrow CRS is the source of printed train manifests. Passengers may make a reservation by calling Amtrak's 800 number, by using Amtrak's Web site, or through a travel agent. The customer is charged for the ticket (i.e., purchases the ticket at the time the reservation is made). Tickets can then be picked up at a station ticket counter or ticket machine later. Walk-up ticket purchases at a ticket counter or ticket machine simultaneously make a reservation (if space is available on the desired train) and generate a ticket sale and a ticket. The Arrow CRS is updated to indicate that a person has picked up his or her ticket.

Several types of revenue and non-revenue persons also ride Amtrak reserved trains but do not make use of the Arrow CRS before boarding and hence are not on the manifest. Instead, their presence on board is recorded on various forms that are added to the conductor's ticket pouch.

Among the non-CRS train riders are passengers purchasing tickets on board, users of monthly and multi-ride tickets or passes, non-fare paying infants and small children, railroad and government officials (such as FRA inspectors), Amtrak and host railroad employees using passes to travel, and passengers who ride past their intended departure station and are issued a ticket on board to go back.

Amtrak policies and procedures are moving toward having fewer cases of non-Arrow riders (e.g., by having reservations and sales transactions include non-paying infants). Infants are now issued $0 value tickets.[15] When pre-purchased, every person on the train in a family gets his or her own ticket (all are named) though if purchased on board, this is not the case. Amtrak's timetables and Web sites inform passengers that "reservations are required" for reserved trains, and "substantial penalties" are charged when a passenger could have bought the ticket from an open staffed station.[16]

Except for working or deadheading crewmembers, all Amtrak employees and family members using passes must have a ticket for reserved trains, and they may not be able to travel on certain trains on certain days. They may have to pay a portion of the lowest available fare and would appear on the manifest. Employees of host railroads must also get a free ticket by presenting a railroad order. The degree to which these policies and rules are followed was not determined, and it is possible that users of employee passes may board without reservations on trains known to have excess capacity and then simply be processed using onboard ticketing and ridership accounting procedures.

Still, absent a substantial change in its policies and procedures some riders will always board trains without an Arrow reservation and hence are not reflected on printed manifests. In particular, allowing onboard ticket sales to persons without reservations is a long-standing, institutionalized Amtrak practice. The large number of un-staffed stations and the inclination to generate additional revenues from persons who lack reservations are important reasons for this practice and would make it difficult to change. Other passenger-friendly practices, such as transporting passengers back to their intended destination, and honoring tickets and multi-ride passes of commuter railroads operating over the same trackage, are also traditions that create exceptions to having Arrow records for all persons on board a train.[17]

4.1.3 Boarding Procedures

It is important to understand Amtrak's boarding procedures and related business practices since they affect passenger accounting and options for its improvement. The descriptions below are based on conversations with Amtrak staff and field observations at NEC stations.

[15] Amtrak's online reservation system now makes provision for children under 2 (non-fare-paying passengers).

[16] The substantial penalty is either $9.00 or 50percent of the fare, whichever is less.

[17] Amtrak generally has agreements under which it derives revenue from the commuter railroads when it honors tickets or passes from their riders.

On Thursday, November 20, 2003, passenger-boarding procedures at Amtrak's South Station, Boston were observed. The boarding of a reserved train (Acela Express 2163, 11:15 a.m. departure) and an unreserved train (Regional 173, 11:35 a.m. departure) were observed. Both procedures were identical.

South Station is the Northern terminus of the NEC. The station has stub end platforms. Platforms are on the same level as the passenger waiting area and are visible through a glass wall.

The platform is cordoned off approximately 30 minutes before departure. Boarding began approximately 10 minutes prior to departure. A train's availability for boarding is announced over the public address (PA) system and passengers are requested to have tickets out and visible when boarding. All passengers must display a ticket to the station attendant (accompanied by a transit system police officer) in order to get onto the platform. No attempt at matching IDs to tickets occurred.

For the most part, only passengers went to the boarding line. Only one meeter/greeter was observed accompanying a passenger to the checkpoint. He left the passenger at that point and returned to the waiting area.

About 20-25 minutes before the scheduled departure of the Regional and prior to the boarding announcement, one passenger crossed the unmanned cordon line and headed down the platform. He returned a few minutes later. Conductors, train crew, and service personnel were on the platform at this time to turn back anyone who attempted to board before the announced boarding time.

Boarding procedures were observed again at South Station on May 11, 2004, and they were consistent with the earlier experience. Controlled access to the boarding platform by Amtrak staff ensures that boarders are authorized to be on the train under current Amtrak policies, though this includes persons not required to have reservations and tickets (e.g., passholders).

On Monday, November 24, 2003, passenger-boarding procedures at Amtrak's Back Bay Station, Boston were observed. The boarding of a reserved train (Acela Express 2163, 11:20 a.m. departure) and an unreserved train (Regional 173, 11:40 a.m. departure) were observed. Both procedures were identical.

Back Bay is an intermediate station on the NEC. Unlike South Station, the passenger waiting area is at street level while the platforms are on a lower level. The platform used for Amtrak southbound trains is shared with commuter rail operations.

Unrestricted access exists to the platforms via stairs, escalators, and elevator. A number of meeter/greeters were in evidence for both departures. Tickets were not checked on the platform prior to boarding and did not appear to be checked inside the train prior to departure. The objective of the boarding process seems to be aimed at minimizing station dwell time and staffing.

Amtrak staff noted that tickets are checked before boarding only at large stations (e.g., South Station, New York, Philadelphia, and Washington in the NEC) primarily for security purposes.[18] The approach used at Back Bay Station (i.e., not checking tickets until they are collected on board) is more typical. Moreover, all doors on a train open and close at each station unless the train is too large to fit the platform. All Acelas have six cars but only a conductor and an assistant conductor, and thus at most stations no means of checking passengers to see if they have tickets before boarding under current procedures and staffing levels exists. Regional trains may have an additional assistant conductor, but may also have more than six cars. Thus, except at a few major stations, it is possible to get on a reserved train without a ticket and without a reservation.

Conclusion Regarding Boarding Procedures

Except at a few major stations, it is possible to get on a reserved train without a ticket and without a reservation. At the many staffed and unstaffed stations with open platform access, ensuring that all boarders are authorized would require a change in business practice that adds to dwell time and/or staffing, and costs. Further, restricting train access to persons with tickets would require abolishing onboard ticket sales and other passenger-friendly practices, or else it would not result in accurate passenger accounting.

4.1.4 Conductor's Ticket Pouch

Conductors sweep the train between stations to collect tickets and to ensure that all persons on board have either paid or have other authorization to be on board. Tickets collected along with records for unticketed persons on board are put into the conductor's ticket pouch. The pouch contains: (1) ticket stubs collected by conductors at each station stop (lifted tickets); (2) Form 3085s (to the extent conductors follow prescribed procedures for any onboard ticket sales and unticketed, non-revenue passengers);[19] (3) cash fare receipts; and (4) the form "Record of Tickets Honored but Not Lifted."[20] Tickets in the pouch are generally sorted in stop order of collection, but there is no form that the conductor uses to summarize the number of tickets lifted

[18] Telephone conversation with Rich Reccardi, Human Resources Officer, March 25, 2004; and Conversation with Hanan Fadel, Boston Trainmaster, May 11, 2004.

[19]The conductor should completed Form 3085 for individuals either buying tickets on board or who are not required to pay a fare and are traveling without a ticket. Form 3085 was developed as part of the procedure to be followed on reserved trains to ensure that the conductor's ticket collections pouch provides an accurate list of everyone on board who may not be ticketed or appear on the manifest, and to ensure that reserved trains have a passenger manifest that is maintained and updated at all staffed, enroute boarding points. The procedure was developed in an attempt to respond to NTSB recommendations. See Appendix B for details on the format and use of Form 3085.

[20]The form "Record of Tickets Honored but not Lifted" also goes into the ticket pouch. The form indicates the number of passengers by class of travel (Coach, Sleeper, Parlor) and their origins and destinations. An Amtrak passholder boarded the Acela on the observation trip from Boston to Providence. The conductors accounted for the passholder on this form, rather than by means of a Form 3085. In practice other cases besides passholders that are accounted for on this form would include passengers with monthly passes from commuter railroads that are honored by Amtrak, employees of other railroads (although they should have a Form 3085), and passengers making a stopover.

or issued after each station stop.[21] The pouch stays on the train until the final destination and is then sent to Revenue Accounting. The conductors generally keep the pouch with their personal belongings. No standard designated safe place exists on the train for storing the conductor's ticket pouch.

Amtrak's *Service Standards Reference Manual for Management Employees*[22] describes the procedures that must be followed on long-distance, overnight, reserved trains to ensure that the conductor's ticket collections pouch[23] provides the source for an accurate list of everyone on board who may not be ticketed or appear on the manifest. Appendix B includes a copy of the relevant section of the manual. Appendix C includes a sample of the passenger accountability documents discussed below along with the face of the ticket pouch envelope and its associated instructions.

Although Amtrak has written policies to discourage but not prohibit onboard ticket sales, normal practice is for conductors to sell tickets on board reserved trains as long as the passenger has an acceptable form of identification and space is available.

The conductors are responsible for the ticket pouch and for informing other crewmembers on the pouch's location. The ticket pouch is supposed to be kept in a place that provides protection from heat, water, or impact damage in the event of a train emergency.

The pouch itself is just a large paper envelope. On an Acela Express, the conductor has an office with a rail phone on the café car usually located near the middle of the train. This is where the pouch is kept, along with the conductor's bag with all required forms, timetables, and emergency procedures manuals. No specially designed protective location exists within the office for the pouch. The Regional trains do not have an office, and the conductors generally operate out of the café car.

A cash fare receipt is issued for onboard ticket sales,[24] and, according to Amtrak policy, the conductor is also required to issue a Form 3085 for each individual in the party. In practice, this

[21]No set system for ticket pouch management exists. On a trip on an Acela Express from New York to Boston, the conductor had not bothered to sort tickets because it was a light load, and she felt that if necessary she could sort and count the tickets rather quickly. She indicated that she also worked the Regional trains (with more stops), and when the load was heavier, she used a more rigorous system of keeping the tickets sorted by origin and destination.

[22] Amtrak, *Service Standards Manual for Train Service & On-Board Service Employees*, Chapter 16, "Train Service Crew Functions & Accountabilities," Part D, "Passenger On-Board Record Procedures," May 3, 2004.

[23]Technically it is Form NRPC 158, the "Train Collections Pouch." Hereafter it will be referred to simply as the "conductor's ticket pouch."

[24]Tickets are sold on board as long as the passenger has a photo ID. If the passenger does not have an ID, he or she is asked to leave the train, and this happens but not often. If the ticket is sold, the passenger pays the regular fare plus a penalty if the ticket is purchased at a time when the ticket office at the passenger's origin station is open. If the ticket was paid for via the reservation system but not picked up before departure, the passenger pays the difference, that is, the penalty portion. On trains operating within the NEC, the conductor would call the last station to verify that the unticketed person had a reservation and had paid if he or she did not appear on the conductor's version of the manifest as an unticketed passenger.

does not always happen. A system-wide audit would be required to find out the extent to which the policy was being followed. The cash fare receipt has the dollar amount, the number of passengers in the party, and origin and destination. One receipt is issued per family or party traveling together. In practice, it does not show all names.[25] If one of the party was an infant, a Form 3085 would be issued for the infant. These receipts never get into the Arrow system but are tallied by revenue accounting after the fact along with all other tickets collected.[26]

Form 3085 is used for each passenger or rider who is not ticketed before boarding. It is issued for riders purchasing tickets on board, infants, and Amtrak and host railroad pass-holders on non-work related trips. Employees deadheading as part of a job assignment are accounted for separately in the crew manifest. The original of each Form 3085 goes into the conductor's pouch and the other copy should be dropped at the next open station for entry into the Arrow system and updating of the train manifest. Form 3085s are used on Acela Express and all long haul/overnight trains. It is Volpe Center's understanding that they are no longer used on Metroliners or NEC reserved Regional trains because, given the large numbers of pass holders on these trains, it would take too long to do a Form 3085 for all pass holders.

The consensus of the Amtrak officials interviewed[27] was that the ticket pouch, rather than the printed manifest, was currently the best (but not perfect) source of passenger count information because it excludes no-shows and includes persons who board without tickets.

Conclusions on Use of Ticket Pouch for Passenger Accounting

- Even if Amtrak policies are followed, the ticket pouch is not a perfect passenger accounting system since: (1) a time lag to "sweep" the train and gather the records exists, during which the pouch does not contain complete records of persons on board; (2) the conductor could miss someone when collecting tickets; (3) a passenger could leave the train before his or her scheduled stop without notifying the conductor either because of a personal emergency or last minute change in travel plans; and (4) in an accident the pouch could be destroyed or lost.

- In actual practice, the ticket pouch records are not likely to be an accurate basis for passenger accounting due to the failure to use the Form 3085 consistently. As noted, exceptions are permitted on some reserved trains in the NEC, and, given their limited

[25]The receipt does provide space for at least one passenger name, address, and phone number. The name of the person paying for the ticket is included on the receipt.

[26]The conductor gives a copy of the receipt to the passenger and puts a copy in the ticket pouch. The conductor keeps a copy since he or she is accountable for all tickets missing from the book he or she was issued. Serial numbers on coupons are tracked since these coupons are considered by Amtrak to be the same as cash. The final copy is turned in with the cash or credit card slip to the ticket office at the end of the run. This is the revenue pouch, which may be a plain envelope or just a collection of loose paper and cash. No formal revenue pouch exists.

[27]Telephone conversation with Ed Mruk, Amtrak Systems Service Trainmaster, March 24, 2004; telephone conversation with Rich Reccardi, Human Resources Officer, March 25, 2004; telephone conversation with David Nogard, Senior Director of Service Delivery, April 5, 2004.

perceived value and importance relative to other conductor records and responsibilities, lapses in the use of Form 3085s in other situations seems likely.

- Regarding passenger identification, since the cash fare receipts lack passenger name information for multi-person groups traveling together, unless the conductor also fills out a Form 3085 for each individual (and, as noted, this process is not uniformly followed), incomplete records of individual names will exist. The same is true of the Record of Tickets Honored but not Lifted as it is applied to revenue pass holders (i.e., any failure to use the Form 3085 results in missing passenger names).

- No designated or specifically designed safe place exists on board for the ticket pouch. Given the possibility that the pouch would be destroyed or be inaccessible in serious accidents (and it is mainly the serious accidents that accurate passenger accounting is needed), a need exists for having some means of transmitting all of the information in the pouch (tickets actually lifted, onboard ticket sales receipts, Form 3085s issued after each station stop, and the "Tickets Honored but Not Lifted" form) to a safe repository off the train, to use this information to update Arrow so it can become a source for an accurate count of on/offs by station, and provide an accurate name list of passengers on board at any given time.

- No standard procedures appear to be in place regarding ticket pouch management, that is, sorting all tickets and forms by origin/destination or summarizing ons and offs after each station stop. This means that, while the pouch may contain most of the information needed to determine the number of passengers on board, the work involved in sorting through the individual pieces of paper precludes determining an accurate count of passengers on board in a timely manner, and would be a daunting task to someone unfamiliar with the various forms and their uses if the conductor was unavailable.

4.1.5 Amtrak's Printed Train Manifests and Arrow CRS

Under Amtrak's current policies and practices, its Arrow reservation and ticketing system is used to create printed train manifests about 30 minutes before departure and crew changes. An Amtrak train manifest provides the train crew with the number (but not names) of all revenue passengers getting on and off at each station, the names of first class and sleeper passengers, train consist information, and special needs and group information. The passenger manifest does not include non-revenue unticketed passengers or working crew.[28]

Travel agents are tied into the Arrow CRS, and their ticket sales are reflected on the manifest, though subject to the same limitations noted for other Arrow users.

The manifest contains different types of information for different types of passengers. The following information is based on an Amtrak training manual, a sample manifest provided by Amtrak, the field trip observation, and conversations with Amtrak staff. For coach passengers

[28]A separate manifest for the crew exists and can be considered a supplement to the passenger manifest for purposes of accounting for persons on board.

the manifest only shows the number of reservations for passengers getting on and off at each station. It does not show passenger names even though that information is contained in the Arrow database and can be printed out. It was noted that a name list of coach passengers has no routine value or use to conductors and would be voluminous for trains with large numbers of passengers. For first class passengers the manifest lists the name of the passenger, their origin and destination, and whether or not they have picked up a ticket. For sleeping car passengers, it includes all of the information for first class passengers plus an actual room assignment. For group travel (minimum size is 20), the manifest lists the number of people in the group but not individual names.[29] Appendix A shows sample manifest information.

The manifest also provides a list of persons with reservations but for whom tickets have not been issued; it is used by conductors in issuing tickets on board. The conductor makes no attempt to match names on the unticketed list to names on the tickets he has collected to determine whether everyone on the reservation list has in fact boarded the train.[30] The conductor does not attempt to reconcile the reservation list with tickets collected, tickets sold/purchased on board, or Form 3085s issued for children and employees.

Because the initial manifest[31] is printed 30 minutes before departure from the train's origin, it does not include tickets purchased in the last 30 minutes prior to departure, nor does it include transactions made after departure (e.g., tickets purchased on board without prior reservations, or reservations made or tickets purchased after departure for boarding at downstream stations even though these are common given the extended operating time of most intercity reserved trains). Thus, the printed manifest the conductor has on board the train will generally be incomplete. It also will contain no-shows, (i.e., persons with reservations who do not actually board the train) because conductors do not check persons boarding against the manifest listing.

Passengers may depart the train before their ticketed destination station for any number of reasons including ticketing errors, changes in travel plans, illness, and even unruly behavior. The Amtrak Service Standards Manual specifies onboard accounting procedures the conductor should follow if aware of these situations, but the open Amtrak system for boarding and deboarding does not ensure that the conductor will know of all such cases and perform the proper accounting, and no provision exists for updating Arrow with this information. Arrow and the train manifest treat the passenger as if he or she is on the train until his or her destination station is reached and thus will not be accurate when exceptions occur.

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[29]Amtrak, *How to Read a Train Manifest*, revised March 2004.

[30]On a trip from Boston to Providence and return (May 11, 2004), it was observed that the conductors made an announcement over the PA system requesting passengers to sign their tickets in the upper right hand corner before they were collected. Trainmaster Hanan Fadel confirmed that this was standard procedure on NEC trains. All Amtrak issued tickets are signed to verify that it belongs to the person holding the ticket. Passengers are not required to show an ID at this time because they had to show an ID when picking up the ticket. (A photo ID is not required if the ticket is picked up at a ticket machine.)

[31] The next subsection discusses updates, which apply more to the Arrow database than to the onboard printed manifest, which is typically only updated at crew change points.

The printed manifest is a predeparture reservation listing and is an inexact source of actual passenger counts since it excludes persons who enter the system after the train departs, includes persons with reservations and tickets who do not actually board the train (i.e., no-shows), and does not reflect the possibility that passengers depart at stations other than their ticketed destination.

Arrow and Manifest Updates during Train Runs

According to Amtrak policy and directives, the Arrow database and the manifest derived from it are updated as the train progresses. In the ideal world the conductor issues Form 3085s to persons without an Arrow reservation,[32] and at the next open staffed station drops off one copy of each Form 3085, which is then used to update the Arrow database by the station staff. At the next downstream staffed station the conductor would leave the train, enter the station, and either get a updated manifest from station staff or use a computer terminal to print it out. The updated manifest that the conductor would obtain at this point would include the Form 3085 updates provided at the prior staffed station, and any additional reservations made to the Arrow system since the last manifest was printed. It would also omit some no-shows (i.e., those where the ticket was not picked up by the purchaser by the time of departure) though, in fact, these could be passengers with reservations who purchased tickets on board. However, even the updated manifest would not account for onboard ticket sales (and any other Form 3085s created) since the Form 3085s were dropped off at the previous station for entry into Arrow nor for any new unticketed boarders at this station stop.

It seems for logistical and practical reasons, however, that even the ideal update process does not occur as described. The update process is based on the Form 3085s, but from both Volpe observations and discussions with Amtrak staff, it seems that the Form 3085s are not prepared for all persons boarding without reservations and tickets. In part, this occurs because conductors do not view it as important in cases where no revenues are involved. Their primary responsibility is to assure that ticketing occurs for those who should be revenue passengers. Form 3085 is redundant for passengers issued tickets on board, and has no other use to conductors except in the unlikely event of an accident. In addition, in cases where many monthly passes or multi-ride tickets are involved, the extra work involved can be viewed as excessive, especially if the next station stop will occur soon or on trains with large numbers of such passengers, and Amtrak policy recognizes this as a sanctioned exception to their use on Metroliners and reserved Regional trains in the NEC.

The second major discrepancy from the ideal is that the station drop-off for entry of Form 3085s into Arrow and the pickup of updated manifests is inconsistent with the practice of having short station dwell times and the physical layout of many stations. Conductors assist passengers in the deboarding and boarding process and thus leaving the platform area would often disrupt this function, especially because at some stations ticket offices are some distance away and

[32]There are two exceptions: (1) Form 3085 is not used for passholders and onboard ticket sales in the NEC; and (2) a relatively infrequent exception exists when a person goes beyond their intended destination and boards a train to be carried back. Though this exception could be easily eliminated with a change in policy, it would have no practical consequence since the person would generally be off the train before the 3085 information could be added to Arrow.

sometimes even on other levels or platforms. Amtrak policy explicitly includes a waiver from following the update procedures at staffed stations where the office is not readily accessible from the train platform or when the process would delay the train. It can be surmised that considerable variation probably occurs in the degree to which the manifest update process follows the ideal.

Typically, an updated manifest would be printed and brought on board when the conductor is relieved at the next crew change point, if any. This revised manifest, would suffer from the same deficiencies as the original; namely, it would not include passengers boarding without a reservation, passengers purchasing tickets without a prior reservation in the last 30 minutes before departure from the crew change point, or reservations being made and tickets sold for departures from stations downstream from that point. It would however omit some no-shows where the ticket was not picked up by the purchaser by the time of departure at prior stations. It would still consider all issued tickets as boarded passengers even if they were no-shows. In general, even a revised manifest will not contain all of the information about persons on board in the conductor's ticket pouch.

Conclusions Regarding Amtrak's Arrow CRS and Manifest System

- Due to the many exceptions arising from special cases and Amtrak policies and practices, the printed manifest on board trains does not meet the objectives of the NTSB recommendation on passenger accounting. To remedy this, the following would need to occur: (1) a means of transmitting all of the information about who is actually on the train–purchased tickets actually used, onboard ticket sales, tickets honored but not lifted, and other Form 3085 cases–into the Arrow CRS; (2) a means to convert this information into an accurate count of on/offs by station and an accurate name list of all passengers on board at any given time; and (3) a means to provide a printed copy of this information on the train.

- At best, the current manifest provides an estimate of what the crew may expect in terms of workload on their tour of duty, information on passengers with special needs, and information on groups.[33] It also provides an incomplete list of unticketed passengers holding valid reservations. It does not appear to be used by the crew for any passenger accounting function, likely because of the limited and outdated information it contains at any point in time.

The current train manifest system of passenger accounting suffers from the following limitations.

- Passengers making reservations or picking up tickets (either at ticket machines or ticket counters) after the train's 30-minute predeparture window at the origin or downstream stations do not appear on the train manifest. Moreover, using their predeparture printed version of the manifest there is no way for the conductor to verify that the passenger without a ticket has made a reservation (and paid) after the train's 30-minute predeparture window, but not picked up his or her ticket.

[33]This was the consensus opinion of the train master and conductors interviewed on a trip from Boston to Providence and return (May 11, 2004).

- It incorrectly includes persons not on the train (no-shows, specifically people who were issued but do not actually use their ticket), and persons departing from the train before the ticket destination. If a ticket is issued, Arrow assumes it is used and that the passenger remains on the train until his or her scheduled destination. If a ticket is not issued by the scheduled time of boarding, the Arrow system will delete a person from the train manifest database, and the updated manifest provided at the crew change point would reflect this.

- The manifest does not account for Form 3085 updates in a timely fashion, and the system for getting the Form 3085 information into Arrow, and for the conductor obtaining an updated manifest, is unreliable. The current system of relying on staffed station's drop-offs and pickups is not adequate even if it worked perfectly because of the large gaps between staffed stations on many routes and because it would always be at least one station behind in terms of completeness. The existence of many unstaffed stations exacerbates this problem.

- Amtrak-sanctioned exceptions exist for using Form 3085 for some reserved trains and classes of riders, and it seems prone to unsanctioned omissions in other situations. To this extent, even the properly updated information in Arrow and any manifest created from it will not always be accurate.

- No way of comparing who actually got on the train with the information on the typical manifest exists. Under current practices the manifest lacks passenger information for coach passengers (name).

4.1.6 Conclusions on Amtrak's Existing Passenger Accounting Systems

- Amtrak's current passenger accountability system does not and cannot meet the NTSB's requirement for accurately knowing the number and identity of passengers on reserved trains at all times.

    1. The Arrow CRS does not have access to information about the number or identity of persons who actually board and depart Amtrak trains and as a result includes persons not on board (mainly no-shows) and excludes persons boarding without prior reservations.
    2. The conductor's ticket pouch has records from which a better list can be developed, but due to various exceptions and time lags it cannot be considered 100 percent accurate, and it suffers from the possibility that it could be destroyed in an accident with no reliable backup system for the information it contains.

- The ticket pouch system can be improved through strict implementation of the policy requiring the issuance of a Form 3085 for passholders, other non-ticket riders, and individuals purchasing tickets on board all reserved trains, though staffing levels might need to be increased on trains with large numbers of such cases. It would remain an imperfect system for reasons described elsewhere.

- The process of dropping off records at staffed stations for entry into Arrow and creation of updated manifests is inherently flawed, even if the sanctioned and unsanctioned exceptions to following the prescribed process are overlooked.

    1. No practical way exists to identify no-shows so Arrow will continue to include these persons in any list developed.
    2. The update process will always be at least one station behind since the Form 3085s are created as part of the conductor's train sweep after the train leaves the station.
    3. Other cases that can cause discrepancies, such as premature train deboardings though probably less common, cannot be completely discounted.

- Printed manifests that conductors have on board trains suffer from the same deficiencies as the Arrow system from which they are generated, are further out-of-date, and in practice lack the names of coach passengers.

- The ticket pouch accounting and Arrow update process involve a number of manual steps that can easily be omitted or performed in ways that create errors and information gaps, thus reducing their effectiveness for passenger accounting purposes. In addition to the system's inherent flaws, its execution is prone to error.

To completely correct these deficiencies would require substantial changes in policies, business practices, and the technology used in processing passengers. Among its characteristics would be requirements that all boarding passengers must have a ticket or pass containing their identity before boarding (i.e., no onboard sales or other exceptions), that these tickets are checked as part of the boarding process, and that the number of passengers boarding and their identity is made available to Arrow before the train departs from the station.

In addition, all departing passengers would need to have their tickets checked/validated, so that the number of passengers departing the train and their identity is made available to Arrow before the train departs the station.

4.2 Past Initiatives to Improve Amtrak's Passenger Accounting System

Amtrak has undertaken several initiatives that would improve its systems for accounting for passengers on board. Following the September 1993 Amtrak accident in Mobile, Alabama, NTSB recommended that Amtrak do the following:

> R-94-7
> Develop and implement procedures to provide adequate passenger and crew lists to local authorities with minimum delay in emergencies.

Amtrak responded to the safety recommendation on July 18, 1995, stating that a three-phase project to provide a satellite and messaging system between long-distance trains and the corporate entities associated with their operation would be implemented. According to Amtrak,

Phase I would develop and install a test version of the system, Phase II would expand the system to more trains, and Phase III would provide nationwide voice communications.

In connection with its investigation of a derailment of Amtrak Train 4 near Kingman, Arizona, in August 1997, Amtrak's General Manager for Operations, Standards, and Compliance told NTSB that Amtrak had a contract with a service to provide a satellite-based communications system known as Star Trak. The system was about 75 percent installed. It consisted of a satellite communications unit in the body of the train that can permit portable two-way communications between the train and Amtrak's national operations center. The locomotive would have a laptop-type computer, and the conductors would be able to communicate through the locomotive's computer and antennae. This communications system would be independent of the locomotive radio for communicating with the host railroad's train dispatcher for train operations. Amtrak was next going to develop a method to use the system to account for passengers on the train.

On March 24, 1998, Amtrak demonstrated its Star Trak satellite communications system for NTSB investigators. The system included an onboard mobile communications terminal in the locomotive, a conductor's portable unit, and a global positioning system (GPS) locator for the locomotive. The system demonstrated that Amtrak had the ability to communicate, independently of a host carrier, with its own trains anywhere in the United States (with certain exceptions, such as tunnels). The system is programmed to accommodate 19 preformatted messages for train status and direct communications between the train and its national operations center. It also provided communications between the train and Amtrak maintenance and customer service personnel. It had no onboard printing capability. In addition, if the locomotive unit loses power, the onboard computer will not work.[34]

The General Manager for Operations, Standards, and Compliance also stated that, in past accidents and incidents, Amtrak personnel have had to search for the conductor's pouch to count the tickets to determine the number of people on the train. The General Manager had prepared a draft policy to change those procedures, and Amtrak had established a working group to ensure that an official passenger count is provided to the national operations center. Under the proposed system the official count would include ticketed revenue passengers (including multi-ride pass holders) and non-revenue non-ticketed passengers such as infants, Amtrak employees traveling on a pass (regardless of travel status), employee dependents, and authorized employees of a railroad over which tracks Amtrak is operating.

According to the General Manager, the plan was for Amtrak to use the satellite communications system to download Arrow data onto a form in the onboard computer. Each train conductor would then add to the form some information about the number of people on board each train, and the information would be transmitted using the communication system back to the national operations center and would be immediately available to other Amtrak personnel. He also stated that, after the process had been tested satisfactorily, it would be implemented on all reserved seat

[34] *Railroad Accident Report Derailment of Amtrak Train 4, Southwest Chief, on the Burlington Northern Santa Fe Railway near Kingman, Arizona August 9, 1997* (Revision August 7, 2003), NTSB Report Number RAR-98-03, adopted on 8/31/1998.

trains. While the Star Trak communication portion of the system is in use, the passenger accounting portion of the system was never implemented.

On September 14, 1999, the president of Amtrak Intercity testified during NTSB's public hearing on the Bourbonnais, Illinois, accident that in 1998 Amtrak had made an investment of $24 million and contracted with Motorola to develop an automated system for onboard accounting of train passengers. It was to replace the onboard manual ticket collection and payment system. The computerization of many tasks and the introduction of smart cards was supposed to make the system more efficient for customers and conductors, who would be able to devote more time to customer service.

He described the system as having a simple handheld device (HHD) to be used by the conductor to scan the tickets and record a passenger's name. Conductors were to use the HHD configured with the train's passenger manifest to read the ticket barcode, process ticket sales using credit cards, checks, cash or smart cards,[35] and issue a receipt or seat check utilizing a separate printer that fits on the belt. As proposed, the information captured by the HHD would be transmitted to an Onboard Computer (OBC) via a HHD docking station. Once the train reached a designated station, the data would be transmitted via wireless local area network (LAN) technology, to a Station Information Computer (SIC), which would in turn be linked to Amtrak's Arrow CRS. Ultimately, data was to be transmitted while the train was in motion, not at designated stations, via a wide area wireless communications network. In this way, the passenger count data could be made available to emergency responders. The Amtrak official said the system was scheduled for implementation in 2000.

The new system was also to give Amtrak more accurate and timely ridership and revenue data, as well as significantly improve its management of seat inventory, helping to generate additional revenue. Real time passenger manifests were to permit the sale of cancelled reservations or sale of seats of ticketed passengers who did not board the train and were to assist accident responders by giving a better accounting of who and how many were on board the train.

The contract also called for Amtrak and Motorola to test two smart card applications and eventually roll them out system wide. In one pilot project, frequent customers of Acela Express' first-class service would be able to use the Motorola M-Smart™ smart card as an e-ticket. In another pilot, the smart card would be used to track onboard meals on Amtrak's long-distance trains.[36]

However, Amtrak did not implement the Motorola passenger accounting system. Early in 2003, an Amtrak official stated in a letter to an NTSB staff member:

> While Amtrak continues to explore realistic technological alternatives to enhance the efficiency of recording ticketed and non-ticketed passengers, we feel that the

[35]Smart cards are credit card-sized devices embedded with a computer chip that can accept, store, and send up to 100 times more information than traditional magnetic-striped cards.

[36]http://www.motorola.com/LMPS/pressreleases/CGISS9949.html

passenger accountability system presently in place is a reliable one.

Amtrak, therefore, still uses the paper onboard record system outlined in its *Service Standards Manual for Management Employees* to account for passengers on its long-distance, overnight, and reserved trains and has abandoned prior initiatives to replace it.

The Amtrak officials interviewed provided several reasons as to why the Motorola effort was abandoned by Amtrak. One person said it was dropped because it could not provide real time information. Another noted that transmitting the data from the train to a central database was the problem at the time. Amtrak's aspirations were much greater than what the technology (at that time) could deliver, and the system would have been extremely costly. Another mentioned that, when the system was tested by conductors on board, it was found to be a slow and cumbersome process. It reportedly took the conductors about 17 minutes (the interval between stations in this case) to use the scanning system to process 8 passengers; conductors should normally be able to process about 5 times that number of passengers in that time using manual methods.[37]

4.3 Amtrak's Current Initiative to Improve Passenger Accounting

Amtrak has issued a Request for Information (RFI) to vendors for a system to replace its current Star Trak satellite communications system on trains. If successful, this effort would also provide the communications system needed to support an automated manifest system. The new system would include the following capabilities:

- automatic train location using GPS
- two-way voice communications between Amtrak's operations center and trains
- onboard fare collection, ticketing, and manifesting
- possibly mechanical monitoring and transmittal of digitized movies

The proposed system would report when the train arrives at a station, and the onboard fare collection would include real time credit card verification.

Amtrak's RFI is asking the venders to tell them the best way of meeting their goals. The RFI responses were received from vendors in May 2004. A Request for Proposal (RFP) will be issued to vendors before the start of fiscal year 2005 (FY05). It is not anticipated that widespread implementation of the new system would occur until FY06 and FY07.

The primary purpose of this project is to develop a communications backbone for Amtrak (i.e., direct communication between the train and Amtrak offices). Currently, Amtrak has no direct voice communication link between its operations center and the majority of its trains because they are not operated on Amtrak right-of-way (ROW). Trains' voice communications link directly with host-railroad dispatchers but not with Amtrak.

An automated manifest system would be only one potential use of the communications backbone and would be a follow-on development once the backbone was in place. Ideally they would have

[37]Telephone conversations with Amtrak staff during March and April of 2004.

a two-way flow of information–from the train to the reservation system and back. The conductor would be able to get an updated manifest while on board the train. This could be a station update or real time update, but the exact approach is still undetermined.

The system would have to handle all types of onboard transactions, including the following:

- passengers boarding with a ticket
- passengers boarding with a paid reservation but without a ticket
- passengers boarding without a reservation or a ticket
- recording information on pass holders, employees, and other passengers who currently require the issuance of a Form 3085

Amtrak believes that it is technically feasible to create a communication data link that will support onboard fare collection and passenger accounting functions, but many uncertainties exist that affect cost. They could need 400 to 800 units at a minimum to equip all trains with a communications box. However, they may or may not need a unit on all cars. They have more than 2,000 pieces of equipment (1,400 passenger cars plus baggage cars, and diners).[38]

Onboard system survivability in an accident remains an issue though any system must withstand a rugged train environment (temperatures, shock, and vibration). The system might have some redundancy with a communication capability from the front (engineer) of the train and the back (conductor) of the train. More importantly, since data from on board the train would be communicated to a central database, they can be retrieved to provide passenger accounting information as a contingency in severe accidents.

Ticket scanning/collection has been done on Amtrak's Keystone Service (Harrisburg to Philadelphia and New York). A bar code scanner is used to scan tickets, but no real time transmission of the data occurs. Information from scanners is downloaded at the end of the line. Bar code scanners are a cheap, proven technology. The major problem appears to be that of sending data from a moving train to an off-train computer and using it to update the Arrow database.[39] It is unclear how this system accounts for persons boarding without tickets.

In addition Amtrak is involved with the CCJPA[40] in a joint-effort, pilot program of an onboard-automated fare collection system in Capitol Corridor trains using handheld ticket readers. Benefits of this system would include customer convenience, real time information on ridership and revenue, and cost efficiencies.[41] As proposed, the system would include a handheld scanner

[38]Telephone Conversation with Chris Jagodzinski, Senior Director of Systems Operations, April 9, 2004.

[39]Telephone Conversation with Chris Jagodzinski, Senior Director of Systems Operations, April 9, 2004.

[40]The Capitol Corridor Joint Powers Authority (CCJPA) is a partnership among the six local transit agencies in the eight county service area which shares the administration and management of the Capitol Corridor.

[41]http://www.amtrakcapitols.com/ccjpa/business_plan/bp06_fares.shtml

that the conductor would use to read the "Arrow" ticket. At some point, the data collected would then be transmitted off the train using cellular or wireless fidelity (WIFI) technology.[42]

Conclusions

The ongoing initiatives will improve Amtrak's passenger accounting capabilities if developed and implemented as planned. Significant business practice, cost, and technology challenges must be overcome, so uncertainty exists as to how effective these initiatives will be. At best, however, they seem to be automating Amtrak's existing ticket lift system, and its inherent flaws will remain as imperfections even if implemented and used consistently. The underlying flaws are the problems caused by not knowing who has boarded until after the sweep is completed after each stop, whether anyone is missed in the train sweep, and whether anyone has departed before his or her ticketed destination.

4.4 Foreign Systems

4.4.1 Eurostar Service

Eurostar connects the capital cities of France (Paris), England (London), and Belgium (Brussels) through the Channel Tunnel. Each train set has 18 cars-1 in Premium First, 5 in first class, 10 in second class, and 2 bar cars. The total seating capacity is 770 seats-205 in first class and Premium First, and 565 in second class. Its maximum commercial speed is 186 miles per hour on the French part of the system.

Reservations and having tickets issued before boarding are mandatory. All Eurostar passengers must follow a controlled boarding process. Eurostar has extended its minimum check-in times to guarantee smooth passage through enhanced security checks. For security reasons, passengers must check in at least 30 minutes before the train is scheduled to depart.

Passengers check in through automated gates if their ticket has a magnetic stripe on the back. If it does not, the non-magnetic ticket must be presented at one of the check-in booths. They then go through security and passport control before entering the waiting area. X-ray and metal detection machines similar to the ones at airports are used. Fifteen minutes before departure, doors, which give access to the platform, are opened and passengers can board the train and head to their designated car and seat.[43]

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[42]Telephone conversation with Ed Mruk, Amtrak Systems Service Trainmaster, May 7, 2004.

[43]http://mercurio.iet.unipi.it/eurostar/ESreport.html

http://lonelyplanet.raileurope.com/us/rail/eurostar/train.html

http://lonelyplanet.raileurope.com/us/rail/eurostar/index.html

http://lonelyplanet.raileurope.com/us/rail/eurostar/service.htm

http://lonelyplanet.raileurope.com/us/rail/eurostar/check_in_times.html

In the United Kingdom proposals have been introduced to extend Eurostar services to Manchester and Edinburgh. However, a major constraint cited against these proposals has to do with problems associated with carrying domestic passengers on international trains. No details are provided, but the overriding consideration seems to be security, in terms of countering the threat of terrorism, followed by problems associated with allowing Customs and Excise to operate effectively, as well as passport control.

The Eurostar boarding system functions like most commercial airlines, and an exact record of passengers boarding is available, but there is a passenger accounting weakness in that no monitoring of departures at the intermediate stops occurs.

4.4.2 British Rail

British trains (BritRail) are mixed because they are unreserved trains, but for an extra fee one can reserve a seat. Except for certain peak periods on certain routes, reservations are not considered necessary because of the high frequency of service.[44] The BritRail approach would not serve as a model for an improved Amtrak manifest system because it lacks a reservation system for all passengers.

4.4.3 Japanese Intercity Passenger Trains

About 70 percent of Japan's railway network are owned and operated by the Japan Railways (JR), while the remaining 30 percent belong to several dozen railway companies, especially in and around metropolitan areas. JR is the successor of the national Japanese National Railways, which was privatized in 1987. The JR Group is made up of six regional passenger railway companies (JR Hokkaido, JR East, JR Central, JR West, JR Shikoku, and JR Kyushu) and one nationwide freight railway company (JR Freight). Together they operate a nationwide network of urban, regional, and interregional train lines, night trains, and bullet trains (Shinkansen).[45]

From local trains to Shinkansen, Japanese trains are typically classified into the following categories:

- **Local**-Local trains stop at every station.
- **Rapid**-Rapid trains skip some stations. There is no difference in the ticket price between local and rapid trains.
- **Express**-Express trains stop at even fewer stations than rapid trains. In case of JR, an express fee has to be paid in addition to the base fare.
- **Limited Express**-Limited express trains stop only at major stations. A limited express fee must be paid in addition to the base fare.

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http://www.eurostar.com/dctm/jsp/subhome/detail.jsp?page=plan_travel&id=09001a5980113466

[44] http://www.britrail.net/britrail_tips_reservations_content.html

[45] http://www.japan-guide.com/e/e2019.html

- **Super Express-Shinkansen** are only operated by JR. Shinkansen use separate tracks and platforms. A limited express fee must be paid in addition to the base fare.

JR offers the choice between two classes, ordinary and green (first class), on all Shinkansen and limited express trains and a small number of slower trains. Most local trains carry only ordinary cars. All seats in green cars are reserved. Most Shinkansen and limited express trains carry non-reserved and reserved seats, while a few carry reserved seats only. On most local, rapid, and express trains, all seats are non-reserved.

Tickets for short distance trips are best purchased at vending machines, while tickets and seat reservations for long-distance trips can be purchased at ticket counters in train stations.

After buying the ticket, the passenger must proceed through the ticket gate. Automatic ticket gates can be found in busy stations. If an invalid ticket is inserted, the gate will close, and an alarm will sound. Some platforms are served by trains of different train categories (e.g., local and rapid trains). Displays indicate the next arriving train's category and, at some stations, the set of upcoming stations served by it. To access Shinkansen platforms, the passenger must pass through a second or separate set of ticket gates.

Any JR train requires the passenger to purchase a basic fare ticket. Regardless of whether the train is fast or slow, this basic amount remains the same. For trains categorized as express trains, the passenger must purchase a surcharge ticket for express trains in addition to the basic fare ticket. Many different types of express trains exist, ranging from airport express trains to Shinkansen trains. An additional first-class car ticket must be purchased for travel in a first-class car.

If the passenger does not have the proper tickets to ride express trains (for example, he or she has purchased only the basic fare ticket and boarded an express train), he or she is required to pay the express surcharge once on board. If he or she has boarded the wrong train (in terms of destination) accidentally and has not purchased the correct ticket, he or she would be required to pay the extra basic fare.

At the destination, the passenger leaves the paid fare zone through the ticket gates in the same way he or she entered. If the correct fare for that destination station was not paid, the passenger must pay the difference at a Fare Adjustment machine or at a staffed gate before leaving through the gates.[46]

Although all entry and exit from the system is controlled, this is at the platform and station, not the specific train. Open boarding occurs on most trains (a passenger can board without the proper ticket), the system does not provide accurate passenger accounting even on the all-reserved trains, and most trains have non-reserved cars with less potential for accurate passenger accounting. It seems that the controlled access functionality is designed to provide accurate revenue collection, not passenger accounting.

[46] http://www.japan-guide.com/e/e2016.html

4.4.4 French Intercity Railways

The French National Railway's (SNCF) Passenger Guide was also examined at their Web site. There was no description of passenger boarding procedures for SNCF trains or passenger manifests, but it did contain a heavy emphasis on ticket validation and inspection procedures. Except for the TGV trains, which are all reserved, trains are unreserved, but for an extra fee one can reserve a seat. Since the French system has a preponderance of unreserved trains, it would not serve as a good model for an improved Amtrak manifest system.

Conclusions from Review of Foreign Passenger Processing Systems

Generally, even the relatively sophisticated foreign systems examined do not seem to have systems that support accurate accounting of passengers on board. Their systems are focused more on accurate fare collection. The Japanese have the only system that requires electronic verification at boarding and departing stations, though Volpe Center staff did not ascertain whether this information is captured by a database system. The more common business model has features that are inconsistent with passenger accounting, namely open access to and egress from trains, trains with at least some unreserved cars, and onboard ticket inspection done using train sweeps by conductors. It is likely these practices exist for cost and passenger convenience reasons.

5. Amtrak Accident History

Amtrak accident and injury information is needed to develop a perspective on the value and benefits of an improved passenger accountability system. This section presents summary statistics on accidents, injuries, and fatalities. Appendix D provides a more detailed synopses of 17 accidents, and Section 6 discusses the implications for more accurate passenger accounting drawn from these cases.

Most accidents involving Amtrak passenger trains do not result in passenger injuries or fatalities. For the period 1993 to 2003, 92 out of 881 accidents (10.4 percent) resulted in a passenger injury or fatality. Most of the other accidents are at highway-rail grade crossings where the primary effects are to vehicles and their passengers or pedestrians (i.e., Amtrak passengers do not suffer injuries).

Most reported injuries to Amtrak passengers do not result from a reportable accident (i.e., they are slip- and fall-type incidents that do not result from a serious derailment). For the period 1993 to 2003, only 827 out of 2,572 reportable passenger injuries (32.2 percent) resulted from a reportable accident. Significant portions of Amtrak passenger fatalities, however, result from a reportable accident. For the period 1993 to 2003, 59 out of 75 reportable passenger fatalities (78.7 percent) resulted from a reportable accident. The remaining 16 fatalities (21.3 percent) were not the result of a reportable accident. Table 4 presents yearly figures on accidents, injuries, and fatalities. All data were obtained from the FRA's safety database.[47]

5.1 Accident Data for Reserved versus Unreserved Trains

When individual accidents are examined and the type of train is identified, it becomes apparent that overnight/sleeper trains accounted for a disproportionate number of accidents, passenger injuries, and fatalities over the period 1993 to 2003.

Overnight/sleeper trains accounted for 68.5 percent of accidents, 100 percent of passenger fatalities, and 84.5 percent of passenger injuries. Yet as shown previously (see Section 3), this type of train accounted for about 18 percent of Amtrak ridership, 36 percent of Amtrak routes, and 11 percent of trains operated per week.

The proposed manifest system would apply to these overnight/sleeper trains and reserved trains not having sleeper service. These two types of trains combined accounted for 89.2 percent of accidents, 100 percent of passenger fatalities, and 94.9 percent of passenger injuries, while representing about 42 percent of Amtrak ridership, 77 percent of Amtrak routes, and 46 percent of trains operated per week.

On the other hand, unreserved trains accounted for 6.5 percent of accidents, 0 percent of passenger fatalities, and 1.8 percent of passenger injuries, while accounting for about 25 percent of Amtrak ridership, 14 percent of Amtrak routes, and 31 percent of trains operated per week.

[47] http://safetydata.fra.dot.gov/officeofsafety/

The tables in Appendix F provide details on accidents reported by Amtrak, which resulted in a passenger injury or fatality for the period 1993 to 2003 by type of service.

5.2 Accident Details

Amtrak accidents and the circumstances surrounding those accidents were examined to determine whether or not the availability of an accurate passenger manifest would have made a difference in saving a person's life or reducing the severity of injury. Published reports and briefs issued by NTSB dealing with accidents involving Amtrak were examined in order to accomplish this objective.

NTSB is an independent Federal agency dedicated to promoting aviation, railroad, highway, marine, pipeline, and hazardous materials safety. Established in 1967, the agency is mandated to investigate transportation accidents, determine the probable causes of the accidents, issue safety recommendations, study transportation safety issues, and evaluate the safety effectiveness of government agencies involved in transportation.

NTSB issues two types of documents: accident reports and accident briefs, based on investigations of rail accidents. NTSB's accident reports contain a fairly detailed description of the circumstances leading up to an accident, the outcome (results) of the accident, an analysis of all factors involved in the accident, conclusions resulting from the analysis, a determination of probable cause, and recommendations for change that NTSB feels would help to eliminate similar accidents in the future.

As the name suggests, NTSB accident briefs contain less detail than its full accident reports. NTSB's accident briefs contain a short summary of the circumstances leading up to an accident, the outcome of the accident, the analysis of factors involved in the accident, conclusions resulting from the analysis, and a determination of probable cause.

All 17 reports and briefs for the period 1993 to 2003 dealing with Amtrak accidents were examined in the course of this study. Of the 92 Amtrak accidents resulting in a passenger injury or fatality that occurred over this period, 10 accidents resulted in NTSB issuing an accident report and 3 resulted in NTSB issuing an accident brief. In addition, the NTSB issued reports dealing with three other Amtrak accidents that did not result in a passenger injury/fatality. One accident report dealing with a commuter rail accident involving passenger fatalities was also included.[48]

[48] In addition to the report included here NTSB issued nine other reports over the period 1993 to 2003 dealing with commuter rail accidents.

Table 4. Amtrak Passenger Casualties

Year	Accidents Involving Amtrak Passenger Trains			Amtrak Passenger Injuries			Amtrak Passenger Fatalities		
	Total	Resulting in Passenger Injury/Fatality	Not Resulting in Passenger Injury/Fatality	Total	Resulting from an Accident	Other Causes	Total	Resulting from an Accident	Other Causes
1993	89	11	78	279	139	140	42	42	0
1994	81	5	76	112	57	55	2	0	2
1995	50	3	47	106	55	51	0	0	0
1996	60	3	57	102	15	87	2	0	2
1997	70	13	57	241	84	157	4	1	3
1998	73	10	63	182	25	157	1	0	1
1999	72	7	65	91	45	46	13	11	2
2000	99	8	91	294	64	230	3	0	3
2001	113	11	102	416	112	304	2	1	1
2002	85	15	70	496	203	293	4	4	0
2003	89	6	82	253	28	225	2	0	2
Total	**881**	**92**	**788**	**2572**	**827**	**1745**	**75**	**59**	**16**

Table 5. Amtrak Passenger Casualty Accidents by Type of Service (1993 to 2003)

Train Type	Number of Accidents	Percent	Passengers Killed	Percent	Passengers Injured	Percent
Sleeper	63	68.5%	59	100.0%	699	84.5%
Reserved	19	20.7%	0	0.0%	86	10.4%
Unreserved	6	6.5%	0	0.0%	15	1.8%
Unknown	4	4.3%	0	0.0%	27	3.3%
Total	**92**	**100.0%**	**59**	**100.0%**	**827**	**100.0%**

Of the 92 Amtrak accidents resulting in a passenger injury or fatality that occurred over the period 1993 to 2003, 5 accidents resulted in at least 1 passenger fatality. NTSB issued an accident report dealing with four of these and an accident brief covering the fifth. These five cases are listed below:

- *Derailment of Amtrak Auto Train on the CSXT Railroad near Crescent City, Florida, April 18, 2002*, NTSB Report Number RAR-03-02, adopted on 8/5/2003.

- *Railroad Accident Brief: Derailment of Amtrak Train No. 5-17 on Burlington Northern and Santa Fe Railway Track near Nodaway, Iowa, March 17, 2001*, NTSB Report Number RAB-02-01, adopted on 3/5/2002.

- *Collision of National Railroad Passenger Corporation (Amtrak) Train 59 with a Loaded Truck-Semitrailer Combination at a Highway/Rail Grade Crossing in Bourbonnais, Illinois, March 15, 1999*, NTSB Report Number RAR-02-01, adopted on 2/5/2002.

- *Railroad Accident Report Derailment of Amtrak Train 4, Southwest Chief, on the Burlington Northern Santa Fe Railway near Kingman, Arizona, August 9, 1997 (Revision August 7, 2003)*, NTSB Report Number RAR-98-03, adopted on 8/31/1998.

- *Derailment of Amtrak Train No. 2 on the CSXT Big Bayou Canot Bridge near Mobile, Alabama, September 22, 1993*, NTSB Report Number RAR-94-01, adopted on 9/19/1994.

The following lists the other 11 Amtrak accidents that were the subject of an NTSB report or brief:

- *Collision of Amtrak Train No. 90 and MARC Train No. 437, Baltimore, Maryland, June 17, 2002*, NTSB Report Number RAB-03-01, adopted on 5/12/2003.

- *Railroad Accident Report: Rear-End Collision of National Railroad Passenger Corporation (AMTRAK) Train P286 with CSXT Freight Train Q620 on the CSX Railroad at Syracuse, New York, February 5, 2001*, NTSB Report Number RAR-01-04, adopted on 11/27/2001.

- *Highway Accident Report: Report of Grade Crossing Accident Regarding a Collision Between an Amtrak Train and a Tractor-Trailer Combination Vehicle Intercession City, Florida, November 17, 2000*, NTSB Report Number HAR-02-02, adopted on 7/23/2002.

- *Railroad Accident Report: Collision of Amtrak Train 304-26 with a Highway Vehicle at a Highway-Rail Grade Crossing in McLean, Illinois, on September 26, 1999,* NTSB Report Number RAR-01-03.

- *Railroad Accident Report: Derailment of Amtrak Train 21 on the Union Pacific Railroad at Arlington, Texas, December 20, 1998,* NTSB Report Number RAR-01-02, adopted on 7/24/2001.

- *Grade Crossing Collision, National Railroad Passenger Corporation (Amtrak) with Coastal Transport Tractor-Semitrailer, Jacksonville, Florida, February 5, 1997,* NTSB Report Number RAB-01-01, adopted on 10/26/2000.

- *Railroad Special Investigation Report Derailment of Amtrak Train No. 12 and Sideswipe of Amtrak Train No. 79 on Portal Bridge Near Secaucus, New Jersey, November 23, 1996,* NTSB Report Number SIR-97-01, adopted on 12/18/97.

- *Collision and Derailment of Maryland Rail Commuter MARC Train 286 and National Railroad Passenger Corporation AMTRAK Train 29 Near Silver Spring, Maryland, February 16, 1996,* NTSB Report Number RAR-97-02, adopted on 6/17/1997.

- *Amtrak Train 87 Derailment after Colliding with Intermodal Trailer from CSXT Train 176 Selma, North Carolina, May 16, 1994,* NTSB Report Number RAR-95-02, adopted on 3/21/1995.

- *Derailment of Amtrak Train 49 On Conrail Trackage near Batavia, New York, on August 3, 1994,* NTSB Report Number RAR-96-02, adopted on 7/11/1996.

- *Collision of Amtrak Train No. 88 with Rountree Transport and Rigging, Inc., Vehicle on CSX Transportation, Inc., Railroad near Intercession City, Florida, November 30, 1993,* NTSB Report Number HAR-95-01, adopted on 5/16/1995.

The commuter rail accident examined in this study was:

- *Collision of Northern Indiana Commuter Transportation District Train 102 with a Tractor-Trailer Portage, Indiana, June 18,1998,* NTSB Report Number RAR-99-03, adopted on 7/26/1999.

Summaries of all of these NTSB accident reports and briefs dealing with Amtrak accidents for the period 1993 to 2003 appear in Appendix D. Table 6 summarizes these 17 accidents.

It should be noted that the numbers for Amtrak passengers injured and killed are as reported in the FRA database. These do not match those reported in the NTSB reports in all cases. FRA reporting requirements are set forth in the Code of Federal Regulations (CFR). The NTSB figures tend to be of a more immediate nature and based on reports by emergency responders of the number of passengers transported to a hospital or treated on scene, without regard to the nature or severity of injuries. For example, regarding fatalities, any passenger fatalities directly resulting from an accident occurring up to 1 year after the accident are attributed to that accident in the FRA data. Such fatalities might not appear in an NTSB report on that accident.

Table 6. Amtrak Accidents Subject to NTSB Reports/Briefs

Case	Location	Date	Accident Type	Result	Train Type	Number of Passengers and Crew	Amtrak Passengers Injured	Amtrak Passengers Killed	Manifest Identified as Issue by NTSB
Collision of Amtrak Train 90 and MARC Train 437	Baltimore, MD	June 17, 2002	Collision-between on track equipment	Locomotive derailed	Sleeper	141 passengers, 6 crew, MARC-60 passengers, 4 crew	5	0	No
Derailment of Amtrak Auto Train	Crescent City, FL	April 18, 2002	Derailment	Derailed/ overturned	Sleeper	413 passengers, 33 crew	107	4	Yes
Derailment of Amtrak Train 5	Nodaway, IA	March 17, 2001	Derailment	Unknown	Sleeper	241 passengers, 16 crew	34	1	No
Rear-End Collision of Amtrak Train 286 with CSXT Freight Train Q620	Syracuse, NY	February 5, 2001	Collision-between on track equipment	Derailed/not overturned	Reserved	100 passengers, 4 crew	37	0	No
Collision of Amtrak Train and Tractor-Trailer	Intercession City, FL	November 17, 2000	Highway-rail collision/impact	Did not derail	Sleeper	83 passengers, 4 crew	0	0	No
Collision of Amtrak Train 304 with Highway Vehicle	McLean, IL	September 26, 1999	Highway-rail collision/impact	Did not derail	Reserved	number passengers unknown, 3 crew	0	0	No
Collision of Amtrak Train 59 and Tractor-Trailer	Bourbonnais, IL	March 15, 1999	Highway-rail collision/impact	Derailed/ overturned/fire	Sleeper	207 passengers, 17 crew, 4 employees	32	11	Yes
Derailment of Amtrak Train 21	Arlington, TX	December 20, 1998	Derailment	Derailed/ overturned	Sleeper	128 passengers, 18 crew	1	0	No
Collision of Amtrak Train and Tractor-Trailer	Jacksonville, FL	February 5, 1997	Highway-rail collision/impact	Derailed/not overturned	Sleeper	182 passengers and crew	7	0	No
Derailment of Amtrak Train 4	Kingman, AZ	August 9, 1997	Derailment	Derailed/not overturned	Sleeper	294 passengers, 18 crew	37	1	Yes

Table 6. Amtrak Accidents Subject to NTSB Reports/Briefs (continued)

Case	Location	Date	Accident Type	Result	Train Type	Number of Passengers and Crew	Amtrak Passengers Injured	Amtrak Passengers Killed	Manifest Identified as Issue by NTSB
Derailment of Amtrak Train 12 and Sideswipe of Amtrak Train 79	Secaucus, NJ	November 23, 1996	Derailment	Derailed/not overturned	Unknown/ Unreserved	Train 79-162 passengers, 4 crew Train 12-90 passengers, 3 crew, 24 employees	13	0	No
Collision and Derailment of MARC Train 286 and Amtrak Train 29	Silver Spring, MD	February 16, 1996	Collision-between on track equipment	Derailed/not overturned/fire	Reserved/ Commuter	164 passengers, 18 crew, MARC-20 passengers, 3 crew	0	0	No
Collision and Derailment of Amtrak Train 29 and CSXT Train 176	Selma, NC	May 16, 1994	Collision-between on track equipment	Derailed/not overturned/fire	Sleeper	415 passengers, 23 crew	13	0	No
Derailment of Amtrak Train 49	Batavia, NY	August 3, 1994	Derailment	Derailed/ overturned	Sleeper	320 passengers, 19 crew	33	0	No
Collision of Amtrak Train 88 and Tractor-Trailer	Intercession City, FL	November 30, 1993	Highway-rail collision/impact	Derailed/not overturned	Sleeper	89 passengers, 10 crew	18	0	No
Derailment of Amtrak Train 21	Mobile, AL	September 22, 1993	Derailment	Derailed/not overturned/fire /immersion	Sleeper	202 passengers, 18 crew	90	42	Yes

6. Value of an Accurate System for Accounting for Persons on Board Amtrak Trains

There are various reasons why it is desirable to have information about train passengers. NTSB contends that one such reason is to provide accurate counts to first responders immediately after recent fatal accidents. This section considers the value of such information from a safety and resource perspective.

6.1 Role of Passenger Accounting in Recent Fatal Accidents

Of the 17 accidents that occurred between 1993 and 2003 and documented by NTSB, 5 involved an Amtrak passenger fatality, and 2 involved fatalities on commuter rail trains. In four out of the five accidents resulting in at least one Amtrak passenger fatality, NTSB explicitly identified the lack of an accurate passenger manifest as an issue in its accident report.

In one example of its criticism of Amtrak's passenger accountability system, NTSB has noted that

> The survival of passengers and crewmembers might well depend on emergency responders, who in turn depend on a complete and accurate accounting of all people on the train to ensure that they locate, evacuate, and treat (if necessary) all those on board. If the passenger list does not include every passenger on the train, emergency responders may leave passengers behind. If the passenger list includes people not on the train, emergency responders may be needlessly exposed to prolonged risks as they search for nonexistent passengers.[49]

However, in none of these cases has NTSB explicitly cited an instance where a surviving passenger had unknowingly been left behind nor an instance where emergency responders had spent time searching for nonexistent passengers.

The following reviews the seven accidents with fatalities to identify survivability factors generally and to explicitly consider whether accurate passenger accounting might have had a role in survivability outcomes.

(1) Derailment of Amtrak Auto Train on the CSXT Railroad near Crescent City, Florida, April 18, 2002

About 5:08 p.m. on April 18, 2002, Amtrak's Auto Train, derailed 21 of 40 cars near Crescent City, Florida. Of the 21 derailed cars, 8 ended up lying on their sides with the other derailed cars remaining in either an upright or leaning position.

[49]Derailment of Amtrak Auto Train on the CSXT Railroad near Crescent City, Florida, April 18, 2002, NTSB Report Number RAR-03-02, adopted on 8/5/2003.

Emergency responders were notified immediately following the accident. However, they were not told the number of people on the train. The first police unit arrived within 6 minutes, the first fire unit within 9 minutes, and the first paramedics within 14 minutes. On-scene incident command was established within 11 minutes, and triage and staging areas were established.

Auto Train onboard service employees told passengers what had happened and that emergency services had been called. Some Amtrak employees provided on-scene first aid to passengers. Amtrak employees continued to assist passengers and emergency service personnel upon their arrival on scene until all the passengers had been evacuated and the site secured.

The first arriving paramedic reported to Putnam County Dispatch that 468 people were on the train; several of whom were trapped, and others who were walking wounded. When NTSB investigators interviewed the incident commander after the accident, he said that he had had problems getting accurate information from Amtrak about the number of people on the train. He said that, soon after he came on scene, the conductor told him that 468 people were on board the train and gave him a greeter list.[50] The incident commander said that the conductor also gave him a passenger list that showed the passengers' locations by car and room, but the greeter and passenger lists did not match. He said that he and other emergency responders spent time attempting to verify the accuracy of the two lists. On April 19 (the next day), Amtrak gave him a computer printout list with information that did not fully correlate with either of the other two lists.

The incident commander said that he was never provided an accurate count of people on the train. During post-accident interviews, the Auto Train conductor told the Deputy Chief of Operations for Putnam County Emergency Services that 437 passengers, 3 infants, and 28 crewmembers, for a total of 468 people, had been on the train. By gathering information from Amtrak, Putnam County Emergency Services, and medical records, NTSB investigators determined about 5 months after the accident that 446 people had been on the Auto Train when it derailed.

The availability of an accurate manifest was not a factor in preventing the four passenger fatalities. All four passengers were partially ejected through the car windows and crushed between the car body and track ballast. The fatally injured passengers were dead when found by emergency responders. No indication exists that emergency responders spent undue amounts of time searching for passengers, or that emergency responders were in danger in searching the wreckage. Two hours after the accident, the incident commander reported that all passengers had been evacuated except for one entrapped fatality, even though he could not reconcile the greeter list and the passenger list, which indicated the location of passengers by car and room.

This accident case illustrates the need and interest of first responders for an accurate passenger count both to bring an appropriate level of resources to the accident scene and to determine when

[50]A greeter list shows the names of all those who made a reservation to travel on that train on that day. When the passengers arrive to board the train, they check in with an Amtrak employee who greets them and checks off their names. It is not uncommon for someone to make a reservation for a particular day and then not show up.

search and rescue efforts can be suspended. The absence of such an accurate list, however, seems not to have affected accident consequences for the passengers and crew.

(2) Railroad Accident Brief: Derailment of Amtrak Train No. 5-17 on Burlington Northern and Santa Fe Railway Track near Nodaway, Iowa, March 17, 2001

The NTSB accident brief does not provide enough information on the nature of the accident, the emergency response, or the victim's cause of death to allow one to determine whether or not an accurate manifest would have resulted in saving the victim's life. The accident brief does not explicitly call out the lack of a manifest as an issue. This was corroborated during an interview with the incident commander, who indicated that passenger counts matched Amtrak's numbers.[51] The victim was an elderly passenger who apparently died as a result of injuries sustained when tossed around within the car as it derailed and overturned.

(3) Collision of National Railroad Passenger Corporation (Amtrak) Train 59 with a Loaded Truck-Semitrailer Combination at a Highway/Rail Grade Crossing in Bourbonnais, Illinois, March 15, 1999

About 9:47 p.m. on March 15, 1999, Amtrak train 59 struck and destroyed the loaded trailer of a tractor-semitrailer combination that was traversing a grade crossing in Bourbonnais, Illinois. Both locomotives and 11 of the 14 cars in the Amtrak consist derailed. One of the cars rolled over onto its side. Another car, although upright, was bent around the back of a locomotive, and portions of the car were engulfed by fire from spilt fuel.

When the first Bourbonnais Fire Protection District personnel arrived at the accident scene, they found that some 30 to 35 employees of Birmingham Steel, a nearby facility, had already responded to the accident and had begun the rescue effort. These steel plant employees had cut a hole in the chain-link fence separating the wreckage site from the steel plant's property and had brought a number of handheld fire extinguishers and ladders from the plant to combat the flames. While some of the steel plant employees applied the fire extinguishers to the flames, others entered some of the damaged passenger cars to extricate entrapped passengers. These efforts were continued for about 45 minutes until Bourbonnais Fire Protection District personnel, who continued the extrication efforts, relieved the steel plant employees.

The first police units arrived on scene within 3 minutes and began helping to evacuate the passenger cars. Within a short time, additional police units responded and officers began evacuating passengers wherever they could. The Bourbonnais Police Department established an initial staging area on the unpaved roadway on the west side of the tracks, in the area adjacent to the wreckage pileup. The evacuated passengers and train crew assembled in this area, where responding ambulances later arrived. The first ambulances arrived at the scene within 6 minutes and the first fire units within 12 minutes. A fire department field command post was established at the initial staging area.

[51]Telephone conversation with Brian Kannas, Adams County Emergency Management Coordinator, May 6, 2004.

In interviews with the NTSB, emergency responders indicated that the immediate focus of the response was the extrication of the trapped and injured passengers and train crew. Because the derailed train cars blocked McKnight Road at the grade crossing, three separate staging areas were established. Upon evacuation, displaced passengers and train crew were taken to one of two triage areas initially established at the scene. Because the temperature that night was estimated to be in the low 20s, the incident commander became concerned about the threat of hypothermia since most of the evacuees lacked warm clothing. A local retail store offered its facility as a temporary shelter, and starting at approximately 10:28 p.m., responders used this third facility both as a shelter and as a triage site for several persons who were later found to have sustained injuries.

At approximately 12:05 a.m. on March 16, an emergency shelter established at a nearby school building began to receive the uninjured displaced passengers who were transferred from the temporary shelter established earlier at the retail store.

About 50 minutes after the accident, a medical trauma team consisting of physicians and medical equipment from local hospitals arrived at the scene. A Braidwood Fire Department officer, who arrived about 50 minutes after the first emergency responder, was familiar with petrochemical fires and recognized almost immediately that a large amount of foam was necessary to combat the blaze. Upon receiving concurrence from the incident commander, he called for heavy foam tanker trucks to come from a local chemical plant. The foam tanker arrived and was set up about 1 hour later; within a few minutes this equipment began to apply foam, and the fire was extinguished. Before the arrival of the Braidwood officer, the incident commander had directed firefighting operations that had proved ineffective at either extinguishing the flames or at keeping the fire away from the sleeper car in which occupants were entrapped.

Relatively early during the response, emergency responders telephoned Amtrak's Consolidated National Operations Center (CNOC) in Wilmington, Delaware, to learn how many passengers rescuers could expect to find. At this time, Amtrak responded that the train could be carrying as many as 400 passengers. When Amtrak management arrived on scene, however, they determined from the contents of the conductor's ticket pouch that the passenger count was 196; this passenger tally was not considered firm on the following morning. Several days after the accident, Amtrak identified the number of confirmed passengers to be 198. However, it was several more days before Amtrak developed a complete list of passenger names, and its accuracy remained in question. It was only later, when investigators were able to compare that list with a list provided by the Illinois State Police, that the correct passenger count of 207 was determined.

NTSB was not able to definitively establish how many individuals were in the sleeping car at the time of the collision, nor could it determine the precise whereabouts of those who were in the car. The degree of injury sustained by the car's occupants ranged from minimal or none, up to fatal. Rescuers reported that they were unable to immediately extricate some of the individuals they believed to be entrapped within the wreckage.

Eleven train passengers, all of who were located in sleeper car 32035, the car bent around the back of the locomotive, sustained fatal injuries. The fatally injured occupants were in the portions of the car at the vertex of the car's bend, where the crush and intrusion were at a

maximum. This portion of the car was also later consumed by fire. The coroner tentatively attributed deaths of 5 of the 11 fatally injured occupants to the effects of the fire. The coroner was unable to determine whether any of these five might have succumbed to their traumatic injuries had they not been exposed to the fire. The other six fatalities apparently resulted from traumatic injuries.

Because of insufficient training in responding to railroad emergencies or inadequate/inappropriate resources, or both, the emergency responders were not prepared to respond effectively to a passenger train accident involving a significant diesel fuel fire.

Six of the passengers apparently died as a result of the crash, before the outbreak of the fire. The other five passengers died as a result of the fire that was not brought under control until nearly 2 hours after the accident. The establishment of three separate outdoor staging areas, followed by the establishment of a temporary indoor shelter, and then a second emergency shelter complicated the task of completing an accurate census of the injured and uninjured passengers in a timely fashion. At that point, even if an accurate manifest were available, knowing that 11 passengers were unaccounted for and in the burning sleeping car would not have resulted in their survival.

This accident case illustrates the difficulty and time lag in developing a list of rescued passengers that could be compared to an accurate manifest to determine the number of missing persons. In this case, such knowledge would have had no effect on search and rescue efforts or passenger survival or degree of injury.

(4) Railroad Accident Report: Derailment of Amtrak Train 4, Southwest Chief, on the Burlington Northern Santa Fe Railway near Kingman, Arizona, August 9, 1997

About 5:56 a.m. on August 9, 1997, Amtrak Train 4, the Southwest Chief, derailed about 5 miles northeast of Kingman, Arizona. The train was traveling at about 89 mph on the eastbound track when both the engineer and assistant engineer saw a hump in the track as they approached bridge 504.1S. They stated that they applied the train's emergency brakes. It was later discovered that the ground under the bridge supporting structure had washed away during a flash flood. As the train passed over bridge 504.1S, the first three locomotive units uncoupled and separated from the rest of the train and each other; each unit coming to a stop east of the derailed train. The fourth unit remained coupled to the train. The third and fourth units, and all but the last car, derailed in the upright position. Although some cars were at a slight angle to each other and leaning, all cars remained coupled and generally aligned with the track. The tenth car, a sleeping car, came to rest spanning what had been the track at the location of bridge 504.1S.

While the NTSB reports no fatalities, the FRA casualty and accident databases attribute one fatality to this accident. The fatality in the FRA data apparently resulted at a later date from injuries incurred during the accident. The victim was not entrapped but apparently injured when thrown from his or her seat during the derailment.

Three police officers were already in the immediate area (searching for people who were reportedly stranded because of flash flooding) and were dispatched to the scene and arrived

within 10 minutes of the accident. They reported that no life threatening injuries were noted. They helped the Kingman Fire Department and emergency services personnel transport passengers and crew to triage areas, searched for train occupants, and secured the scene. The first medical, rescue, and fire units arrived within 20 minutes of the accident.

According to the conductor and one assistant conductor, at the time of this accident they were in the dining car working on tickets. The conductor said that he did not have time to look at the manifest because it was in the dormitory car. He also stated that the manifest contained the number of passengers in coach sections and a complete list of passengers in the sleeping cars. The conductor said that the manifest should have been up-to-date except for tickets taken at Kingman.

During the emergency response to the Kingman accident, the incident commander requested a copy of the Train 4 manifest from an Amtrak employee. The conductor told NTSB investigators that a passenger manifest was located in the dormitory car, but he did not have time to obtain it because he was helping passengers. The chief of onboard services said that he gave a copy of a sleeping car manifest to a firefighter. It took several days for Amtrak to provide an accurate passenger count of the entire train.

Given the nature of the accident (no fire or possibility of entrapped passengers exists) and the nature of the injuries (none were life threatening at the time), having an accurate accounting of all passengers would have had no impact on saving a life.

According to the NTSB report, "Although no complete manifest was available during the emergency response in this instance, the lack of one did not appear to negatively affect the efficiency of the emergency response."

This accident case also illustrates the potential problems with locating a manifest and providing it to appropriate rescue personnel in a timely manner.

(5) Derailment of Amtrak Train No. 2 on the CSXT Big Bayou Canot Bridge near Mobile, Alabama, September 22, 1993

On September 22, 1993, about 2:45 a.m., barges that were being pushed by the towboat MAUVILLA in dense fog, struck and displaced the Big Bayou Canot railroad bridge near Mobile, Alabama. About 8 minutes later at 2:53 a.m., Amtrak Train 2, the Sunset Limited, with 220 persons on board, struck the displaced bridge and derailed. The three locomotive units, the baggage and dormitory cars, and two of the six passenger cars fell into the water. The fuel tanks on the locomotive units ruptured, and the locomotive units and the baggage and dormitory cars caught fire.

Since most Onboard Service crewmembers were asleep in the dorm-coach and since the train attendants were in the cars on the bridge, passengers in the submerged cars had to make decisions on their own and evacuate without assistance. According to passengers in the totally submerged car (coach 34068), the lower level and front section of the car filled with water in seconds, limiting the time passengers in those sections had to evacuate. The center and rear

sections on the upper level remained out of the water for about 10 minutes, and passengers evacuated through the open rear door and window exits on the upper level. Passengers inside the coach that was partially submerged and sinking (coach 34083) also stated that the lower level and rear of the car filled with water in seconds, limiting the evacuation time for passengers in those sections. Bridge timbers held the upper level and front of the second car out of the water, and passengers in those sections evacuated through the window exits on the upper level in about 30 minutes.

The MAUVILLA's crew, SCOTT PRIDE (another towboat that arrived on scene) personnel, and train crewmembers were all instrumental in rescuing people from the water and evacuating passengers from the train immediately following the accident. When the towboats and train crew had rescued most of the people from the water, the conductor and assistant conductor began taking a head count of the passengers and passed out blankets and pillows. After emergency responders arrived at the accident site, they began rescue operations, recovery of bodies, triage, and firefighting activities. At this point, had an accurate manifest been available, it would have been of little use in saving the lives of passengers identified as missing and presumed trapped in the submerged cars.

The first emergency responders did not arrive until an hour after the accident. Autopsy reports show that 42 passengers died from asphyxia due to drowning within minutes of the cars entering the water.

This accident case illustrates the inherent complexity of post-accident passenger accounting and survivability in immersion accidents. Surviving passengers were initially in several locations (two boats and several land points) so developing a count and list to identify missing persons could not be done in a time frame that would impact rescue of surviving passengers.

This case also shows the value of having records of persons on board in a non-train location that would be accessible after an accident. Although in this case, ticket records were kept in a non-submerged car, retrieval of passenger accounting information in either paper or electronic form may be impossible if the source is located in a submerged car.

(6) Collision and Derailment of Maryland Rail Commuter (MARC) Train 286 and National Railroad Passenger Corporation AMTRAK Train 29 near Silver Spring, Maryland, February 16, 1996

On Friday, February 16, 1996, at 5:39 p.m., an eastbound Maryland Rail Commuter (MARC) train 286 collided with the westbound Amtrak passenger train 29 Capitol Limited. The accident occurred during a blowing snowfall at a railroad location, referred to as Georgetown Junction, about 1 mile west of Silver Spring, Maryland. The MARC train 286 was a push-pull commuter train consisting of a locomotive unit on the rear end, two passenger cars, and a passenger coach cab control car in the lead. The engineer was operating the train from the cab control car in the push mode at the time of the collision. The left front quadrant of the MARC cab car (the leading passenger car) separated and was destroyed as a result of the collision. The fuel tank of the Amtrak lead locomotive ruptured on impact, and the diesel fuel ignited. Fire engulfed the rear

superstructure of the locomotive. Fuel also spilled onto the MARC cab car, ignited, and destroyed the car.

Even though the Montgomery County Fire and Rescue Services (MCFRS) personnel responded promptly (about 7 minutes after the accident) to the emergency, they could do nothing to save any of the accident victims because passenger coach cab control car 7752 was already completely engulfed in flames when the first firefighter arrived on scene.

The first firefighters to the car reported that the car was fully involved in fire and that they did not observe any survivors. They made several attempts to enter the car. The fire was extinguished within 10 minutes, after which the firefighters were able to enter the car. They were later assisted by members of the Montgomery County Police Department (MCPD) in the recovery of 11 victims for coordinating the identification and notification process with the Maryland medical examiner. All fatalities were on MARC Train 286. Two crewmembers and seven passengers died of smoke inhalation, and one crewmember and one passenger died as a result of impact injuries. No attempt to account for missing MARC passengers prior to rescue attempts appears to have occurred. Even if an accurate manifest had been available, it would have been of little use in saving the lives of passengers identified as missing and presumed trapped in the burning car.

Amtrak reported to NTSB investigators that at approximately 6:15 p.m. (about 35 minutes after the accident) one of its officers made four attempts within 10 minutes to provide the passenger list and other information to the MCFRS personnel at the command center. He was told that the information was not needed and that he should wait.

This accident case illustrates that fire control and rescue are the immediate focus for responders and that passenger accounting is less essential and occurs later in the response process (i.e., immediate information is not needed or used to guide rescue efforts in a severe accident).

(7) Collision of Northern Indiana Commuter Transportation District Train 102 with a Tractor-Trailer Portage, Indiana, June 18,1998

About 4:31 a.m. on Thursday, June 18, 1998, Northern Indiana Commuter Transportation District (NICTD) train 102, a 2-car passenger train, collided with the right side of a long combination vehicle (LCV) at the Midwest Division of the National Steel Corporation's grade crossing near Portage, Indiana. About 542 feet east of the crossing, the train 102 crew noticed the LCV's second semitrailer, which carried a steel coil weighing about 19 tons, on the crossing. The engineer said that he placed the train in emergency braking; followed by the conductor, he then exited the control compartment and ran toward the rear of the passenger compartment. The crew alerted passengers in that area about the impending collision and told them to evacuate.

As the collision occurred, the single chain securing the steel coil to the second semitrailer broke. The released steel coil entered the lead car of the train through the front bulkhead. The coil moved through the car until it came to rest about 34 feet into the passenger compartment.

The emergency response personnel arrived at the accident site within 10 minutes. The uninjured passengers and the crew exited through the last door on the south side of the second car. By the time they had exited the train, emergency personnel (police) were arriving, and the engineer told them where to find the injured passengers. At this time, the incident commander was advised that three people were inside the first NICTD car and that two were dead and one was alive, but severely injured and pinned under the steel coil. The incident commander immediately requested a crane to raise the coil, requested a University of Chicago Aeromedical Network helicopter, and contacted a nearby trauma center and advised them to prepare for emergency surgery. While the additional help was being sought, a paramedic firefighter tried to communicate with, administer oxygen to, and monitor the cardiac status of the severely injured person pinned under the coil. Approximately 10 minutes later, the incident commander was told that the injured person had lost all vital signs.

A 19 ton steel coil crushed the victim. Despite timely response by emergency responders, despite the fact that all passengers and crew were accounted for, and despite the fact that emergency responders were told the exact location of the entrapped victim, he died shortly after the arrival of the emergency responders due to the nature of his injuries. An accurate accounting of all passengers would have had no impact on saving the victim's life.

Conclusions from Examining Fatal Accidents

Given the sparse data available it is difficult to draw sweeping general conclusions. Based on the cases available (including the two involving commuter rail fatalities), however, it seems that the availability of a perfectly accurate passenger manifest would not have resulted in a passenger's life being saved or the degree of injury reduced. No examples have been found in which promptly accounting for passengers and crew has affected survivability or severity of injury.

However, a good approximate figure (e.g., 75 passengers versus 400 passengers) is needed in reporting the accident to give the emergency responders a sense of what they will encounter and what resources need to be marshaled.

Moreover, an accurate manifest is only one part of the solution to the passenger accountability problem. Matching known passengers to a list either by means of a simple head count or taking attendance (a head count with associated names) as soon as possible after the accident is the other necessary part of the solution. In the Amtrak accident at Syracuse, New York, it took about an hour for first responders to count 100 passengers. In the Amtrak accident at Nodaway, Iowa, it took first responders between 3 and 4 hours to count 241 passengers. Of the accidents involving Amtrak trains that occurred between 1993 and 2003 and documented by NTSB, the number of Amtrak passengers has varied from 83 (Intercession City, Florida) to 413 (Crescent City, Florida).

An accurate manifest would appear to be of more use in determining when rescue/recovery efforts can be declared officially over. Anecdotal information and interviews with first

responders indicates that the emergency responders will complete a search of the wreckage before doing this, irrespective of passenger accounting information.

Finally, an accurate manifest or passenger list must be developed after an accident for the notification of next of kin and in processing and determining the validity of potential liability claims against the carrier. Both on-site records by first responders and Amtrak passenger databases are used for these purposes and checked for consistency.

6.2 Factors Affecting Passenger Survivability in a Train Accident

A review of the NTSB reports on Amtrak accidents revealed a number of factors that have an impact on a passenger's survivability after a train accident. Similar considerations from earlier Volpe Center work on this subject appear in Appendix E. It is useful to examine the role of accurate passenger accounting on survivability from the context of all the factors that influence the effectiveness of emergency response teams in assisting accident victims. The factors identified in reviewing accident reports affecting survivability and injury severity after a passenger train accident include the following:

Type of accident result–fire, immersion, cars tipped or mangled, or none of the above

> Accidents that result in fire and/or immersion imply the need for immediate evacuation. Accidents resulting in cars on their side, otherwise mangled or twisted imply the potential for occupant ejection or their being trapped in wreckage. Less severe accidents involving none of these consequences allows for a more leisurely assessment of injuries and accounting of passengers. The first three types of more severe accidents imply an increased chance of fatalities.
>
> The availability of an accurate manifest would seem to be of no use in the fire and immersion cases except for recovery (as opposed to rescue) efforts. The availability of an accurate manifest would seem to be of little use in the last (less severe) case since accounting for missing persons is not an issue. The availability of an accurate manifest could be a factor in the case of tipped or mangled cars depending on the timeliness of the emergency response, the extent of extrication efforts required, the time it takes to develop an accurate head count of the passengers and crew, and the severity of the passenger injuries.

Type of equipment–sleeper or coach only

> Sleepers complicate search, rescue, and recovery since there are more compartments to search and access may be hindered in more severe accidents. The presence of sleepers can increase the chance of fatalities and injury severity if it delays rescue efforts.

Time of day

Darkness hampers evacuation and rescue efforts, especially with a lack of adequate emergency lighting both inside and outside of cars. Darkness results in an increased chance of fatalities.

Training of crew

Has the crew received recent training in emergency procedures? Have the passengers been given the opportunity to become familiar with emergency procedures? Up-to-date crew training in emergency response and passenger familiarization with emergency procedures and location of emergency exits result in a decreased chance of fatalities.

Crew incapacitated

The crewmembers are often the first emergency responders. If the crew is not available, the passengers are on their own until outside help arrives. The lack of a functioning crew results in an increased chance of fatalities. This possibility also suggests the need to have a copy of the manifest at an off-the-train location in case the onboard copy is inaccessible and/or the crewmember responsible for the manifest is incapacitated.

Bystanders/good Samaritans involved

If available, good Samaritans would most likely be the second emergency responders, after the crew. The good news-bad news is that while they may save lives, they are not likely to be organized and may complicate the problem of accounting for all passengers. Their presence implies a decreased chance of fatalities, since in an emergency situation the standard operating procedure (at least in the first three types of accidents noted above) is to evacuate/rescue everyone who can be located as soon as possible and then worry about the issue of accounting for missing passengers.

Timeliness of emergency response

This is affected by location (urban/rural), accessibility, and communications (accurate reporting of accident location in terms responders can understand). Increased response time, for whatever reason, results in an increased chance of fatalities.

Training of emergency responders

Have emergency responders received training in dealing with a passenger rail accident? Specialized training in responding to a rail accident results in a decreased chance of fatalities.

Number of passengers and crew

> Counting heads or taking attendance takes time, resources, and organization; the time required increases with the number of passengers involved and accident severity. The knowledge that all passengers are not accounted for does little to increase their chances of survival if it takes an excessive amount of time to make that determination. An established, controlled staging and triage area is as important as an accurate manifest in accounting for passengers, and well-trained and organized first responders routinely attempt to keep records on those rescued. The greater the number of passengers and the more diffuse the accident and recovery area, the greater the amount of time needed to compare information and determine whether anyone is missing, and the more likely that life-threatening injuries will prove fatal or more debilitating.

It can be concluded that factors other than a reliable and accurate passenger accounting system generally determine a passenger's survivability.

6.3 Emergency Responders' Perspective on the Value of an Accurate Manifest

A key issue in this study is to determine how an accurate manifest would make the emergency responders' efforts more successful and the likelihood that it would be effective in typical accident situations. To address this issue, Amtrak safety and other emergency (first) responder organizations were contacted in an attempt to document both the typical or ideal case and the real-world complexities sometimes encountered.

Results of interviews with emergency responders are consistent with the conclusions of the limited value of an accurate manifest noted in the previous section.[52]

All of the responders interviewed recognized the value of good information. Ideally, they would like to know the order of magnitude of the problem in terms of the number of passengers and number of injuries before arriving on scene. This allows them to arrange for the required resources (e.g., ambulances, alternative transportation for uninjured passengers, and emergency shelters) as expeditiously as possible. If they did not have that information before arriving on scene, they would try to locate the train crew or contact Amtrak to obtain the information. Otherwise, the first responder to the accident would call for required backup after assessing the situation and assuming the worst in determining the need for additional resources.

In the Nodaway, Iowa derailment, the first call the emergency responders received indicated that there had been a train accident. Only in a subsequent call were they told that it was an Amtrak accident. They then had to request backup (from as far as 70 miles away) because of the possibility of a large number of injuries. They did not learn the number of passengers on the train until they arrived on scene and were given this information by the conductor. The

[52]Telephone conversation with Brian Kannas, Adams County Emergency Management Coordinator, May 6, 2004; telephone conversation with Joe Rienfrerd, Onondaga Director of Fire, May 5, 2004; telephone conversation with Pat Sullivan, Chief, Gulfport, Mississippi Fire Department, May 5, 2004.

conductor first checked on the status of the crew, and then directed the crew to check on the status of each car, with individual crewmembers assigned to specific cars. He reported the location and number of injured to the first responders. The incident commander ordered school buses to transport the uninjured to shelters and ambulances to transport the injured to hospitals. He also had medivac helicopters from Omaha and Des Moines available, as well as a police helicopter with a heat detection camera to search for people if needed.[53]

One responder noted that his approach was to first do a hasty initial search, find all passengers, comfort passengers, and get their names. This hasty search would be only the first of multiple searches. The responder felt that an accurate list was invaluable so that they could match it to people in the field. He also noted that names would be important in notifying loved ones. He would try to match names to the passenger list if it were available. He felt that knowing the number of passengers in each car was important since he would have teams assigned to search individual cars to speed up the process of accounting for passengers. He also recognized the need to cordon off the area, and to control the scene so that people did not wander off or be taken away by bystanders.[54]

Another responder was involved with the Amtrak collision accident near Syracuse, New York, in 2001. Their approach to any hazardous situation is to save lives first. This applies to a rail accident. First they locate and evacuate passengers, then obtain a count, and finally look for missing people, if any.

In this case, the engineer gave the emergency responders the number of passengers on the train. The incident commander then called for buses to transport the uninjured, provided for shelter, and established triage. Their approach was to round all the people up, put up barrier tape, and keep them penned in. One of the first things responders do is get names. This is done in triage. All passengers are evaluated in triage whether hurt or not. Part of the triage process is to create a pre-hospital care report (PCR) for each individual. The emergency medical technician (EMT) completes this medical evaluation form. Passengers were sent to a transfer area were buses were provided for the uninjured and ambulances for the injured.

They developed an initial name list from the PCRs and did a double check. In this case it took about an hour to get a count of 100 passengers. The responder noted that the time required to get a count would vary with the number of passengers.

Ideally, the emergency responders would like a passenger list to check against their list of treated passengers to determine if they have everybody. It took several hours to get a list from Amtrak, and all passengers had been transported from the scene when the list arrived.

[53]Telephone conversation with Brian Kannas, Adams County Emergency Management Coordinator, May 6, 2004.

[54]Telephone conversation with Pat Sullivan, Chief, Gulfport, Mississippi Fire Department, May 5, 2004.

People can be thrown some distance from the train cars. The emergency responders did not suspend rescue and recovery efforts until after searching all cars and the nearby area. A big red X was painted on each car to show that it had been searched and that it was empty.

According to this first responder the value of an accurate manifest is in obtaining closure, in knowing absolutely that you have everybody, and that you did not leave someone behind.[55]

In the Nodaway, Iowa, derailment no problem occurred in evacuating passengers from cars. They were first sent to a staging area, then to buses or ambulances. The responders did not collect names at this point but only did a count of those put on buses and the number sent in ambulances. They did not have a name list from Amtrak. Names were taken at the shelter and hospitals.

The emergency responders relied on a head count and a search of the area surrounding the accident. The number of passengers was never an issue, since their counts matched Amtrak's numbers. The head count took 3-4 hours. There were 241 passengers in this case. They counted people as they left the scene and counted them again at the shelters and hospitals.

After all cars were evacuated, a second search of each car was conducted, and an X was spray painted on each car when the search was completed to indicate that the car was all clear. This second search is standard procedure (i.e., is done irrespective of passenger accounting information).

If it was believed someone was missing, they would have used the police helicopter to search the area. They would do whatever it took to find the missing persons and would search until they were found. At this point, names would be important because the responders would start matching names collected at hospitals and shelters to those on Amtrak's passenger list to determine if a person was in fact missing and who they were.[56]

Two of the responders mentioned another value of an accurate manifest not identified in the previous discussion, namely, security. The tracking issue was becoming increasingly important on all public transportation modes (rail, bus, etc.), implying not only a need to know that a person was unaccounted for, but also who that person was in order to attempt to determine if the missing person might be a terrorist.[57]

Amtrak's Director of Emergency Preparedness recognized the problem inherent in comparing the passenger count from the electronic manifest with that of the ticket pouch. He saw the value of an accurate manifest as assuring the responders that no one was left behind. He also noted that the responders exercise extreme diligence to avoid leaving anybody behind. He had never

[55]Telephone conversation with Joe Rienfrerd, Onondaga Director of Fire, May 5, 2004.

[56]Telephone conversation with Brian Kannas, Adams County Emergency Management Coordinator, May 6, 2004.

[57]Telephone conversation with Joe Rienfrerd, Onondaga Director of Fire, May 5, 2004; telephone conversation with Pat Sullivan, Chief, Gulfport, Mississippi Fire Department, May 5, 2004.

heard of a specific case of a person being unaccounted for and discovered later. While he felt that the emergency responders were usually effective in preventing people from leaving the accident scene before being identified, he thinks that it probably has happened.[58]

6.4 Hypothetical Scenario in Which Survivability is Affected by Passenger Accounting

A hypothetical accident scenario in which a manifest might matter in saving lives would include the following elements:

> The accident involved a serious derailment with cars on their sides, some seriously injured passengers trapped in the wreckage, and the absence of fires or other continuing hazardous conditions.
>
> The crew survives, has an accurate passenger list, takes attendance quickly (e.g., in less than 10-15 minutes), and determines that one or more passengers are missing in the wreckage and their likely location.
>
> Emergency responders arrive on scene quickly (e.g., in less than 10-15 minutes) with equipment needed for extrication efforts.
>
> The injuries are severe and the entrapped passengers will only survive if quickly found, treated, and delivered to a hospital, but they will die if not quickly found and tended to.
>
> Emergency responders can locate and extricate the severely injured victims and get them to a hospital within the window of opportunity.

Several of these circumstances are improbable. That they would occur in combination such that one or more lives would be saved is extremely unlikely and this would seem to explain at least partly why no such case was found in reviewing recent accidents.

6.5 Conclusions about the Value of an Accurate System for Accounting for Persons on Board Amtrak Trains

When serious Amtrak accidents occur, having a count of the number of persons on board has three main uses. First, if an estimate is provided as part of the accident reporting process first responders will be able to better gauge the need for resources. Second, as the search and rescue process proceeds, an accurate list to compare with persons evacuated can be used to determine whether there may be missing persons or that all persons are accounted for. Third, a list containing names and other personal information will also be of subsequent use to Amtrak for purposes, such as notifying next of kin and in dealing with legal liability matters.

The NTSB recommendation that an accurate accounting system be developed and implemented implicitly assumes it would have a meaningful safety benefit. It is thus necessary to assess the value of such a system in terms that can be compared to the costs of implementation. Each of the

[58]Telephone conversation with Larry Beard, Senior Director of Emergency Preparedness for Amtrak, May 13, 2004.

identified uses are examined below to determine its affect on safety and indicate a measure of the likely impacts.

Gauging Resources Required for an Accident Response

To gauge the amount of resources to dispatch to a rail accident, responders need information about the type and size of the accident and the number of casualties requiring emergency medical care and transportation. Amtrak crews are trained to quickly assess the situation and include this information in reporting the accident. Reporting the number of persons on board is a very indirect way to provide some indication of the possible number of casualties and perfect accuracy is not required for this purpose. In spite of their imperfections, Amtrak's current reservation, manifest, and ticket pouch systems are satisfactory sources for approximate counts of persons on board, especially if existing guidelines for their use are followed. Timely knowledge of the number of casualties and their severity, rather than an accurate count of persons on board, could expedite treatment and have potential life-saving implications.

Indicating the Possibility of Missing Persons

Emergency response teams are trained to perform systematic searches of accident and disaster sites to locate all victims. Part of this standard practice is to count rescued persons and collect personal information about these individuals. Comparing this on-site accident response information to records of persons on board takes time and is not the first priority of emergency responders. Even if the two counts are consistent, prudent practice dictates that names be matched, and this is a cumbersome process in the post-accident emergency response environment. Even if both lists are perfectly accurate, the combination of circumstances that would lead to finding additional persons quickly enough to affect their survivability is improbable. No such cases are known to have occurred, and, in recent cases with detailed published accident reports, the rescue of surviving passengers were completed before the time that missing person data could be assimilated and analyzed.

Emergency responders will normally perform careful searches irrespective of any indication of missing persons. Inaccurate records of persons on board might cause some continuation of search and rescue operations that might otherwise have ceased, but only if the error was to list more persons than were actually on board. It is more likely that imperfections in Amtrak's passenger accounting system would result in undercounts rather than overcounts of persons on board and thus would not cause unnecessary searches. The extra costs of extending the search period could be extra pay, but might be performed within regularly scheduled duty time. Any extra search costs would likely be so small and infrequent as to be ignored in any cost-benefit analysis, and in any event do not have direct safety implications.

Providing Information for Post-Accident Notification and Records

As a common carrier, Amtrak has post-accident responsibilities that require information as to persons on board. Pre-accident data will always be compared, verified, and supplemented by information collected during the emergency response. Accurate pre-accident information would

facilitate this process, but has no safety benefit nor notable cost saving other than potentially reducing fraudulent liability claims.

7. Alternative System Concepts for Improved Passenger Accounting: Description and Evaluation

7.1 Introduction

A key objective of an improved passenger accountability system is to provide an accurate listing of persons on board, including limited personal information to be used as part of an emergency response (i.e., name, and perhaps age or age category, gender, and contact person/number). If NTSB is to be taken literally, the new system will have to provide information on the exact number and identity of passengers on board at all times.

The proposed system improvements do not include linkages to security databases or passenger screening. However, it seemed prudent to anticipate Transportation Security Administration (TSA) concerns and suggest system options that include the capability of indicating who is on the train at all times.

To evaluate the feasibility of system improvement options, Volpe Center staff estimated their development, capital, and operating costs. It is likely that an interface with Amtrak's existing reservation system will need to be developed, though an upgrade or replacement would likely be considered early in any implementation planning effort. The other system elements would likely be off-the-shelf hardware.

The estimated costs indicated in this study should be viewed as order of magnitude estimates. A more detailed level of analysis would be required to develop more precise estimates based on a comprehensive list of components, quantities, unit costs, and the cost of operating the current baseline system.

This feasibility assessment identifies the advantages and disadvantages of the options considered in qualitative terms. Systems are defined on the basis of the components needed. Benefits are discussed in qualitative terms but not quantified in terms of dollars or other measures.

Concept descriptions for six options are considered. These include the current system, assuming the ideal operating case, followed by five other options that range from simple changes to the existing system to options involving significant changes in Amtrak operating policies as well as significant changes in technology. The latter four alternatives involve some degree of automation of the ticket collection process and the use of some type of machine readable ticket. The alternatives considered include the following:

- *Base Case*
  Amtrak's current passenger accountability system based on Arrow CRS and the conductor's ticket pouch. Tickets are collected on board. Tickets are not required to board a reserved train.

- *Improved Onboard Paper-Based System*
  Allows onboard collection (sale) of paper tickets with improved paper accounting of passengers. Updated passenger reservation system information is manually transferred to the train at stops with staffed stations. Information about passengers not previously captured by the reservation system, for the just-completed route segment, is manually transferred at stops with staffed stations.

- *Automated Onboard Ticket Collection System*
  Allows onboard collection (sale) of machine-readable tickets. Updated passenger reservation system information is electronically transferred to the train at station stops. Updated passenger (ticket lift) information for the just-completed route segment is electronically transferred to the reservation system at station stops.

- *Automated Onboard Ticket Collection System with Improved Information Transfer*
  Allows onboard collection (sale) of machine-readable tickets. Updated reservation system information is electronically transferred to the (moving) train prior to the ticket lift, and passenger (ticket lift) information is electronically transferred from the (moving) train upon completion of the ticket lift.

- *Electronic Tickets with Platform Gate Readers and Car Door Readers*
  Electronic verification of smart card-based tickets on entry to and exit from the train or station platform (at major stations only). Tickets are required for boarding (i.e., no onboard sales). Updated passenger list information is electronically transferred at each station stop before train departure.

- *Electronic Tickets with Car Door Readers*
  Electronic verification of smart card-based tickets on entry to and exit from the train. Tickets are required for boarding (i.e., no onboard ticket sales). Updated passenger list information is electronically transferred at each station stop before train departure.

The remainder of this section includes the following:

- Describes the current and proposed alternative passenger accountability systems in terms of their general functionality, advantages, disadvantages, and order-of-magnitude cost estimates.

- Provides information on the sources and derivation of the unit costs and quantities used in deriving the cost estimates.

- Presents a qualitative discussion of the potential benefits of an improved passenger accountability system.

- Offers some conclusions and recommendations based on a consideration of the characteristics of the alternative passenger accountability systems.

7.2 Alternatives for Improved Passenger Accounting

Order-of-magnitude costs for a number of alternative passenger accountability systems were estimated. Both one time and annual ongoing (operating) costs were estimated. These systems represent a spectrum of alternatives starting with the current system, the Base Case, and moving toward alternatives that would require increasing changes in Amtrak's current way of doing business.

Only two of the proposed options meet NTSB requirements for a passenger accountability system. The others are straw men to illustrate the point that changes to the existing system will likely involve increased costs while not meeting requirements or providing any significant benefits. Table 7 summarizes the characteristics of the alternatives and the following subsections describe them in more detail. Appendix H describes unit costs and quantities that form the basis of the estimates.

Cost estimates for the alternatives do not include costs associated with integration with Amtrak's Arrow CRS or an upgrade or replacement of Arrow. Cost changes associated with conductors, ticket agents, or ticket offices were also not estimated. Costs associated with processing cash revenues were not estimated. These three costs would be common to all four automated (electronic) alternatives. For four of the alternatives considered, revenue accounting could be done electronically, essentially in real time. This is a potential benefit of an automated ticketing/fare collection system. However, the potential savings due to the conversion of the revenue accounting process from a paper-based to an electronic system were not estimated. These estimates were made assuming that future ridership and revenues levels were the same as the historic 2003 level.

Table 7. Characteristics of the Alternative Passenger Accountability Systems

Alternative	Ticket Collected	Ticket Lift Information Processed	Manifest Updated	Sales/Reservations/ Collections Reconciled in Near Real Time	Information Transfer Train/CNOC	Basis of Information	Onboard Sales
Base Case	On board	In Revenue Processing	At CNOC	No	Partial Transfer at Select Staffed Stations	Reservation /Sales	Permitted
Improved Onboard Paper-Based System	On board	In Revenue Processing	At CNOC	No	At All Staffed Stations	Reservation /Sales	Permitted
Automated Onboard Ticket Collection System	On board	On board	On board	Yes	At All Stations	Tickets Used	Permitted
Automated Onboard Ticket Collection System with Improved Information Transfer	On board	On board	On board	Yes	At Completion of the Ticket Lift	Tickets Used	Permitted
Electronic Tickets with Platform Gate Readers and Car Door Readers	At gate/at car door	At gate/at car door	At gate/at car door	Yes	At All Stations Prior to Train Departure	Tickets Used	Not Permitted
Electronic Tickets with Car Door Readers	At car door	At car door	At car door	Yes	At All Stations Prior to Train Departure	Tickets Used	Not Permitted

CNOC is Amtrak's Consolidated National Operations Center

Table 7. Characteristics of the Alternative Passenger Accountability Systems (continued)

Alternative	Timeliness of Updates	Consistency Onboard List /CNOC List	Always Accurate	Provides Number Onboard	Provides Names
Base Case	Meaningless	No	No	Yes	No
Improved Onboard Paper-Based System	Always one staffed station behind	No	No	Yes	Yes
Automated Onboard Ticket Collection System	Time lag due to ticket lift and data transfer	No	No	Yes	Yes
Automated Onboard Ticket Collection System with Improved Information Transfer	Time lag due to ticket lift	No	No	Yes	Yes
Electronic Tickets with Platform Gate Readers and Car Door Readers	Always current	Yes	Yes	Yes	Yes
Electronic Tickets with Car Door Readers	Always current	Yes	Yes	Yes	Yes

CNOC is Amtrak's Consolidated National Operations Center.

7.2.1 Base Case

System Description

Passenger accountability on reserved trains is part of the larger Amtrak system for reservations, ticket sales, ticket collection, and revenue accounting. A major factor complicating passenger accountability is the nature of travel on intercity trains, that is, with multiple intermediate stops and long trip duration. Moreover, under current policies and practices it is possible to get on an Amtrak reserved train without a ticket and without a reservation. Thus, a verified list of passengers on board is not available at the time of a train's departure from its station of origin.

Amtrak's current passenger accountability system includes three elements: the conductor's ticket pouch, the printed onboard manifest, and the Arrow system's database. Under the current system there are no, or at best inadequate, real time links between these three elements to reconcile reservations made, tickets issued, and tickets used. At any point in time a count of the number of passengers on board will be different in each of the three elements. Formal counting of tickets used, which provides a historical record of the number of passengers that were on the train, is not completed until the conductor's pouch is put through the revenue accounting process sometime after completion of the train run.

Procedures are in place to handle various unusual events, such as stopovers, carry-bys, and passengers leaving the train before their scheduled stop. These procedures are geared toward keeping the conductor's ticket pouch up-to-date and to reflect an accurate picture of what happened on the train for revenue accounting. However, no provisions are in place to update the Arrow manifest to reflect these circumstances, and even the updated information in the ticket pouch can be incorrect because of various weaknesses in the system.

Ticketed passengers are included in the Arrow manifest. However, no provision exists for accounting for no-shows until the passenger applies for a refund. Unticketed passengers (those who have not physically picked up their ticket prior to boarding) also appear on the Arrow manifest. The onboard manifest is printed 30 minutes before departure from the station of origin and 30 minutes before departure from intermediate crew change points. Reservations and ticket sales made after the predeparture window do not appear on the printed onboard manifest. Tickets collected are added to the ticket pouch upon completion of the ticket lift after departure from each station. Onboard sales receipts for tickets issued to unticketed revenue passengers are also added to the ticket pouch. Ideally, the conductor completes a Form 3085 in addition to the onboard sales receipt, add this to the ticket pouch, and drop a copy at the next open staffed station to update the Arrow manifest and the onboard manifest created at crew change points.

Amtrak multi-ride ticket options (and commuter railroad passes[59]) are sold outside the context of the reservation system by phone, mail, ticket counter, or ticket machine. Passengers using these passes are accounted for in the ticket pouch and revenue accounting by the "Record of Tickets

[59] MARC passes are honored on a Reserved Regional and Unreserved Regionals. Virginia Railway Express passes are honored on the Carolinean, Crescent, Cardinal, Reserved Regionals, and Unreserved Regionals. Shore Line East passes are honored on Reserved Regionals, an Unreserved Regional, and an Acela Express. NJ Transit passes are only honored on unreserved trains. Metrolink passes are only honored on unreserved trains.

Honored but not Lifted." They are not accounted for in the printed onboard manifest or in the Arrow manifest.

Non-revenue passengers may have a ticket reflecting either a reduced fare or no fare and would be treated like any other ticketed passenger. Non-revenue passengers not holding a ticket enter into the manifest updates by way of Form 3085. This requires the conductor to complete a Form 3085, to drop off the Form 3085s at the first staffed station, and station personnel to enter the data into Arrow. The conductor can obtain an updated manifest by departing the train and logging onto Arrow, though this does not regularly occur. Non-revenue passengers are accounted for in the ticket pouch and revenue accounting by either a Form 3085 or a ticket.

Advantages/Disadvantages of Base Case

Amtrak's passenger accountability system does not meet NTSB's requirement for knowing the number and identity of passengers on reserved trains at all times. Three inherent defects exist in the current set of procedures for passenger accountability.

The first is the difference between actual practice as opposed to the official policy outlined in the Service Standards Manual. It is not clear how rigorously the procedures outlined in the Service Standards Manual in regard to Form 3085s are followed in practice. Perfect compliance would assume that conductors issued a Form 3085 for all passengers not having an Arrow ticket and appearing on the Arrow manifest, and they would then drop the Form 3085s at the first open staffed station that would not result in delaying the train.

However, even with perfect compliance with the official policy, defects exist in the policy itself which preclude its being a satisfactory solution to meeting the NTSB requirements. First, the policy of dropping off Form 3085s at the next open staffed station results in significant gaps in time in which this information is not available to Arrow. In some cases this information will not be available to Arrow until after the train has completed its run. Another problem associated with the timeliness of information is due to the use of the ticket lift. Collecting tickets after the train leaves the station creates a time gap in which the number of passengers on board is unknown, even if the results of the lift could be transmitted off the train immediately upon completion of the lift.

The final defect is that because of the implicit assumption that passengers will in fact always depart the train at the station indicated on their ticket. Not accounting for passengers leaving the train leads to potential discrepancies in the actual number of passengers on board as opposed to a list of passengers who should be on board according to the origin-destination indicated on their ticket.

Form 3085s are not issued in case of individuals who have missed their stop and are returning to their intended destination, or to commuter rail passholders or Amtrak multiride passholders who are legitimately or illegitimately riding a reserved Amtrak train. In addition, no procedures are in place to communicate to Arrow the fact that an individual who has missed his or her stop is still on the train, or that individuals have left the train before the stop indicated on their ticket either because of a stopover, illness, injury, disruptive behavior, or other personal reasons. If the

conductors have completed all the specified forms, these individuals would be accounted for after the fact in the revenue accounting process. However, individuals who left the train without first informing the conductor are not accounted for.

7.2.2 Improved Onboard Paper-Based System

System Description

This alternative would be the same as the current Amtrak passenger accountability system with the following changes. First, conductors would have a complete list of passenger names for check off as part of the ticket lift process. They would be required to complete a Form 3085 for all passengers not holding an Arrow ticket without exception, including all passholders and all individuals traveling in families and multi person parties who purchase tickets on board, and create negative 3085s for no-shows. Conductors would be required to drop off Form 3085 updates at all staffed stations without exception, but the conductor would not be required to leave the platform. Instead, station staff would be required to meet the conductor on the platform to collect the Form 3085s and provide the conductor with the latest version of the Arrow manifest.

Advantages/Disadvantages of Improved Onboard Paper-Based System

This case takes a step toward ensuring that actual practice follows the policy on Form 3085 updates outlined in the Service Standards Manual and makes the stated policy more meaningful in requiring Form 3085 drop-offs at all staffed stations. While this system addresses some of the problems in the current system related to actual practice versus stated policy, it does not address inherent defects in the current system.

It has advantages over the current system because it provides name information for all passengers including pass holders and onboard sales, and accounts for passholders and onboard sales in the manifest update. At staffed station stops, it accounts for no-shows, eliminates the need for the conductor to verify reservations for unticketed passengers over a phone, and ensures that the manifest is updated at each station stop.

This approach does not meet NTSB requirements. It would not capture people leaving before their scheduled stop or those missed by the conductor in the ticket lift. Timeliness of information would still be a problem as under the current system, since the information about passengers surrendering or purchasing a ticket on board that is available through the Arrow CRS at CNOC will always be one station behind.

Costs of Improved Onboard Paper-Based System

Additional conductor workload may require increasing the number of conductors on select trains.

Depending on current station staff levels and work loads, additional station staff or staff hours would be needed to accommodate the new job function of collecting Form 3085 updates from the conductor on the platform and immediately entering the data into Arrow.

In addition, a mobile, system-wide, auditing department would be required to ensure near perfect compliance with a requirement for conductors to complete a Form 3085 for all passengers not holding an Arrow ticket. Attempting to reconcile Form 3085s after the fact in revenue accounting would not provide an accurate check on conductors.

Costs associated with these additional requirements would mostly be the subject of detailed staffing analyses, probably union negotiations over changed working conditions and management decisions, and thus were not estimated.

7.2.3 Automated Onboard Ticket Collection System

System Description

Under this alternative the conductor would use a handheld device to scan tickets and passes, and issue tickets. All revenue and non-revenue passengers would have or be issued a ticket or pseudo ticket. All tickets and passes issued by ticket machines, ticket offices, travel agents, and on board would have a consistent machine readable format. Ticket lift data would be downloaded to an onboard computer. This would have to be a hardened and protected computer. Data would be transmitted at the next station stop via WIFI[60] technology to the station computer and then to CNOC where the manifest would be updated. The latest version of the passenger list, including the latest list of ticketed and unticketed individuals scheduled to board at the upcoming station, would be transmitted to the station computer from CNOC just before the train's arrival at the station and then to the train upon its arrival at the station via WIFI technology. Current practice of allowing onboard sales would continue since tickets would not be checked prior to boarding.

Advantages/Disadvantages of Automated Onboard Ticket Collection System

This alternative would have an advantage over the current system because it would provide name information for all passengers including pass holders and onboard sales, would account for passholders and onboard sales in the manifest update, would account for no-shows at each station, would eliminate the need for the conductor to verify reservations for unticketed passengers over a phone, and would ensure that the manifest was updated at each station stop.

This system addresses some of the problems in the current system related to actual practice versus stated policy but does not address inherent defects in the current system, such as timeliness (the one-station-behind problem) of updates to the manifest. Since the list of passenger tickets scanned in the ticket lift is not transmitted off the train until the next station stop, any list available at CNOC would not include passengers boarding at the current station stop, would not be valid for the current route segment, and at best might be valid for the route segment just completed.

[60] WIFI uses radio frequency transmission to connect computers to each other. WIFI operates in the 2.4 and 5GHz radio bands with data transfer rates of 11 Mbps or 54 Mbps providing performance similar to wired Ethernet networks.

The manifest produced under this alternative would provide a list of passenger tickets scanned/issued by the conductor after completion of the ticket lift, less scheduled departures at the given station stop. This may or may not be a list of passengers on the train at that point due to potential fare evaders, conductor mistake, or premature departure (a potential security concern).

This approach does not meet NTSB requirements. This system will not capture people leaving before their scheduled stop or those missed by the conductor in the ticket lift. Timeliness of information would still be a problem as under the current system, since the information on passengers surrendering/purchasing a ticket on board, that is available at CNOC, will always be one station behind.

Costs of Automated Onboard Ticket Collection System

Table 8 shows the one-time costs and annual ongoing costs associated with this alternative, along with the quantities and types of equipment needed to implement the alternative. One-time costs for required hardware and software were estimated as $29,300,000 to $50,300,000. Ongoing costs were estimated as $2,700,000 to $4,900,000 per year.

Table 8. Automated Onboard Ticket Collection System

Cost Element	Unit Cost (dollars)		Quantity	Total Cost (dollars)		Nature of Cost	
	Low	High		Low	High	One Time	Ongoing
Vehicle-Related Costs							
Data communications system to/from train for each train	200	400	336	67,000	134,000	X	
Onboard computer hardware and software for each train	4,600	5,600	336	1,546,000	1,882,000	X	
Portable (handheld) ticket scanner with ticket issue capability for each conductor	2,400	3,900	728	1,747,000	2,839,000	X	
Station-Related Costs							
Ticket vending machine at select stations	29,000	58,100	72	2,088,000	4,183,000	X	
Booking office machines for all stations with staffed ticket offices		11,800	310	3,658,000	3,658,000	X	
Station hardware/software at each station	6,400	9,200	515	3,296,000	4,738,000	X	
Central hardware/software		2,759,000	1	2,759,000	2,759,000	X	
Data communications system to/from train for each station	200	400	515	103,000	206,000	X	
Communications infrastructure linking station computers and CNOC		6,798,000	1	6,798,000	6,798,000	X	
Fare Media Costs							
Ticket media per ticket	0.02	0.04	11,606,000	232,000	464,000		X

Table 8. Automated Onboard Ticket Collection System (continued)

Cost Element	Unit Cost (percent)		Quantity	Total Cost (dollars)		Nature of Cost	
	Low	High		Low	High	One Time	Ongoing
Variable System Costs							
Spare Parts (% of equipment cost)	10	15	-	2,206,000	4,080,000	X	
Support services include training, documentation, revenue testing, and warranties (% of equipment cost)	10	15	-	2,206,000	4,080,000	X	
Installation (% of equipment cost)	3	10	-	662,000	2,720,000	X	
Nonrecurring engineering and software costs (% of equipment cost)	0	30	-	0	8,159,000	X	
Contingency (% of equipment/operating cost)	10	15	-	2,206,000	4,080,000	X	X
Equipment maintenance costs (% of equipment cost)	5	7	-	1,103,000	1,904,000		X
Software licenses/system support (% of systems/software cost)	15	20	-	1,140,000	1,876,000		X
One Time Costs				29,342,000	50,315,000		
Total Annual Ongoing Costs				2,723,000	4,880,000		

7.2.4 Automated Onboard Ticket Collection System with Improved Information Transfer

System Description

Under this alternative a handheld device would be used to scan tickets and passes, and issue tickets. All non-revenue passengers would have or be issued a ticket or pseudo ticket. All tickets and passes issued by ticket machines, ticket offices, travel agents, and on board would have a consistent machine readable format. The latest version of the passenger list, including the latest list of ticketed and unticketed individuals scheduled to board at the upcoming station would be transmitted to the train from CNOC just before the train's arrival at the station. Upon completion of the ticket lift, the passenger data would be downloaded to an onboard computer, and would then be transmitted to CNOC where the manifest would be updated, and a revised manifest would be transmitted back to the train. Data transmission would be via satellite or cellular technology. Current practice of allowing onboard sales would continue since tickets would not be checked prior to boarding.

Advantages/Disadvantages of Automated Onboard Ticket Collection System with Improved Information Transfer

This alternative would have an advantage over the current system because it would provide name information for all passengers including pass holders and onboard sales, would account for passholders and onboard sales in the manifest update, would account for no-shows at each station, and would ensure that the manifest was updated after completion of the ticket lift following each station stop. This approach would allow for real time or near real time verification of reservations/payment for unticketed passengers.

This system addresses some of the problems in the current system related to actual practice versus stated policy and addresses an inherent defect in the current system, which is timeliness (the one-station-behind problem) of updates to the manifest. However, a complete list of passenger tickets scanned/issued would not be available in the interval between the train departing the station and completion of the ticket lift.

The manifest produced under this alternative would provide a list of passenger tickets scanned/issued by the conductor after completion of the ticket lift, less scheduled departures at the given station stop. This may or may not be a list of passengers on the train at that point due to potential fare evaders, conductor mistake, or premature departure (potential security concern).

This approach does not meet NTSB requirements. This system will not capture people leaving before their scheduled stop or those missed by the conductor in the ticket lift. Timeliness of information would still be a problem, since a ticket lift takes time, and no guarantee exists that an accident would not occur after station departure but before transmittal of the updated passenger information from the train to CNOC.

Associated Costs of Automated Onboard Ticket Collection System with Improved Information Transfer

Table 9 shows the one-time costs and annual ongoing costs associated with this alternative, along with the quantities and types of equipment needed to implement the alternative. One-time costs for required hardware and software were estimated as $17,000,000 to $31,200,000. Ongoing costs were estimated as $1,600,000 to $2,900,000 per year. These costs do not include the costs of the satellite/cellular infrastructure.

Table 9. Automated Onboard Ticket Collection System with Improved Information Transfer

Cost Element	Unit Cost (dollars)		Quantity	Total Cost (dollars)		Nature of Cost	
	Low	High		Low	High	One Time	Ongoing
Vehicle-Related Costs							
Data communications system to/from train for each train	1,100	2,100	444	488,000	932,000	X	
Onboard computer hardware and software for each train	4,600	5,600	336	1,546,000	1,882,000	X	
Portable (handheld) ticket scanner with ticket issue capability for each conductor	2,400	3,900	728	1,747,000	2,839,000	X	
Station-Related Costs							
Ticket vending machine at select stations	29,000	58,100	72	2,088,000	4,183,000	X	
Booking office machines for all stations with staffed ticket offices		11,800	310	3,658,000	3,658,000	X	
Central hardware/software		2,759,000	1	2,759,000	2,759,000	X	
Fare Media Costs							
Ticket media per ticket	0.02	0.04	11,606,000	232,000	464,000		X

Table 9. Automated Onboard Ticket Collection System with Improved Information Transfer (continued)

Cost Element	Unit Cost (percent)		Quantity	Total Cost (dollars)		Nature of Cost	
	Low	High		Low	High	One Time	Ongoing
Variable System Costs							
Spare Parts (% of equipment cost)	10	15	-	1,229,000	2,438,000	X	
Support services include training, documentation, revenue testing, and warranties (% of equipment cost)	10	15	-	1,229,000	2,438,000	X	
Installation (% of equipment cost)	3	10	-	369,000	1,625,000	X	
Nonrecurring engineering and software costs (% of equipment cost)	0	30	-	0	4,876,000	X	
Contingency (% of equipment/operating cost)	10	15	-	1,229,000	2,438,000	X	X
Equipment maintenance costs (% of equipment cost)	5	7	-	614,000	1,138,000		X
Software licenses/system support (% of systems/software cost)	15	20	-	646,000	928,000		X
One Time Costs				16,955,000	31,207,000		
Total Annual Ongoing Costs				1,641,000	2,910,000		

7.2.5 Electronic Tickets with Platform Gate Readers and Car Door Readers

System Description

Under this alternative the platform area at all currently staffed stations would be sealed off. Passengers would not be allowed to enter or exit the platform area without a valid ticket. Readers on the gates would be used to read the tickets of passengers getting on and off the platform. Entry to the platform area would not be allowed until all debarking passengers had exited the platform area. Station personal would be required to assist passengers and ensure compliance. At unstaffed stations, readers at select car doors would be used to read tickets of passengers getting on and off the train. The only operable doors would be those monitored by the crew, which implies only two or three doors used per train. This should not cause delays given the low passenger volumes at unstaffed stations.

All passengers would be required to have a ticket before boarding. Onboard ticket sales would be eliminated. All non-revenue passengers would have a ticket or pseudo ticket. Tickets would likely be disposable contactless smart cards,[61] eliminating the need for passengers to insert their ticket into some sort of device and then retrieve their ticket. Tickets would contain data on origin, destination, fare, type of passenger (full fair, child, Amtrak employee), name, and other personal information deemed appropriate. Ticket vending machines (TVMs) or a ticket office would be required at all stations.[62] Conductors would no longer be part of the revenue/ticket collection process, with an increased customer service/safety role. However, conductors would monitor active doors at unstaffed stations to ensure that all passengers were in possession of a valid ticket.

The latest version of the passenger list, including the latest list of individuals holding tickets to board at the upcoming station, would be transmitted to the station from CNOC just prior to the train's arrival. All tickets would be processed at the gates or at the car door. All boardings and alightings would be accounted for before the train departed the station. An updated manifest (list of passengers on board) would be transmitted to a station computer via WIFI technology prior to departure from the station and then on to CNOC.

Advantages/Disadvantages of Electronic Tickets with Platform Gate Readers and Car Door Readers

This alternative meets NTSB requirements (and potential TSA requirements) because it provides a list of passengers on the train as it departed the station that is valid until arrival at the next

[61] A disposable contactless smart card would be made of paper and contain a small imbedded computer chip containing the relevant ticket information. The ticket information is transferred by means of radio frequency transmission. The card contains a radio transponder that is activated only upon receipt of a specific radio frequency. Upon activation, the card generates a response that acts as an identifier.

[62] In remote station areas, banks or local retail outlets could serve as Amtrak ticket agents on a commission basis. These outlets could serve as a substitute for an Amtrak ticket office or ticket vending machine. The cost of this option was not estimated for the current analysis.

station. A copy of this list would reside at the CNOC, and a copy would be available to the train crew.

This alternative would necessitate a radical change in Amtrak's way of doing business. All passengers would be required to have a ticket prior to boarding, even if it were a zero fare ticket. No onboard sales and no Form 3085s would exist. Amtrak multiride passes would be just another form of ticket. Commuter railroad passholders would need to present their pass and identification at a ticket office to get a ticket, or the policy of honoring commuter railroad passes on selected Amtrak reserved trains would have to be abolished. (Commuter rail passholders would not be able to get a ticket at unstaffed stations.) Reservation and ticket issuing processes would remain unchanged otherwise. Revenue accounting would be done at each station stop as passengers enter/exit the platform area or train.

Costs for Electronic Tickets with Platform Gate Readers and Car Door Readers

Table 10 shows the one-time costs and annual ongoing costs associated with this alternative, along with the quantities and types of equipment needed to implement the alternative. In addition to the fare gates, various modifications would be required to segregate the platform boarding area from the rest of the station.

The cost elements for typical station modifications required to go to a gated system include the following:

- Removal of existing fencing, gates, walls, and concessions to clear access to the control area and enlarge space for fare gates.

- Relocation of station furniture, such as waiting room benches, advertising displays, directional and information panels, and trash containers.

- Installation of power and communication lines encased in partitioned wireway or rigid conduit, and addition of electrical panels with switches/circuit breakers.

- Installation of fare gates and TVMs, including concrete mounting pads and anchor bolts, but excluding the hookup and startup testing of the machinery, which is usually done by the equipment manufacturer as part of the equipment purchase price.

- Fencing of the station fare control areas and platforms and installation of gates, not including the capital cost of the remotely controlled service gates installed in the fare gate arrays.

- Construction or major renovation of doorways, stairways, footbridges, passageways, equipment shelters, and ticket offices.[63]

[63] Grenzeback, Lance R. and Tomasz M. Wiktor, *Evaluation of Automatic Fare Collection Technology – Volume IVB – Station and Vehicle Modifications: Commuter Rail,* prepared for New York Metropolitan Transportation Authority, Arthur D. Little, Inc., Cambridge, Massachusetts, November 1984.

One-time costs for required hardware and software and station modifications to 211 stations were estimated as $130,700,000 to $208,500,000. Ongoing costs were estimated as $7,200,000 to $21,200,000 per year.

If only the top 20 stations (in terms of passenger volume) were equipped with gates, then the estimated one-time costs would range from $63,200,000 to $127,000,000, while ongoing costs would range from $6,800,000 to $20,100,000 per year.

Table 10. Electronic Tickets with Platform Gate Readers and Car Door Readers

Cost Element	Unit Cost (dollars)		Quantity	Total Cost (dollars)		Nature of Cost	
	Low	High		Low	High	One-Time	Ongoing
Vehicle-Related Costs							
Stand-alone smart card processing unit for each operable car door	1,000	6,800	2,108	2,108,000	14,334,000	X	
Data communications system to/from train for each train	200	400	336	67,000	134,000	X	
Onboard computer hardware and software for each train	4,600	5,600	336	1,546,000	1,882,000	X	
Station-Related Costs							
Ticket vending machine at select stations	29,000	58,100	359	10,411,000	20,858,000	X	
Booking office machines for all stations with staffed ticket offices		11,800	310	3,658,000	3,658,000	X	
Bidirectional fare gate (contactless card)	19,400	33,900	443	8,594,000	15,018,000	X	
Station hardware/software for all stations	6,400	9,200	515	3,296,000	4,738,000	X	
Central hardware/software		2,759,000	1	2,759,000	2,759,000	X	
Data communications system to/from train for each station	200	400	515	103,000	206,000	X	
Communications infrastructure linking station computers and CNOC		6,798,000	1	6,798,000	6,798,000	X	
Station modifications required to go to a gated system				78,332,000	78,332,000		
High Cost Station	-	1,037,100	20	20,742,000	20,742,000	X	
Moderate Cost Station	-	581,200	56	32,547,000	32,547,000	X	
Low Cost Station	-	185,500	135	25,042,000	25,042,000	X	
Fare Media Costs							
Contactless disposable smart cards per card	0.3	1	11,606,000	3,482,000	11,606,000		X

Table10. Electronic Tickets with Platform Gate Readers and Car Door Readers (continued)

Cost Element	Unit Cost (percent)		Quantity	Total Cost (dollars)		Nature of Cost	
	Low	High		Low	High	One-Time	Ongoing
Variable System Costs							
Spare Parts (% of equipment cost)	10	15	-	3,934,000	10,558,000	X	
Support services include training, documentation, revenue testing, and warranties (% of equipment cost)	10	15	-	3,934,000	10,558,000	X	
Installation (% of equipment cost)	3	10	-	1,180,200	7,038,000	X	
Nonrecurring engineering & software costs (% of equipment cost)	0	30	-	0	21,116,000	X	
Contingency (% of equipment/operating cost)	10	15	-	3,934,000	10,558,000	X	X
Equipment maintenance costs (% of equipment cost)	5	7	-	1,967,000	4,927,000		X
Software licenses/system support (% of systems/software cost)	15	20	-	1,140,000	1,876,000		X
One Time Costs				130,654,000	208,544,000		
Total Annual Ongoing Costs				7,248,000	21,170,000		

7.2.6 Electronic Tickets with Car Door Readers

System Description

Under this alternative, car doors would be equipped with readers to read tickets of passengers getting on and off trains. The only operable doors would be those monitored by the crew, which implies only two or three doors used per train. This could result in potential delays at major stations with substantial numbers of passengers boarding and alighting each train, although the technology allows for the rapid processing of passengers as they board and depart.

All passengers would be required to have a ticket prior to boarding. Onboard ticket sales would be eliminated. All non-revenue passengers would have a ticket or pseudo ticket. Tickets would be disposable contactless smart cards, eliminating the need for passengers to insert their ticket into some sort of device and then retrieve their ticket. Tickets would contain data on origin, destination, fare, type of passenger (full fair, child, Amtrak employee, etc.), name, and other personal information deemed appropriate. Ticket machines or a ticket office would be required at all stations. Conductors would be effectively out of the revenue/ticket collection loop, with an increased customer service/safety role. However, conductors would monitor active doors in order to ensure that all passengers were in possession of a valid ticket.

The latest version of the passenger list including the latest list of individuals holding tickets to board at the upcoming station would be transmitted to the station from CNOC just prior to the train's arrival. All tickets would be processed at the car door. All boardings and alightings would be accounted for prior to the train departing the station. An updated manifest (list of passengers on board) would be transmitted to a station computer via WIFI technology prior to departure from the station and then on to CNOC.

Advantages/Disadvantages of Electronic Tickets with Car Door Readers

This alternative meets NTSB requirements (and potential TSA requirements) in that it provides a list of passengers on the train as it departed the station that is valid until arrival at the next station. A copy of this list would reside at the CNOC and a copy would be available to the train crew.

Like the previous alternative, this alternative would also necessitate a radical change in Amtrak's way of doing business. All passengers would be required to have a ticket prior to boarding, even if it were a zero fare ticket. There would be no onboard sales and no Form 3085s. Amtrak multiride passes would be just another form of ticket. Commuter railroad passholders would have to present their pass and identification at a ticket office in order to get a ticket, or the policy of honoring commuter railroad passes on selected Amtrak reserved trains would have to be abolished (Commuter rail passholders would not be able to get a ticket at unstaffed stations). Reservation and ticket issuing processes would remain unchanged otherwise. Revenue accounting would be done at each station stop as passengers enter/exit the train.

Costs for Electronic Tickets with Car Door Readers

Table 11 shows the one-time costs and annual ongoing costs associated with this alternative, along with the quantities and types of equipment needed to implement the alternative. One-time costs for required hardware and software were estimated as $40,900,000 to $102,400,000. Ongoing costs were estimated as $6,800,000 to $20,000,000 per year.

Table 11. Electronic Tickets with Car Door Readers

Cost Element	Unit Cost (dollars)		Quantity	Total Cost (dollars)		Nature of Cost	
	Low	High		Low	High	One Time	Ongoing
Vehicle-Related Costs							
Stand-alone smart card processing unit for each operable car door	1,000	6,800	2,108	2,108,000	14,334,000	X	
Data communications system to/from train for each train	200	400	336	67,000	134,000	X	
Onboard computer hardware and software for each train	4,600	5,600	336	1,546,000	1,882,000	X	
Station-Related Costs							
Ticket vending machine for all stations	29,000	58,100	359	10,411,000	20,858,000	X	
Booking office machines for all stations with staffed ticket offices		11,800	310	3,658,000	3,658,000	X	
Station hardware/software for all stations	6,400	9,200	515	3,296,000	4,738,000	X	
Central hardware/software		2,759,000	1	2,759,000	2,759,000	X	
Data communications system to/from train for each station	200	400	515	103,000	206,000	X	
Communications infrastructure linking station computers and CNOC		6,798,000	1	6,798,000	6,798,000	X	
						X	
Fare Media Costs							
Contactless disposable smart cards per card	0.3	1	11,606,000	3,482,000	11,606,000		X

Table 11. Electronic Tickets with Car Door Readers (continued)

Cost Element	Unit Cost (percent)		Quantity	Total Cost (dollars)		Nature of Cost	
	Low	High		Low	High	One Time	Ongoing
Variable System Costs							
Spare Parts (% of equipment cost)	10	15	-	3,075,000	8,305,000	X	
Support services include training, documentation, revenue testing, and warranties (% of equipment cost)	10	15	-	3,075,000	8,305,000	X	
Installation (% of equipment cost)	3	10	-	922,000	5,537,000	X	
Nonrecurring engineering and software costs (% of equipment cost)	0	30	-	0	16,610,000	X	
Contingency (% of equipment/operating cost)	10	15	-	3,075,000	8,305,000	X	X
Equipment maintenance costs (% of equipment cost)	5	7	-	1,537,000	3,876,000		X
Software licenses/system support (% of systems/software cost)	15	20	-	1,140,000	1,876,000		X
One Time Costs				40,892,000	102,430,000		
Total Annual Ongoing Costs				6,775,000	19,961,000		

7.3 Potential Benefits of Electronic Ticketing

All of the alternatives considered above (except one) involve some form of electronic or machine readable ticket. As noted in the companion report of this study,[64] it would be difficult to justify the cost of any passenger manifest system on the basis of lives potentially saved, or reduced search and rescue costs. It may be possible, however, to justify the investment cost of a new reservation/ticketing/revenue accounting process which includes the capability of meeting NTSB requirements for a passenger accountability system, based on a reduction in operating costs and the value of better information (planning data, reduced liability claims, yield management).

A basic premise of this analysis is that any passenger manifest system will not exist in a vacuum. Its costs and benefits must be tied into the overall passenger reservation, ticketing and revenue accounting systems, and also into the role of the conductors. This later consideration involves a potential trade-off between their part in the ticket sale, ticket collection and revenue accounting process, and alternative roles in ticket enforcement, safety, security, and customer service. Alternative models for the role of conductors include the U.S. commuter railroads using proof-of-payment (POP) ticket systems,[65] and the Japanese and French railroads.

Automation of Amtrak's ticketing procedures can be viewed as similar to efforts undertaken by various urban transit agencies in implementing automatic fare collection (AFC) systems. Proponents of AFC have noted that potential cost savings are possible in moving to an automated revenue collection and processing system. A detailed analysis of Amtrak's current cost of reservations, ticket sales, ticket collection, and revenue processing versus those of any proposed system would be required in order to determine if in fact there were any cost savings that could be attributed to the automated system.

The costs of fare collection and revenue processing can be substantial. It was not possible to derive an actual figure for revenue collection and processing from Amtrak's published financial data. However, a rough estimate can be derived from data on commuter railroads where various studies have indicated that the cost of fare collection ranged from 1.8 percent to 27 percent of ticket revenue.[66] The commuter rail costs include labor, materials, and services associated with

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[64] Mauri, Ronald and Joseph Mergel, *Amtrak Passenger Accountability System, Baseline Description and Emergency Response Uses of Passenger Information, DRAFT,* prepared for the Federal Railroad Administration, Volpe National Transportation Systems Center, Cambridge, Massachusetts, September 2004.

[65] VRE (Virginia Railway Express) Alexandria, Virginia, TRE (Trinity Railway Express) Dallas, Texas, Metrolink (Southern California Regional Rail Authority) Los Angeles, California, Coaster (North County Transit District) Oceanside, California, Tri-Rail (South Florida Regional Transportation Authority) Pompano Beach, Florida, and CALTRAIN (Peninsula Corridor Joint Powers Board) San Carlos, California.

[66] Metz, Peter J., et al., *Evaluation of Automatic Fare Collection Technology – Volume IB – Summary, Conclusions, and Recommendations: Commuter Rail,* prepared for New York Metropolitan Transportation Authority, Arthur D. Little, Inc., Cambridge, Massachusetts, November 1984, p.12.

> The annual operating and maintenance cost of fare collection represent 26 percent of passenger revenues on the LIRR (Long Island Rail Road) and 20 percent on the MNCR (Metro-North Commuter Railroad). This cost includes the wages and benefits of all fare collection personnel, materials and supplies, services and a small amount of revenue from bad checks. The duties of trainmen include pass and ticket inspection, ticket

the production and distribution of the fare media, as well as collection and processing. In FY03, Amtrak ticket revenue was $1,180.1 million.[67] Applying these percentages to Amtrak's ticket revenues results in an estimated annual revenue processing cost to Amtrak of $21 million to $319 million.

The effect of introducing an automated payment program on operating and maintenance costs will depend on changes to existing cost elements, including cost savings, and new cost elements. The introduction of electronic ticketing could be expected, at least in theory, to produce various benefits to an agency. These include:

- Reduced fare collection costs
- Improved revenue accounting and security in terms of improved ability to track transactions and discourage employee theft or mishandling of fare revenues
- Reduced fare abuse including reduction of counterfeiting of media, short payment, or illegal use of media
- Improved ridership data

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cancellation, onboard ticket sales, and control of doors. The off-train personnel involved in fare collection sell tickets, supervise ticket offices, account for and audit revenues, and sell passes by mail.

Fleishman, Daniel, *Multipurpose Transit Payment Media, T C R P Report 32,* Transportation Research Board, National Research Council, National Academy Press, Washington, D.C. 1998, p. 46.

> Reports transit agency fare collection costs (based on a survey of transit agencies in June 1996) as a percent of fare revenues. Results for commuter rail systems indicate a range of media production and distribution costs of 0.2 – 7.0 percent (average 2.7 percent), a range of collection and processing costs of 1.6 – 15 percent (average 9.2 percent) with total cost of 1.8 – 22 percent (average 11.9 percent) of fare revenues. Systems surveyed were: Tri-Rail (Ft. Lauderdale), SCRRA (Los Angeles), MNCRR (New York), GO Transit (Toronto), and BC Transit (Vancouver). With the exception of MNCRR, all systems are proof-of-payment (POP) operations.

Commuter Rail Fare Collection, A Comprehensive Strategy for Improvements, prepared for New Jersey Transit Corporation, Ernst & Whitney, December 1982, p. III-21.

> Major direct cost elements related to ticket sales and fare collection include: onboard ticket collection labor, station agent labor, and administrative costs. The overall cost relating to ticket sales, fare collection, and revenue accounting was 27 percent of revenues. Train crew labor made up 65 percent of these costs (with an average of 2.7 conductors per train).
>
> The cost of revenue processing (station agents, revenue accounting and control) at NJTC was 9 percent of revenues. This compared to 5 percent at the B&M (Boston) and 17 percent at GO (Toronto).

[67] *National Railroad Passenger Corporation and Subsidiaries (Amtrak) Consolidated Financial Statements, September 30, 2003 and 2002, (With Independent Auditor's Report Thereon),* KPMG LLP, McLean, Virginia, February 25, 2004.

- Reduced data collection costs

Actual data on documented benefits of AFC systems in the urban transit arena are scarce and results are inconclusive as indicated in the examples below.

Comprehensive analyses of the cost effects of implementing multipurpose fare systems were undertaken as part of the Central Puget Sound and Bay Area TransLink regional fare studies. The former study compared new and existing costs for the King County Metro transit system and estimated that the effect of the recommended smart card system on Metro's fare collection operating and maintenance costs could range from an increase of $139,000 per year (roughly 4 percent of the total annual current cost) to a reduction of $309,000 (more than 9 percent of the current total).

The TransLink study compared the costs associated with existing fare collection for the entire region with the estimated TransLink implementation and operation costs. The study determined that TransLink would result in total 5-year costs approximately 4 percent lower than comparable costs for the existing system, producing a savings of more than $1.5 million over the 5-year analysis period.[68]

However, a rough cost benefit analysis of a smart card-based AFC for Toronto concluded that, given the circumstances then prevailing in Toronto, one could not make a good business case for the system. The report notes, "In all the AFC systems which staff visited and which were in actual operation, there were insufficient operating costs savings to offset the capital investment required for the system."[69]

This same report notes that TTC staff visited a number of cities that have implemented, or are in the process of testing or implementing AFC systems. The purpose of the visits was to determine what these cities were trying to achieve by implementing an AFC system.

The major reason given for implementing or testing new systems was to address the problem of ageing or failing fare collection equipment. Every city visited had been driven to seek out new fare collection equipment because their existing equipment was old and at the end of its usable economic life.

Amtrak's latest strategic plan[70] notes that Amtrak has reached this point in regard to its reservation, and ticketing systems, and is considering the implementation of electronic ticketing (see Appendix A).

An improved passenger accountability system may be viewed as an ancillary benefit associated with an improved overall ticket sales, distribution, collection and post processing system.

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[68] Fleishman, Daniel, *Multipurpose Transit Payment Media, T C R P Report 32*, Transportation Research Board, National Research Council, National Academy Press, Washington, D.C. 1998.

[69] *TTC Fare Collection Study*, Toronto Transit Commission, October 2000.

[70] *Amtrak Strategic Plan FY 2005-2009*, June 29,2004.

7.4. Conclusions

- Improved passenger accountability systems may have benefits (cost savings) within the overall ticket reservation/sales/collection/revenue accounting function, but Volpe Center staff did not quantify them as part of this study.

- A detailed analysis of the total costs of Amtrak's current ticket reservation/sales/collection/revenue accounting function would be required along with an estimate of the total cost of the proposed alternatives in order to make a business case for an automated alternative.

- Cost estimates presented in this study are partial costs only (i.e., the marginal or incremental costs of the automated alternatives).

- Of four alternatives considered, the two least costly would not meet NTSB requirements although they also involved significant costs.

- A system based on disposable smart card tickets and door mounted ticket readers would meet NTSB requirements and cost less than an alternative that relied on gated platforms.

- Amtrak is at a point where requirements for a passenger accountability system can be incorporated into planned improvements to ticketing, stations, rolling stock, and support functions.

If viewed as a stand-alone system, the safety benefits of a passenger accountability system are negligible, while the costs of implementing and operating the system on a stand-alone basis are substantial. However, when placed in the context of the overall process associated with the production, distribution, sales, collection, and processing of fare media, and given that Amtrak has or is planning on embarking on a major overhaul of what they consider an outdated system, the marginal costs of producing a passenger manifest that meets the NTSB's requirements may prove to be manageable. Amtrak should be encouraged to include considerations related to producing an improved manifest system as they proceed with their strategic plans for marketing and sales and transportation support systems. (see Appendix A for relevant excerpts from Amtrak's Strategic Plan).

If the NTSB is to be taken literally, any passenger manifest must provide information on the number and identity of passengers on board at all times.

The current system does not meet these requirements and cannot be made to meet these requirements, even with extensive automation.

Identified deficiencies in the current process imply that to meet the NTSB recommendation, all boarding passengers must have a ticket or pass containing their identity before boarding (no onboard sales), these tickets must be checked/validated prior to train movements, and the number

of passengers boarding and their identity must be made available to Arrow (or its replacement) prior to the train departing the station.

In addition, all departing passengers would have to have their tickets checked/validated, so that the number of passengers departing the train and their identity is made available to Arrow before the train departs the station.

Only a system that accounts for ons and offs, tracks named, individual tickets, and updates to produce a passenger list prior to the train's departure from a station will meet NTSB recommendations.

Implementation will require a change in Amtrak's business model i.e., no onboard ticket sales, no passengers allowed to board without a ticket, and a change in policy on honoring passes of commuter railroads. Commuter rail passholders would be required to get a ticket before boarding. This is the current policy for Amtrak passholders wishing to ride the Acela Express or Metroliners.

A basic premise of this analysis is that any passenger manifest system will not exist in a vacuum. Its costs and benefits are tied into the overall passenger reservation, ticketing and revenue accounting systems, and into the role of the conductors. This later consideration involves a potential trade-off between their part in the ticket sale, ticket collection and revenue accounting process, and alternative roles in safety, security, and customer service. Alternative models for the role of the conductor include the POP commuter railroads, the Japanese, and French railroads.[71]

It will be difficult to justify the cost of any passenger manifest system on the basis of lives potentially saved, or reduced search and rescue costs. However, it may be possible to justify the investment cost of a new reservation/ticketing/revenue accounting process which includes the capability of meeting the NTSB requirements for a passenger manifest system, based on a reduction in operating costs and the value of better information (planning data, reduced liability claims, yield management).

An improved passenger accountability system may be viewed as an ancillary benefit associated with an improved overall ticket sales, distribution, collection, and post processing system.

All alternatives considered here, other than the base case or "do nothing" alternative, will require increased costs over the base case, and some will result in a system that does not meet NTSB requirements.

The improved base case would require draconian enforcement of the stated policies related to onboard passenger-accounting procedures (i.e., a system-wide audit to determine the extent of non-compliance by conductors, followed by enforcement measures to ensure full compliance).

[71] Note that POP ticketing is used on various commuter railroads including VRE, TRE, Metrolink, Coaster, Tri-Rail, and CALTRAIN. The conductor's role is one of enforcement rather than fare collection. Under POP, there are no onboard sales. Passengers must have a valid ticket. Not having a valid ticket results in a substantial fine.

This case would also involve increased station staffing levels and increased crew size on certain reserved trains.

Table 12 summarizes one-time costs and annual ongoing costs for the alternatives discussed in the previous section. The least costly alternative both in terms of first costs and ongoing costs is Alternative 2, which is based on conductors using handheld devices to collect ticket information, and the transfer of the passenger list to/from the CNOC using satellite/cellular technology. The most costly alternative is Alternative 3, which is based on gated staffed stations and the use of door readers at unstaffed stations. As noted in the previous section, however, Alternatives 1 and 2 cannot meet the NTSB's stated requirements for a passenger accountability system. Of the considered alternatives that do meet NTSB requirements, Alternative 4 (based on door mounted ticket readers) is the least costly.

Table 12. Alternative Systems' Cost Summary

Alternative	One-Time Costs (dollars)		Total Annual Ongoing Costs (dollars)	
	Low	High	Low	High
1-Automated Onboard Ticket Collection System	29,300,000	50,300,000	2,700,000	4,900,000
2-Automated Onboard Ticket Collection System with Improved Information Transfer	17,000,000	31,200,000	1,600,000	2,900,000
3-Electronic Tickets with Platform Gate Readers and Car Door Readers	131,000,000	208,500,000	7,200,000	21,200,000
3a-Electronic Tickets with Platform Gate Readers (at Top 20 Stations Only) and Car Door Readers	63,200,000	127,000,000	6,800,000	20,100,000
4-Electronic Tickets with Car Door Readers	40,900,000	102,400,000	6,800,000	20,000,000

The estimated annual ongoing costs should be considered in light of Amtrak's current revenue handling costs. It was not possible to derive actual figures for revenue collection and processing from Amtrak's published financial data. However, information from commuter railroads indicates that Amtrak may be spending from 2 percent to over 25 percent of annual ticket revenues on revenue collection and processing. In FY03, Amtrak's ticket revenue was $1,180.1 million.[72] Thus, Amtrak may be currently spending $21 to $319 million on costs related to ticket sales, fare collection, and revenue accounting with the more likely figure tending toward the high end of the scale. The lower figure is representative of POP operations while the higher figure is representative of more conventional operations involving ticket collection and onboard sales by conductors.

While there are negligible safety benefits to having an improved manifest system, there may be potential operating cost savings in implementing an electronic ticketing/AFC system which would be capable of also providing a passenger accountability function that met NTSB

[72] *National Railroad Passenger Corporation and Subsidiaries (Amtrak) Consolidated Financial Statements, September 30, 2003 and 2002, (With Independent Auditor's Report Thereon),* KPMG LLP, McLean, Virginia, February 25, 2004.

requirements. It was not possible to prepare a detailed estimate of potential savings within the scope of this current project.

In order to place the one-time costs of a passenger accountability system in context consider the following from Amtrak's latest strategic plan.[73]

Capital Needs FY05-FY09	
Infrastructure	$2,123 million
Fleet	$1,476 million
System Support	$394 million

Infrastructure includes $171 million in station improvements, primarily deferred maintenance and Americans with Disabilities Act (ADA) requirements. Station modifications required under Alternative 3 (gated stations), were estimated at $20.7 million to $78.3 million depending on the number of stations outfitted with ticket-reading gates.

Fleet includes $745 million in existing fleet overhaul of passenger cars, and $380 million in new equipment acquisition. (Heritage replacements, rail diesel cars, next generation corridor equipment, and auto carriers)

One-time vehicle-related costs under both Alternative 3 and 4 were estimated at $3.7 million to $16.3 million.

There would seem to be opportunities for cost sharing between the requirements for an improved manifest system and Amtrak's current capital investment plans in the area of station modification and car replacement/rehabilitation.

System Support includes environmental, marketing/sales, police, procurement, real estate, transportation, finance, planning, and technology. The relevant items from the Strategic Plan are information technology, planning, and finance at $94 million, transportation at $60 million, and marketing/sales at $ 47 million for a total of $201 million.

One-time costs for station-related and central hardware/software were estimated to vary from $37.4 million under the alternative utilizing onboard door ticket readers to $118.6 million under the alternative based on a mix of gated stations and onboard door ticket readers.

The major reason given for implementing new fare collection systems in urban transit systems has been that existing systems were at the end of their usable economic lives. As indicated in its Strategic Plan, Amtrak appears to be approaching this point with its current ticketing and reservation systems.

There would also seem to be opportunities for cost sharing between the requirements for a manifest system and Amtrak's current investment plans in the area of System Support.

[73] *Amtrak Strategic Plan FY 2005-2009*, June 29,2004.

As a result of this preliminary analysis it would be desirable for Amtrak to consider whether meeting NTSB's passenger accountability recommendation can be accomplished as part of its more general plans for system improvements. Amtrak could consider the following possible solutions:

- As part of any effort to upgrade its passenger accounting systems, Amtrak could initiate a more detailed study of the potential costs and benefits of implementing a passenger accountability system based on electronic tickets with car door readers, in conjunction with implementation of planned programs of fleet replacement, station modernization, and support system development.

- Amtrak should define its end-state reservation, ticketing, and passenger accountability systems, and then incorporate the associated requirements for an improved passenger accountability system into its planned programs of fleet replacement, station modernization, and support system development, even if they do not meet all aspects of the NTSB recommendation.

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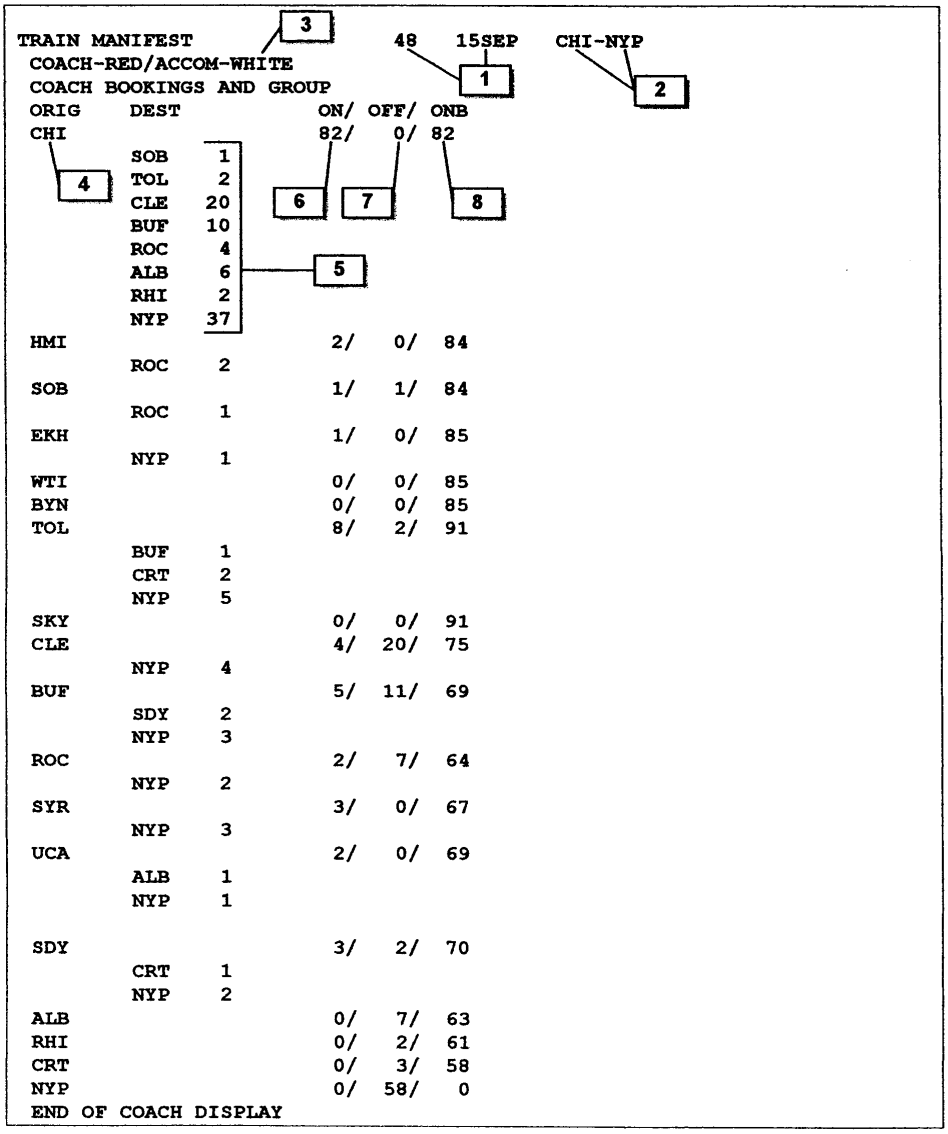
Acronyms

AFC	Automatic Fare Collection
CCJPA	Capitol Corridor Joint Powers Authority
CFR	Code of Federal Regulations
CNOC	Consolidated National Operations Center
CRS	Computerized Reservation System
FRA	Federal Railroad Administration
GPS	Global Positioning System
HHD	Handheld Device
JR	Japan Railway
LAN	Local Area Network
LCV	Long Combination Vehicle
MARC	Maryland Rail Commuter
MCFRS	Montgomery County Fire and Rescue Services
MCPD	Montgomery County Police Department
NEC	Northeast Corridor
NICTD	Northern Indiana Commuter Transportation
NTSB	National Transportation Safety Board
OBC	Onboard Computer
PCR	Pre-hospital Care Report
POP	Proof of Payment
RFI	Request for Information
RFP	Request for Proposal
ROW	Right-of-Way
SIC	Station Information Computer
SNCF	French National Railways
TGV	Train à Grande Vitesse
TSA	Transportation Safety Administration
TVM	Ticket Vending Machine
VRE	Virginia Railway Express
WIFI	Wireless Fidelity

Appendix A. Amtrak Manifest Samples[1]

Coach Car

Illustration Shown below is a typical coach manifest that displays the passenger count for an Amtrak train:




```
TRAIN MANIFEST                    48   15SEP   CHI-NYP
 COACH-RED/ACCOM-WHITE
 COACH BOOKINGS AND GROUP
 ORIG     DEST              ON/ OFF/ ONB
 CHI                        82/   0/ 82
          SOB    1
          TOL    2
          CLE   20
          BUF   10
          ROC    4
          ALB    6
          RHI    2
          NYP   37
 HMI                         2/   0/  84
          ROC    2
 SOB                         1/   1/  84
          ROC    1
 EKH                         1/   0/  85
          NYP    1
 WTI                         0/   0/  85
 BYN                         0/   0/  85
 TOL                         8/   2/  91
          BUF    1
          CRT    2
          NYP    5
 SKY                         0/   0/  91
 CLE                         4/  20/  75
          NYP    4
 BUF                         5/  11/  69
          SDY    2
          NYP    3
 ROC                         2/   7/  64
          NYP    2
 SYR                         3/   0/  67
          NYP    3
 UCA                         2/   0/  69
          ALB    1
          NYP    1

 SDY                         3/   2/  70
          CRT    1
          NYP    2
 ALB                         0/   7/  63
 RHI                         0/   2/  61
 CRT                         0/   3/  58
 NYP                         0/  58/   0
 END OF COACH DISPLAY
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[1] Amtrak, *How to Read a Train Manifest*, revised March 2004.

Coach Car (Continued)

Description The table below describes the various parts of a coach manifest:

PART	*DESCRIPTION*
1	Train number and date of departure
2	Train origin and destination
3	Amtrak employee pass discount information: **BLUE** - accommodations designated as ***BLUE*** allow Amtrak employees to travel *free*. **RED & WHITE** - accommodations designated as ***RED*** or ***WHITE*** require that employees pay 80% of the lowest fare.
4	Station stop
5	Destination stations for those passengers boarding at station in Part 4
6	**"ON"** = Number of passengers boarding the train
7	**"OFF"** = Number of passengers getting off the train
8	**"ONB"** = Total number of passengers aboard the train

Coach Reservations The coach manifest does not indicate the names of passengers nor does it assign passengers a specific seat. Passengers are usually directed to occupy cars according to their destination. Generally, passengers who are traveling long-distance are seated in cars closest to the food service cars and those traveling shorter distances are seated farthest away. Usually the conductor will inform the on-board services employees of the boarding plan so they can help the passengers find the proper cars.

Sleeping Car

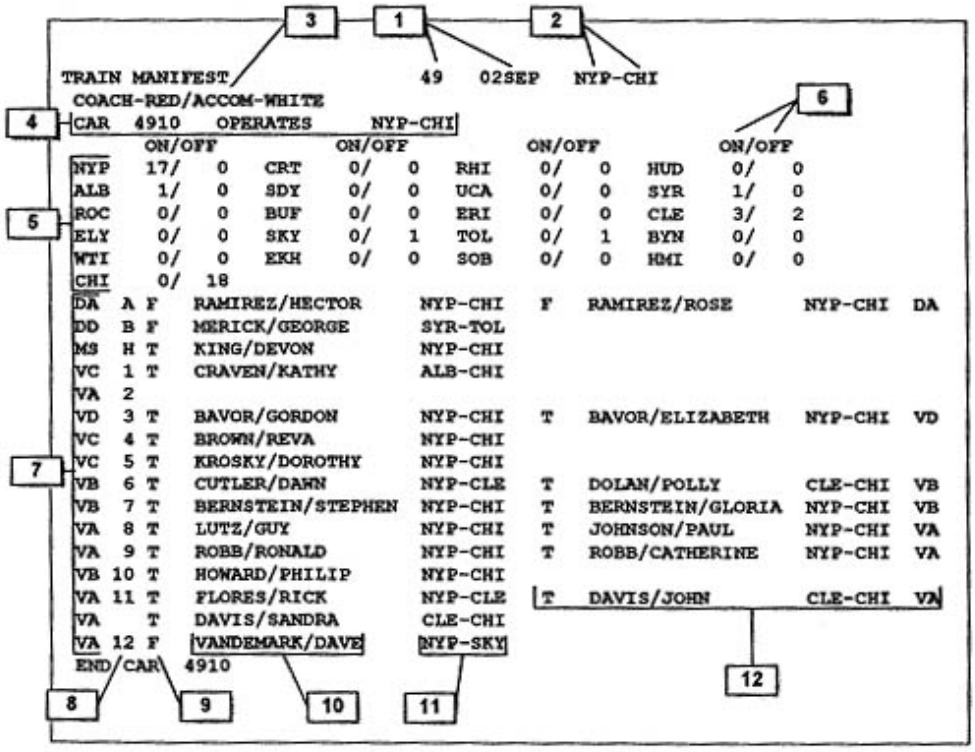
Introduction Amtrak has two types of sleeping cars for revenue passengers:

- Superliner
- Viewliner

Superliner sleepers are bi-level cars that are primarily found on Western trains and on some Eastern routes with ample clearances.

Viewliner sleepers are single level sleepers that can be found in the Eastern area of the country.

Example Shown below is a typical Viewliner manifest.



Sleeping Car (Continued)

Description The table below describes the various parts of sleeping car manifest:

<table>
<tr><th>PART</th><th>DESCRIPTION</th></tr>
<tr><td>1</td><td>Train number and date of departure</td></tr>
<tr><td>2</td><td>Train origin and destination</td></tr>
<tr><td>3</td><td>Amtrak employee pass discount information:
BLUE - accommodations designated as BLUE allow Amtrak employees to travel free.
RED & WHITE - accommodations designated as RED or WHITE require that employees pay 80% of the lowest fare.</td></tr>
<tr><td>4</td><td>Car line number and origin & destination</td></tr>
<tr><td>5</td><td>Station stops (read from left to right)</td></tr>
<tr><td>6</td><td>"ON/OFF" = number of passengers boarding and detraining the car at a particular station stop</td></tr>
<tr><td>7</td><td>Accommodation Codes
<table>
<tr><th>Base Code</th><th>Description</th><th>Discount Codes</th></tr>
<tr><td>DS</td><td>Deluxe Bedroom</td><td>DA,DB,DC,DD</td></tr>
<tr><td>MS</td><td>Viewliner Accessible Bedroom</td><td>MA,MB,MC,MD</td></tr>
<tr><td>VS</td><td>Viewliner Standard Bedroom</td><td>VA,VB,VC,VD</td></tr>
<tr><td>ES</td><td>Superliner Standard Bedroom</td><td>EA,EB,EC,ED</td></tr>
<tr><td>FS</td><td>Family Bedroom (Superliner only)</td><td>FA,FB,FC,FD</td></tr>
<tr><td>HS</td><td>Superliner Accessible Bedroom</td><td>HA,HB,HC,HD</td></tr>
</table></td></tr>
<tr><td>8</td><td>Room letter or number</td></tr>
<tr><td>9</td><td>Ticket Status
T Ticketed
F Confirmed (ticketed by a travel agency or otherwise protected from cancellation)
Blank Un-ticketed</td></tr>
<tr><td>10</td><td>Passenger's Name</td></tr>
<tr><td>11</td><td>Passenger's Origin and destination</td></tr>
<tr><td>12</td><td>Additional Passenger(s) sharing room with 1st passenger or passenger occupying room at down line station</td></tr>
</table>

First Class (Continued)

Description The table below describes the various parts of a First Class car manifest:

PART	DESCRIPTION		
1	Train number and date departure		
2	Origin and destination		
3	Station stop		
4	**"ON / OFF / ONB"** = Number of passengers boarding, detraining and on board the car at each station stop.		
5	Destination stations for those passengers boarding at station in Part 3.		
6	Ticket Status	***T***	Ticketed
		F	Confirmed (ticketed by a travel agency or otherwise protected from cancellation)
		Blank	Un-ticketed
7	Name of passenger		
8	Destination station		

First Class (Continued)

Description The table below describes the various parts of a First Class car manifest:

PART	DESCRIPTION		
1	Train number and date departure		
2	Origin and destination		
3	Station stop		
4	**"ON / OFF / ONB"** = Number of passengers boarding, detraining and on board the car at each station stop.		
5	Destination stations for those passengers boarding at station in Part 3.		
6	Ticket Status	***T***	Ticketed
		F	Confirmed (ticketed by a travel agency or otherwise protected from cancellation)
		Blank	Un-ticketed
7	Name of passenger		
8	Destination station		

Un-ticketed Passenger Display

Introduction The un-ticketed passenger display section of the train manifest shows a list of passengers that have reservations for travel on the train, but have not obtained a ticket. This information is most useful when passengers are boarding from "un-staffed" stations. In addition, this information is helpful for the sale of sleeping accommodations on board the train.

Example Shown below is a typical un-ticketed passenger display with the explanations on the following page:

UNTICKETED PASSENGERS DISPLAY

NYP	NAME	PNR#	CAR#	RBD	RM/SEAT	PHONE NUMBER	IND	BRD	OFF	SEG
	ALMAN/DANIEL	01F4B7		YA		N/A	A	NYP	CHI	1
*	ANDERSON/ADRIANNE	062865		YA		N/A	A	NYP	CHI	1
*	BAKER/MICHAEL MR	0AEFC1		YA		N/A	A	NYP	UCA	1
*	CARMEN/LUCY	0A5932	4911	VS	7	N/A		NYP	CHI	1
	CARMEN/MICHAEL	0A5932	4911	VS	7	N/A		NYP	CHI	1
*	CERVANTES/HILDA	0AF000		Y		N/A		NYP	CHI	1
*	COLON/VICKIE	0B6EDC		Y		N/A		NYP	CHI	1
*	DAVIS/SHARON	01F4B7		YA		N/A	A	NYP	CHI	1
	EDMONDS/SANDY	126E10		YB		N/A	F	NYP	TOL	11
*	FRANQUI/MARIA MS	06C67B		YA		N/A	A	NYP	UCA	1
*	GAGLIARDO/PASQUALE	0B1AD7		Y		N/A		NYP	CHI	1
	GARDNER/SHIRLEY	126E10		YB		N/A	F	NYP	TOL	11

1 2 3 4 5 6 7

Un-ticketed Passenger Display (Continued)

Description The table below explains the various parts of the un-ticketed passenger display on the opposite page:

Part	Description		
1	Station passenger is boarding		
2	Passenger name		
3	Reservation number		
4	Accommodation: car number (if sleeper) accommodation code, room number		
5	Phone number: EX: N/A = not available		
6	**Ticket Status**	***A***	Advance Payment
		F	Confirmed (ticketed by a travel agency or otherwise protected from cancellation)
		Blank	Un-ticketed
7	Train origin, destination and segment number from reservation.		

Appendix B. Passenger On-Board Record Procedures from Amtrak *Service Standards Manual for Train Service and On-Board Service Employees*[2]

D. Passenger On-Board Record Procedures

This section covers the procedures that must be followed on long-distance, overnight, reserved trains to ensure that the Conductor's Ticket Collections Pouch provides an accurate list of everyone on board who may not be ticketed or appear on the manifest.

The National Transportation Safety Board (NTSB) has further recommended that designated reserved overnight trains have a passenger manifest that is maintained and updated at all staffed, enroute boarding points.

This standard outlines procedures for these trains. The Conductor's Ticket Collections Pouch will provide an accurate list of all individuals on board who may not be ticketed or who may not appear on the manifest. To comply with the NTSB recommendation, the following is effective immediately:

1. **Requirements and Responsibilities**
    a. All Conductor(s) and Assistant Conductor(s) working designated trains must pick up an updated manifest/Passenger Name List before reporting to their train.
    b. While the Conductor is responsible for the Train Collections Pouch, they will also brief other crewmembers on the location of the pouch.
    c. The Train Collection Pouch must be kept in a place that provides protection from heat, water, or impact damage in the event of a train emergency.
    d. In addition the Conductor will ensure Assistant Conductor(s) keep an ample supply of Form NRPC 3085 *Passenger On-Board Record* with them while on duty.
    e. Conductor(s) and Assistant Conductor(s) must also provide all open, staffed, stations with the yellow copy of any NRPC 3085 information completed and received from unticketed passengers and/or crewmembers while on route. This does not apply to large intermediate stations where station personnel are physically located a significant distance from the train platform, and when such delivery would cause delay to the train. In such cases, the yellow copy of the Form NRPC 3085 should be given to the designated station personnel at the final terminal or crew change point for entry into Arrow. At crew change points where no station personnel exist or are on duty, the Conductor must call the information in to CNOC so that the manifest information may be updated.
    f. This information is to be given to station personnel for entry into the ARROW system. Providing this information allows Conductor(s) to receive an updated Passenger Name List at the next open, staffed, station.

[2] Amtrak, *Service Standards Manual for Train Service & On-Board Service Employees*, Chapter 16 Train Service Crew Functions & Accountabilities, Part D Passenger On-Board Record Procedures, May 3, 2004.

g. Conductor(s) can pull the passenger name list information from any ARROW terminal by entering SOL*N followed by the train number (e.g., SOL*N92).

2. When to Use the Form

a. The following are examples of persons who may not be ticketed or listed on the Passenger Name List manifest:
   - Infants and small children
   - Passengers purchasing tickets on board
   - Railroad officials
   - Government officials
   - Medical personnel
   - Vendors and/or contractors
   - Host railroad employees

b. All Amtrak employees whether on business, deadheading (to or from work) or personal travel should have a printed ticket or must complete Form NRPC 3085. For those employees boarding at stations that are closed, the Conductor(s) or Assistant Conductor(s) must complete a Form NRPC 3085.

c. All Amtrak employees and pass riders must provide valid Amtrak photo identification.

d. In the case of an unticketed small child and/or infant, an individual Form NRPC 3085 is also to be completed.

e. All private car owners are required to have a Form NRPC 3085 completed for persons traveling providing valid photo identification.

f. Conductor(s) and Assistant Conductor(s) must complete Form NRPC 3085 for any passenger or employee who has no associated transportation to lift or does not appear on the Passenger Name List, including passengers purchasing their tickets on board the train and passengers traveling in a group whose name does not appear on the manifest/Passenger Name List.

g. A Form 3085 *Passenger On-Board Record* must be completed for each individual providing commentary on board the train. Those currently authorized include the National Park Service (through Trails and Rails), California State Railroad Museum, Train Host Association, and Native American Guides. All guides must present a valid form of photo identification, valid identification for the organization they are representing, and give a signed Form 3085 to either the Conductor or Assistant Conductor at the time of boarding. If the onboard guide does not have a Form NRPC 3085, the Conductor or Assistant must provide one and ensure that it is properly filled out and signed. The Conductor is responsible for placing the completed NRPC 3085(s) into the NRPC 158 *Train Collections Pouch* to provide a record of the individual's presence on the train. The Conductor must also present the yellow copy of the Form NRPC 3085 to the agent at the next staffed station so that the manifest may be updated in Arrow in compliance with Items1.e and 1.f in this section.

3. Documenting the Travel Using the Passenger On-Board Record

a. A specimen of Form NRPC 3085 is reproduced below. Supplies of these forms are available at all crew base locations.

b. These are one-part, unnumbered forms, bound in booklets of twenty-five (25). Conductor(s) and Assistant Conductor(s) must ensure that all of the required information is provided on the forms, and must punch the form upon completion in the lower right hand corner to certify the record.

Specimen Form NRPC 3085

AMTRAK

On-Board Passenger Record

Conductor must place this completed form in train pouch for each passenger who is not listed on the manifest, group or crew list or does not have transportation lifted between city pairs shown.

Passenger Name:	**From:**	**To:**
Emergency Contact (optional):	**Date Boarded:**	
Reservation Number (PNR):	**Train:**	

Passenger Category:

❑ Customer ❑ Other Railroad ❑ Government Agent/Law Enforcement
❑ Media Person ❑ Travel Agent ❑ Guide/Entertainer/Vendor
❑ Employee ❑ Other _____

Status:
❑ Adult
❑ Child
❑ Infant

Accommodation Type:

❑ Coach # _____ ❑ Sleeper # _____, Room # _____
❑ Private Car ❑ Crew Car, Room # _____
❑ Other (describe): _____

Special Needs:
❑ Mobility Impaired
❑ Vision Impaired
❑ Hearing Impaired

Conductor's Punch:

White Copy – Pouch **Yellow Copy** – Station

NRPC 3085 (10/02) Amtrak is a registered service mark of the National Railroad Passenger Corporation.

c. The following is a list of Amtrak trains for which these procedures apply:

Train Number	Train Name
1&2	Sunset Limited
3&4	Southwest Chief
5&6	California Zephyr
7&8/27&28	Empire Builder
11&14	Coast Starlight
19&20	Crescent
21&22	Texas Eagle
29&30	Capitol Limited
40&41	Three Rivers
48&49/448&449	Lake Shore Limited
50&51	Cardinal
52&53	Auto Train
58&59	City of New Orleans
66&67	Federal
89&90	Palmetto
91&92	Silver Star
97&98	Silver Meteor
All	Acela Express
68&69/70&71	Empire Service

Appendix C. Passenger Accountability Forms

AMTRAK®

On-Board Passenger Record

Conductor must place this completed form in train pouch for each passenger who is not listed on the manifest, group or crew list or does not have transportation lifted between city pairs shown.

Passenger Name:	**From:**	**To:**
Emergency Contact (optional):	**Date Boarded:**	
Reservation Number (PNR):	**Train:**	

Passenger Category:
- ☐ Customer ☐ Other Railroad ☐ Government Agent/Law Enforcement
- ☐ Media Person ☐ Travel Agent ☐ Guide/Entertainer/Vendor
- ☐ Employee ☐ Other ____________

Status:
- ☐ Adult
- ☐ Child
- ☐ Infant

Accommodation Type:
- ☐ Coach # ______ ☐ Sleeper # ______, Room # ______
- ☐ Private Car ☐ Crew Car, Room # ______
- ☐ Other (describe): ____________

Special Needs:
- ☐ Mobility Impaired
- ☐ Vision Impaired
- ☐ Hearing Impaired

Conductor's Punch:

White Copy – Pouch **Yellow Copy** – Station

NRPC 3085 (10/02) Amtrak is a registered service mark of the National Railroad Passenger Corporation.

Figure 1. Form 3085

Amtrak

RECORD OF TICKETS HONORED BUT NOT LIFTED

AMTRAK TRAIN NO. ______________ DATE ______________

NUMBER OF PASSENGERS	CLASS OF TRAVEL (MARK ONE)			HONORED ON TRAIN		REMARKS
	Coach	Parlor	Sleeper	FROM STATION	TO STATION	

Signature of Trainman

____

NRPC 157 (1/86)

NOTE LIST ONLY TICKETS WHICH WILL NOT BE INCLUDED IN THE TRAIN COLLECTIONS FOR THE ENTIRE RUN OF THE TRAIN. INCLUDE THIS RECORD IN THE TRAIN COLLECTIONS POUCH.

Figure 2. Record of Tickets Honored but Not Lifted

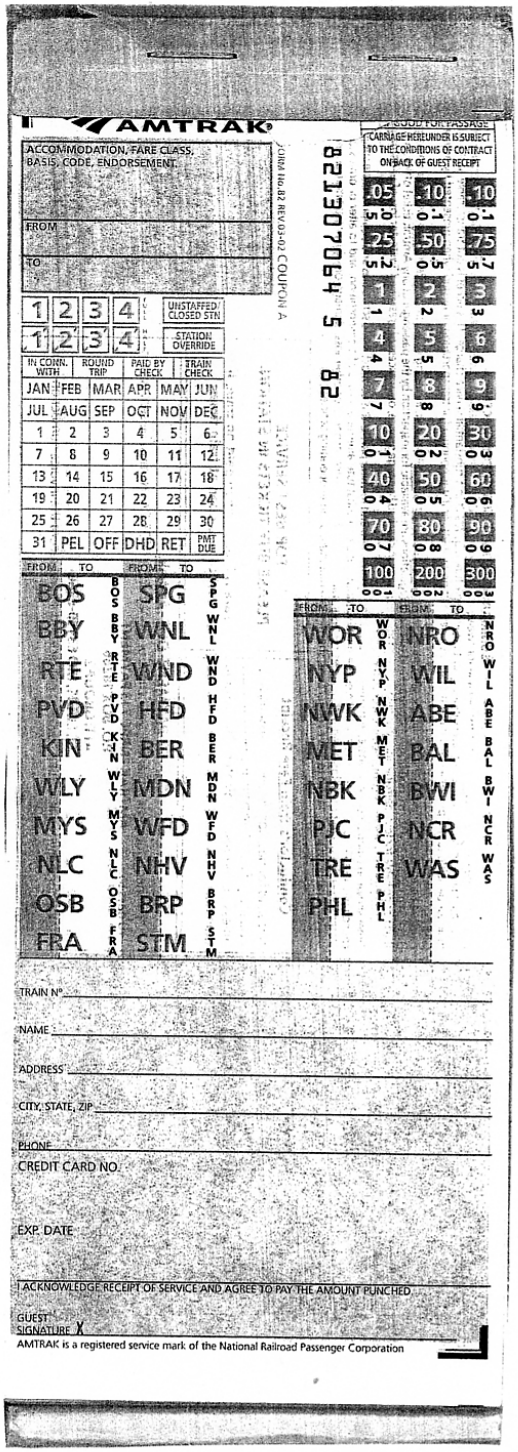
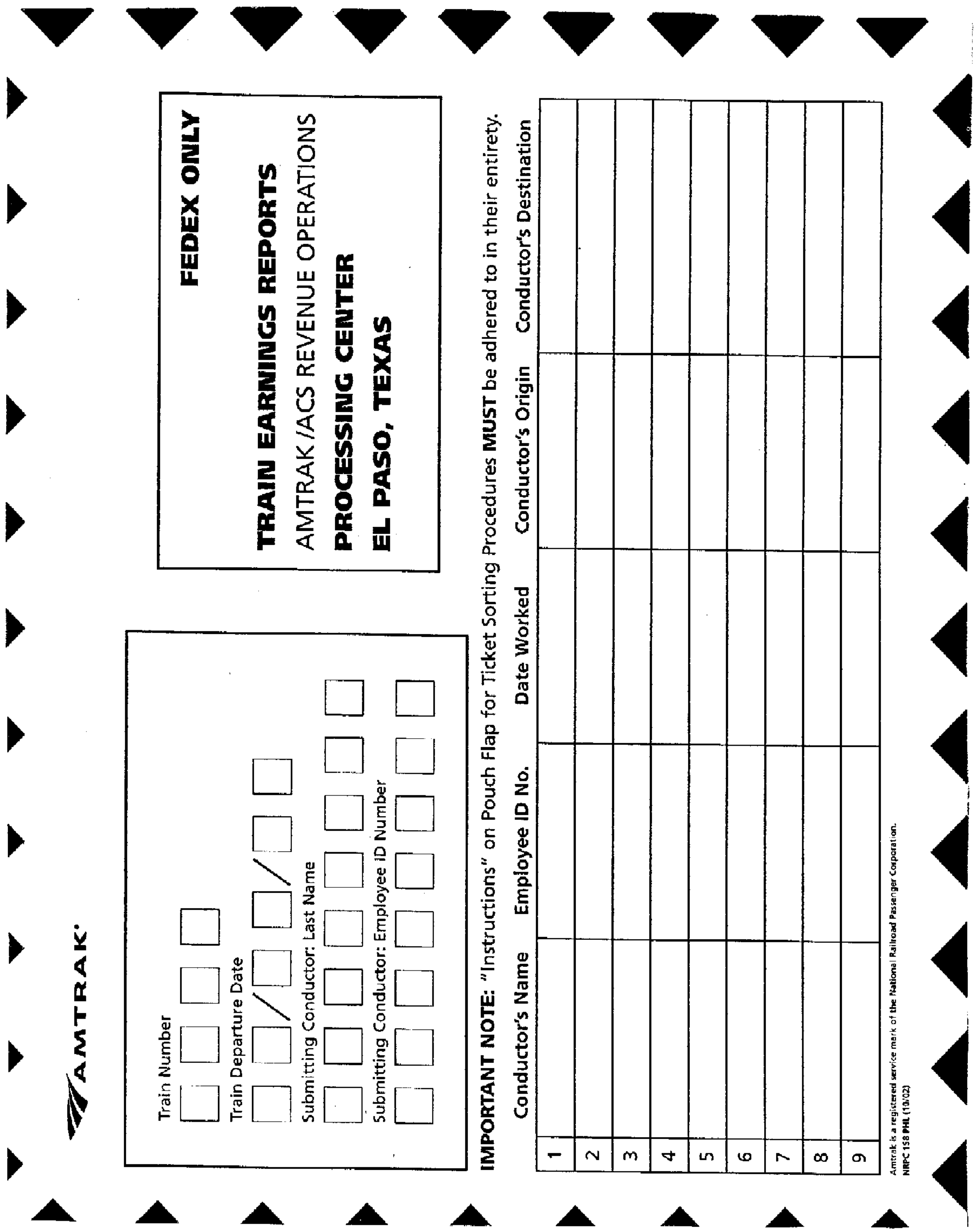


Figure 3. Onboard Ticket Sale Receipt



AMTRAK

Train Number

Train Departure Date

Submitting Conductor: Last Name

Submitting Conductor: Employee ID Number

FEDEX ONLY

TRAIN EARNINGS REPORTS
AMTRAK/ACS REVENUE OPERATIONS
PROCESSING CENTER
EL PASO, TEXAS

IMPORTANT NOTE: "Instructions" on Pouch Flap for Ticket Sorting Procedures **MUST** be adhered to in their entirety.

	Conductor's Name	Employee ID No.	Date Worked	Conductor's Origin	Conductor's Destination
1					
2					
3					
4					
5					
6					
7					
8					
9					

Amtrak is a registered service mark of the National Railroad Passenger Corporation.
NRPC 158 PHL (10/02)

Figure 4. Face of Ticket Pouch Envelope

INSTRUCTIONS

1. This train collections pouch MUST include adequate evidence for each passenger carried.

2. **Tickets MUST be bundled in two (2) categories within the pouch as follows:**

    1. Arrow tickets and ATB Travel Agency (Card Stock) mixed together. Tickets must face in same direction, right side up. **DO NOT** separate coach and first class. Remove all staples from tickets.

    2. All other tickets and documents, including passage coupons from onboard sales, book-type tickets, carry orders, and other revenue related documents.

3. The first Conductor will be responsible for identifying the Amtrak train collections pouch by recording in ink: the train number and scheduled departure date.

4. The first and each succeeding conductor will record his signature, employee ID number, his scheduled departure date, and his origin and destination.

5. At the completion of the train run, the last conductor MUST check to see that all information on the face of the pouch is complete and accurate, see that all required documents are in the pouch, and close pouch. The last conductor must also record his/her last name and employee ID number in designated blocks for "Submitting" Conductor of pouch.

6. Before leaving railroad property, this completed pouch MUST be placed in the designated depository.

7. A separate pouch must be utilized for each train.

8. SEE CONDUCTOR / ASSISTANT CONDUCTOR PROCEDURES FOR DETAILED INSTRUCTIONS.

Figure 5. Ticket Pouch Instruction Flap

Appendix D. Summary of NTSB Accident Reports and Briefs Related to Amtrak Accidents, 1993 to 2003

Collision of Amtrak Train No. 90 and MARC Train No. 437, Baltimore, Maryland, June 17, 2002, NTSB Report Number RAB-03-01, adopted on 5/12/2003.

Synopsis: At approximately 5:42 p.m., Eastern Standard Time, on June 17, 2002, northbound Amtrak train No. 90, *The Palmetto*, collided with southbound MARC train No. 437 in Baltimore, Maryland. Amtrak train No. 90 consisted of 2 locomotives and 11 cars (2 mail handlers, 4 coaches, 1 dinette car, 1 baggage car, and 3 RoadRailers). The train had 141 passengers and 6 crewmembers on board. MARC train No. 437 consisted of 1 locomotive and 7 cars. The train had 60 passengers and 4 crewmembers on board. The collision resulted in six minor injuries. The accident resulted in minor injuries to three MARC passengers, one MARC conductor, one Amtrak passenger, and one Amtrak conductor. All injured were treated and released.

Type of Accident: Collision between on track equipment.

Accident Result: Lead truck of Amtrak locomotive derailed, two MARC cars derailed but remained upright.

Type of Train: The Palmetto is a reserved train.

Type of Equipment: Did not have sleeper cars.

Time of day: 5:42 p.m.–daylight.

Crew Training: Not discussed in the NTSB report.

Crew Incapacitated: One Amtrak conductor received minor injuries.

Bystanders Involved: Not discussed in the NTSB report.

Timeliness of Emergency Response: Not discussed in the NTSB report.

Training of Emergency Responders: Not discussed in the NTSB report.

Number of Passengers and Crew: 141 passengers and 6 crewmembers.

Passenger and Crew Injuries: 1 Amtrak passenger and 1 crewmember received minor injuries.

Cause of Death: Not applicable.

Manifest Identified as Issue by NTSB: No.

Other Issues Identified by NTSB: Engineer's lack of familiarity with the equipment and lack of a positive train control system.

Likely Impact of Having a Manifest: None. In accidents in which cars have remained upright and in which minimal structural damage to the cars and no passenger ejection has occurred, little danger exists to first responders in searching the cars for all passengers, and little likelihood exists that passengers would be missed in a search of the cars. In this case, the first responders would be reasonably sure that they had not missed any passengers in their search efforts; while an accurate manifest would be nice to have, it would not be essential to their efforts.

Derailment of Amtrak Auto Train on the CSXT Railroad near Crescent City, Florida, April 18, 2002, NTSB Report Number RAR-03-02, adopted on 8/5/2003.

Synopsis: At approximately 5:08 p.m., Eastern Standard Time, on April 18, 2002, northbound National Railroad Passenger Corporation (Amtrak) train P052-18,2, the Auto Train, derailed 21 of 40 cars on CSX Transportation (CSXT) track near Crescent City, Florida. The train was carrying 413 passengers and 33 Amtrak employees. Of the 33 Amtrak employees on the train, 24 were service personnel, 5 were service managers, and 4 were train-operating crewmembers. The derailment resulted in 4 fatalities, 36 serious injuries, and 106 minor injuries.

Type of Accident: Derailment.

Accident Result: Of the 21 derailed cars, 8 ended up lying on their sides with the other derailed cars remaining in either an upright or leaning position.

Type of Train: The Auto Train is a reserved train.

Type of Equipment: Did have sleeper cars.

Time of day: 5:08 p.m.–dusk.

Crew Training: With one exception, all crewmembers had received Amtrak's Personnel Emergency Preparedness Training. Whether or not passengers had been briefed on emergency procedures upon departure is unknown.

Crew Incapacitated: Amtrak employees on board sustained one serious and one minor injury.

Bystanders Involved: Bystanders were not involved in evacuation or rescue efforts.

Timeliness of Emergency Response: Emergency responders were notified immediately following the accident. However, they were not told the number of people on the train. The first police unit arrived within 6 minutes, the first fire unit within 9 minutes, and the first paramedics within 14 minutes. On scene incident command was established within 11 minutes, and triage and staging areas were established.

Training of Emergency Responders: On September 19, 1997, an Amtrak emergency preparedness manager provided Passenger Train Emergency Response training to 63 members of various emergency response agencies in Putnam County. Personnel who received the Amtrak training and responded to the Crescent City derailment included the chief of the Crescent City Fire Department, who was the initial incident commander; the training coordinator for Putnam County Emergency Services, who was the final incident commander; and the Putnam County Sheriff's Office communications captain. Amtrak subsequently provided similar training to emergency responders from the surrounding counties.

Some emergency responders were already somewhat familiar with Amtrak equipment, because of a prior Amtrak accident in the area (December 17, 1991).

Number of Passengers and Crew: 413 passengers and 33 crewmembers (24 service personnel, 5 service managers, and 4 train-operating crewmembers).

Passenger and Crew Injuries: 4 passenger fatalities, 35 serious passenger injuries, 104 minor passenger injuries, 1 serious injury to an employee on board, and 1 minor injury to an employee on board.

Cause of Death: The four passengers were partially ejected through the car windows and crushed between the car body and track ballast.

Manifest Identified as Issue by NTSB: Yes.

Other Issues Identified by NTSB: Track maintenance procedures and railcar crashworthiness.

Likely Impact of Having a Manifest: None. The four fatally injured passengers were dead when found by emergency responders. No indication exists that emergency responders spent undue amounts of time searching for passengers or that emergency responders were in danger in searching the wreckage. Two hours after the accident, the incident commander reported that all passengers had been evacuated except for one entrapped fatality, even though he could not reconcile the greeter list and the passenger list, which indicated the location of passengers by car and room.

Railroad Accident Brief: Derailment of Amtrak Train No. 5-17 on Burlington Northern and Santa Fe Railway Track near Nodaway, Iowa, March 17, 2001, NTSB Report Number RAB-02-01, adopted on 3/5/2002.

Synopsis: On March 17, 2001, at approximately 11:40 p.m., Central Standard Time, westbound Amtrak train No. 5-17, the *California Zephyr*, derailed near Nodaway, Iowa. Amtrak train No. 5-17 consisted of 2 locomotive units and 16 cars. All but the last five cars derailed. No fire or hazardous materials were involved in the accident. The train crew consisted of 1 engineer and 2 conductors with 13 onboard service (OBS) personnel. In addition, 241 passengers were on the train. As a result of the derailment, 78 people were injured, including 1 fatal injury.

Type of Accident: Derailment.

Accident Result: No indication as to whether derailed cars remained upright.

Type of Train: The California Zephyr is a reserved train.

Type of Equipment: Not discussed in the NTSB report.

Time of day: 11:40 p.m.–darkness.

Crew Training: Not discussed in the NTSB report.

Crew Incapacitated: Not discussed in the NTSB report.

Bystanders Involved: Not discussed in the NTSB report.

Timeliness of Emergency Response: Not discussed in the NTSB report.

Training of Emergency Responders: Not discussed in the NTSB report.

Number of Passengers and Crew: 241 passengers and 16 crewmembers (13 service personnel and 3 train-operating crewmembers).

Passenger and Crew Injuries: 78 people were injured, including 1 fatal injury.

Cause of Death: Not discussed in the NTSB report.

Manifest Identified as Issue by NTSB: No.

Other Issues Identified by NTSB: Track maintenance procedures.

Likely Impact of Having a Manifest: Unknown. Accident circumstances not discussed in sufficient detail in the NTSB report.

Railroad Accident Report: Rear-End Collision of National Railroad Passenger Corporation Train P286 with CSXT Freight Train Q620 on the CSX Railroad at Syracuse, New York, February 5, 2001, NTSB Report Number RAR-01-04, adopted on 11/27/2001.

Synopsis: At approximately 11:40 a.m., Eastern Standard Time, on February 5, 2001, eastbound Amtrak train 286 with 100 passengers and 4 crewmembers struck the rear of eastbound CSXT freight train Q620 on the CSXT Railroad near Syracuse, New York. On impact, the lead Amtrak locomotive unit and four of the train's five cars derailed. The rear truck of the last car of the 92-car CSXT freight train derailed, and the car lost a portion of its load of lumber. At the time of impact, the passenger train was traveling 35 mph; the freight train was traveling 7 mph. The accident resulted in injuries to all 4 crewmembers and 58 of the passengers aboard the Amtrak train. No CSXT crewmember was injured. A small amount of diesel fuel spilled from the fuel tank on the lead Amtrak locomotive unit, but no fire resulted.

Type of Accident: Collision between on track equipment.

Accident Result: All cars remained upright.

Type of Train: Train 286 was an Empire Service train and operated as a reserved train between Niagara Falls and Albany.

Type of Equipment: Did not have sleeper cars.

Time of day: 11:40 a.m.–daylight

Crew Training: Not discussed in the NTSB report.

Crew Incapacitated: All crewmembers received minor injuries.

Bystanders Involved: Bystanders were not involved in evacuation or rescue efforts.

Timeliness of Emergency Response: Both train crews immediately notified the CSXT dispatcher after the collision, who immediately notified emergency responders that a train accident had occurred involving multiple injuries but no fire. However, they were not told the number of people on the train. The first fire units arrived within 15 minutes and set up an incident command post. The first medical units arrived within 32 minutes and established a triage area. Patients were evaluated, treated, and transported to local hospitals. The first patient left the scene 1 hour and 24 minutes after the accident, while the last of 44 people transported to a hospital left the scene 2 hours and 4 minutes after the accident.

Training of Emergency Responders: No previous training had been done with regard to passenger trains with or without Amtrak or CSXT. Amtrak does provide passenger train equipment and locomotives, along with an instructor, to the New York State Association of Fire Chief's annual conference, which is held in Syracuse. However, in May 2000, Onondaga County conducted a mass casualty exercise that simulated an airplane crash involving 43 casualties plus 18 fatalities.

Number of Passengers and Crew: 100 passengers and 4 crewmembers (1 service personnel and 3 train-operating crewmembers).

Passenger and Crew Injuries: 4 serious passenger injuries, 54 minor passenger injuries, 3 minor operating employee injuries, and 1 minor injury to an employee on board.

Cause of Death: Not applicable.

Manifest Identified as Issue by NTSB: No.

Other Issues Identified by NTSB: The need to include rail mileposts on emergency responders' maps, and the lack of a positive train control system

Likely Impact of Having a Manifest: None. In accidents in which cars have remained upright and in which minimal structural damage to the cars and no passenger ejection has occurred, little danger exists to first responders in searching the cars for all passengers, and little likelihood exists that passengers would be missed in a search of the cars. In this case, the first responders would be reasonably sure that they had not missed any passengers in their search efforts; while an accurate manifest would be nice to have, it would not be essential to their efforts.

Highway Accident Report: Report of Grade Crossing Accident Regarding a Collision between an Amtrak Train and a Tractor-Trailer Combination Vehicle Intercession City, Florida, November 17, 2000, NTSB Report Number HAR-02-02, adopted on 7/23/2002.

Synopsis: On November 17, 2000, at approximately 4:35 p.m., Eastern Standard Time, near Intercession City, Florida, a 23-axle, heavy-haul vehicle was delivering an 82-ton condenser to the Kissimmee Utility Authority (KUA) Cane Island Power Plant. The private access road to the electricity generating facility crossed over a single railroad track owned by CSXT. As the vehicle, traveling between 1 and 3 mph, crossed the tracks, the crossing warning devices activated, and the gates came down on the load. Seconds later, Amtrak train 97, operated by the National Railroad Passenger Corporation, collided with the right side of the rear towed four-axle tractor. Amtrak train 97 was traveling approximately 57 mph at the time of the collision. Two train crewmembers and three passengers were taken to area hospitals for observation; no injuries occurred. The Amtrak train was bound from New York City to Miami, Florida, with 83 passengers and 4 crewmembers on board.

Type of Accident: Highway-rail collision/impact.

Accident Result: The locomotive and all train cars remained upright.

Type of Train: Train 97, the Silver Meteor is a reserved train.

Type of Equipment: Did have sleeper cars.

Time of day: 4:35 p.m.–dusk

Crew Training: Not discussed in the NTSB report.

Crew Incapacitated: No.

Bystanders Involved: No.

Timeliness of Emergency Response: The engineer of the train initiated the standard emergency tone-9 radio procedure to contact the CSXT train dispatcher after the train came to a stop. The train dispatcher contacted the CSXT Police Communications Center, which contacted the local emergency services without delay. The first law enforcement officer arrived within 12 minutes, and 3 fire department vehicles and the first ambulance arrived within 15 minutes. The fire department dispatched three fire engines, seven ambulances, two hazardous materials specialty units, five staff/supervisors, and two service vehicles (one with portable light towers and one food service truck). Two emergency medical technicians boarded the locomotive and examined the engineer and assistant engineer. Emergency medical technicians also searched the train cars for injured passengers. One passenger fell as the train passengers were being evacuated and was transported to an area hospital.

Training of Emergency Responders: The Osceola County Fire Chief stated that his department had a railway plan that specifically addressed railway transportation accidents. He further indicated that the response plan was written in the early 1990s and had not been updated.

Number of Passengers and Crew: 83 passengers and 4 operating crewmembers.

Passenger and Crew Injuries: No reportable injuries to passengers or crew.

Cause of Death: Not applicable.

Manifest Identified as Issue by NTSB: No.

Other Issues Identified by NTSB: Improved procedures to ensure that railroads are notified that oversized, slow-moving vehicles will be crossing their tracks.

Likely Impact of Having a Manifest: None. In accidents in which cars have remained upright and in which minimal structural damage to the cars and no passenger ejection has occurred, little danger exists to first responders in searching the cars for all passengers, and little likelihood exists that passengers would be missed in a search of the cars. In this case, the first responders would be reasonably sure that they had not missed any passengers in their search efforts; while an accurate manifest would be nice to have, it would not be essential to their efforts.

Railroad Accident Report: Collision of Amtrak Train 304-26 with a Highway Vehicle at a Highway-Rail Grade Crossing in McLean, Illinois, on September 26, 1999, NTSB Report Number RAR-01-03.

Synopsis: On September 26, 1999, at approximately 5:08 p.m., northbound National Railroad Passenger Corporation (Amtrak) train 304-26, which was en route from St. Louis, Missouri, to Chicago, Illinois, collided with an automobile, which was westbound on U.S. Route 136. The collision occurred at the highway-rail grade crossing (DOT #290 964A) where the Union Pacific Railroad's (UP) St. Louis Division main line and U.S. Route 136 cross near McLean, Illinois. The automobile driver and passenger were killed as a result of the collision. Amtrak train 304-26 did not derail, and no injuries to the train crewmembers or passengers were reported.

Type of Accident: Highway-rail collision/impact.

Accident Result: The locomotive and all train cars remained upright on the rail.

Type of Train: Train 304, the Ann Rutledge is a reserved train.

Type of Equipment: Did not have sleeper cars.

Time of day: 5:08 p.m.–dusk.

Crew Training: Not discussed in the NTSB report.

Crew Incapacitated: No.

Bystanders Involved: No.

Timeliness of Emergency Response: When the train came to a stop, the Amtrak conductor, who was in the lead coach car with the assistant conductor, walked through the train advising and instructing the passengers. He then detrained through the rear coach car and observed the wreckage. He placed an emergency 911 call using a cellular telephone. According to the engineer and the conductor, emergency medical services personnel responded within minutes of the call. Additionally, a physician who was onboard the train at the time offered his services at the scene.

Training of Emergency Responders: Not discussed in the NTSB report.

Number of Passengers and Crew: Three operating crewmembers, the number of passengers was not indicated by NTSB.

Passenger and Crew Injuries: None reported.

Cause of Death: Not applicable.

Manifest Identified as Issue by NTSB: No.

Other Issues Identified by NTSB: Improper grade crossing signal maintenance procedures.

Likely Impact of Having a Manifest: None. In accidents in which cars have remained upright and in which minimal structural damage to the cars and no passenger ejection has occurred, little danger exists to first responders in searching the cars for all passengers, and little likelihood exists that passengers would be missed in a search of the cars. In this case, the first responders would be reasonably sure that they had not missed any passengers in their search efforts; while an accurate manifest would be nice to have, it would not be essential to their efforts.

Collision of National Railroad Passenger Corporation Train 59 with a Loaded Truck-Semitrailer Combination at a Highway-Rail Grade Crossing in Bourbonnais, Illinois, March 15, 1999, NTSB Report Number RAR-02-01, adopted on 2/5/2002.

Synopsis: At approximately 9:47 p.m. on March 15, 1999, National Railroad Passenger Corporation (Amtrak) train 59, with 207 passengers and 21 Amtrak or other railroad employees on board and operating on Illinois Central Railroad (IC) main line tracks, struck and destroyed the loaded trailer of a tractor-semitrailer combination that was traversing the McKnight Road grade crossing in Bourbonnais, Illinois. Both locomotives and 11 of the 14 cars in the Amtrak consist derailed. The derailed Amtrak cars struck 2 of 10 freight cars that were standing on an adjacent siding. The accident resulted in 11 deaths and 122 people being transported to local hospitals.

Type of Accident: Highway-rail collision/impact.

Accident Result: One of the cars rolled over onto its side. Another car, although upright, was bent around the back of a locomotive, and portions of the car were engulfed by fire from spilt fuel.

Type of Train: Train 59, the City of New Orleans is a reserved train.

Type of Equipment: Did have sleeper cars.

Time of day: 9:47 p.m.–darkness.

Crew Training: Not discussed in the NTSB report.

Crew Incapacitated: 5 crewmembers sustained serious injuries, 4 minor injuries, and 12 were uninjured.

Bystanders Involved: When the first Bourbonnais Fire Protection District personnel arrived at the accident scene, they saw that some 30 to 35 employees of Birmingham Steel had responded to the scene and had begun the rescue effort. These steel plant employees had cut a hole in the chain-link fence separating the wreckage site from the steel plant's property and brought a number of handheld fire extinguishers and ladders from the plant to combat the flames. While some of the steel plant employees applied the fire extinguishers to the flames, others entered some of the damaged passenger cars to extricate entrapped passengers. These efforts were continued for approximately 45 minutes, when Bourbonnais Fire Protection District personnel, who continued the extrication efforts, relieved the steel plant employees.

Timeliness of Emergency Response: The time of the accident was at approximately 9:47 p.m. The conductor stated that he was walking through the coach behind the diner when he heard the train's brakes apply and felt a bump. He believed that the train accelerated, and then the car rolled over on its side. The conductor stated that at this point, he helped a passenger remove a

window and climbed outside; once outside, he communicated by radio with the assistant conductor and the locomotive engineer. When the engineer said that he was trapped in the locomotive, the assistant conductor said he would go help the engineer. The conductor remained at the coach and helped passengers evacuate.

At 9:48 p.m., the Kankakee County Sheriff's Police 911 communications desk received the initial request for emergency assistance via telephone from the Birmingham Steel security office. Shortly thereafter, a second call came from the Birmingham Steel Company; this was followed by a number of additional calls from various sources. The first police units arrived on scene within 3 minutes and began helping to evacuate the passenger cars. Within a short time, more police units responded, and officers began evacuating passengers wherever they could. The Bourbonnais Police Department established an initial staging area on the unpaved roadway on the west side of the tracks, in the area adjacent to the wreckage pileup. The evacuated passengers and traincrew assembled in this area, where responding ambulances later arrived. The first ambulances arrived at the scene within 6 minutes and the first fire units within 12 minutes. A fire department field command post was established at the initial staging area.

In interviews with NTSB, emergency responders indicated that the immediate focus of the response was the extrication of the trapped and injured passengers and traincrew. Because the derailed train cars blocked McKnight Road at the grade crossing, three separate staging areas were established. Upon evacuation, displaced passengers and traincrew were taken to one of two triage areas initially established at the scene. Because the temperature that night was estimated to be in the low 20s, the incident commander became concerned about the threat of hypothermia, since most of the evacuees lacked warm clothing. A local retail store offered its facility as a temporary shelter; starting at approximately 10:28 p.m., responders used this facility as a shelter and a triage site for several persons who were later found to have sustained injuries.

Approximately 50 minutes after the accident, a medical trauma team consisting of physicians and medical equipment from local hospitals arrived at the scene. About this time, police officers were extricating passengers through the emergency exit windows of an overturned coach car (No. 34089) that lay on the eastern side of the pileup.

A Braidwood Fire Department officer, who arrived approximately 50 minutes after the first emergency responder, was familiar with petrochemical fires and recognized almost immediately that a large amount of foam was necessary to combat the blaze. Upon receiving concurrence from the incident commander, he called for heavy foam tanker trucks to come from a local chemical plant. The foam tanker arrived and was set up about 1 hour later. Within a few minutes of this equipment applying foam, the fire was extinguished. Before the Braidwood officer arrived, the incident commander had directed firefighting operations that had proved ineffective at either extinguishing the flames or at keeping the fire away from the sleeper car in which occupants were entrapped.

At approximately 12:05 a.m. on March 16, an emergency shelter established at a nearby school building began to receive the uninjured displaced passengers who were transferred from the temporary shelter established earlier at the retail store.

Training of Emergency Responders: Upon request, Amtrak provides an instructional information/training program for those local agencies most likely to respond to an Amtrak emergency. Without this training, local emergency responders may not know how to gain access to an overturned locomotive or passenger car, may not know where in cars to search for trapped occupants, and may not be aware of the quantities of diesel fuel available to fuel a fire. Before this accident, neither the Bourbonnais Fire Protection District nor other Kankakee County emergency responders had been provided onsite instruction or training in responding to such emergencies.

Number of Passengers and Crew: 207 passengers, 17 Amtrak crewmembers, and 4 off-duty Amtrak and IC railroad employees.

Passenger and Crew Injuries: 11 passenger fatalities, 34 serious passenger injuries, 55 minor passenger injuries, 5 serious crewmember injuries, and 4 minor crewmember injuries.

Cause of Death: Eleven train passengers, all of who were located in sleeper car 32035, which was bent around the back of the locomotive, sustained fatal injuries. The fatally injured occupants were in the portions of the car at the vertex of the car's bend, where the crush and intrusion were at a maximum. This portion of the car was also later consumed by fire. The coroner tentatively attributed 5 of the 11 deaths of the fatally injured occupants to the effects of the fire. The coroner was unable to determine whether any of these five might have succumbed to their traumatic injuries had they not been exposed to the fire. The other six fatalities apparently resulted from their traumatic injuries.

Manifest Identified as Issue by NTSB: Yes.

Other Issues Identified by NTSB: Because of insufficient training in responding to railroad emergencies or inadequate/inappropriate resources, or both, the emergency responders were not prepared to respond effectively to a passenger train accident involving a significant diesel fuel fire.

Likely Impact of Having a Manifest: None. In accidents involving fire, the need for immediate passenger evacuation supersedes the need for passenger accountability. This, combined with the fact that counting evacuated passengers takes hours, minimizes the value of having an accurate manifest readily available.

Six of the passengers apparently died as a result of the crash, before the outbreak of the fire. The other five passengers died as a result of the fire, which was not brought under control until nearly 2 hours after the accident. The establishment of three separate outdoor staging areas, followed by the establishment of a temporary indoor shelter and then a second emergency shelter, would have complicated the task of completing an accurate census of the injured and uninjured passengers in a timely fashion. At that point, knowing that 11 passengers were unaccounted for and in the burning sleeping car would have done little to ensure their survival.

Railroad Accident Report: Derailment of Amtrak Train 21 on the Union Pacific Railroad at Arlington, Texas, December 20, 1998, NTSB Report Number RAR-01-02, adopted on 7/24/2001.

Synopsis: At approximately 7:00 p.m., Central Standard Time, on December 20, 1998, National Railroad Passenger Corporation (Amtrak) train No. 21, the *Texas Eagle*, derailed on UP tracks in Arlington, Texas. The train was traveling westbound at a reduced speed of about 36 mph due to reports of rough track near milepost (MP) 231. Three locomotives and six cars derailed in a curve at MP 230.62. Of the 198 passengers and 18 employees on the train, 12 passengers and 10 employees were injured. No fatalities resulted from the accident.

Type of Accident: Derailment.

Accident Result: All 3 locomotives and 6 of the 10 cars derailed. The lead and second locomotives remained upright and aligned with the track. The third locomotive and the first four cars turned at different angles to the track and rolled onto their sides. The fifth and sixth cars derailed but remained upright and essentially aligned with the track.

Type of Train: Train 21, the Texas Eagle is a reserved train.

Type of Equipment: Did have sleeper cars.

Time of day: 7:00 p.m.–darkness.

Crew Training: Not discussed in the NTSB report.

Crew Incapacitated: 10 crewmembers sustained minor injuries.

Bystanders Involved: No.

Timeliness of Emergency Response: At 7:02 p.m. (2 minutes after the accident), an unknown caller told the Arlington emergency operator about the derailed train. Numerous additional calls followed to report the accident. The Arlington Fire Department responded with 13 engine companies (pumping trucks), 1 aerial platform truck, 3 truck companies, and 2 additional support/utility vehicles.

According to the Arlington Fire Department battalion chief, when the firefighters crossed the drainage ditch with rescued train occupants, they had to maneuver through passenger cars that were lying on their sides. None of the people on board the train had been trapped in the wreckage. Passengers in cars that were essentially upright were able to leave immediately and directly through open passageways and doors. In cars that were not upright, some passengers were unable to leave directly through open passageways (open doors or emergency windows) and were extricated by means of ladders, which firefighters put through opened emergency exit windows.

Training of Emergency Responders: Not discussed in the NTSB report.

Number of Passengers and Crew: 198 passengers, 6 operating crewmembers, and 12 OBS crewmembers.

Passenger and Crew Injuries: 12 passengers and 10 crewmembers sustained minor injuries; 8 crewmembers and 186 passengers sustained no injury.

The NTSB report notes:

> The number of documented medical transports by the municipal ambulance service differs from the total treated at medical facilities because several family members accompanying patients were later evaluated by hospital personnel, and several persons were transported to the hospital by private automobile, rather than being transported by the municipal ambulance service.

Cause of Death: Not applicable.

Manifest Identified as Issue by NTSB: No.

Other Issues Identified by NTSB: Inadequate procedures for responding to reports of track problems, oversight of track maintenance and communicating changes in track classification.

Likely Impact of Having a Manifest: None. In accidents in which cars have overturned and suffered structural damage, a possibility for passenger ejection and/or entrapment exists. In this case, passenger ejection/entrapment was not an issue. The potential safety benefits of having an accurate manifest in terms of improving passenger survivability are minimized by the fact that counting evacuated passengers takes hours under controlled circumstances. As indicated above in Passenger and Crew Injuries, some passengers apparently proceeded to hospitals on their own and were not accounted for by first responders on the scene.

Collision of Northern Indiana Commuter Transportation District Train 102 with a Tractor-Trailer Portage, Indiana June 18,1998, NTSB Report Number: RAR-99-03, adopted on 7/26/1999.

Synopsis: At approximately 4:31 a.m., Central Standard Time, on Thursday, June 18, 1998, Northern Indiana Commuter Transportation District (NICTD) train 102, a two-car passenger train, collided with the right side of a long combination vehicle (LCV) at the Midwest Division of the National Steel Corporation's (Midwest Steel) grade crossing near Portage, Indiana. At this grade crossing, a private road leads north from U.S. Route 12 (US 12), intersects NICTD and Consolidated Rail Corporation (Conrail) railroad tracks, and continues to the Midwest Steel facility and other businesses. The collision occurred on the westward NICTD track.

Shortly before the collision, while the LCV was traversing the NICTD tracks, the approach of the westbound Conrail train 201 had activated the flashing light signals and automatic gates at the Conrail crossing. The truck driver stopped the LCV before the Conrail crossing's south gate. The vehicle's second semitrailer was resting on the westward NICTD track. At this time, NICTD train 102 traveling westbound about 68 mph was approaching the Midwest Steel grade crossing.

About 542 feet east of the crossing, the train 102 crew noticed the LCV's second semitrailer, which carried a steel coil (weighing about 19 tons), on the crossing. The engineer said that he placed the train in emergency braking; followed by the conductor, he then exited the control compartment and ran toward the rear of the passenger compartment. The crew alerted passengers in that area about the impending collision and told them to evacuate.

As the collision occurred, the LCV's second semitrailer broke away from the first semitrailer and was dragged by the front of the NICTD train, while the single chain securing a steel coil to the second semitrailer broke. The released steel coil entered the lead car of the train through the front bulkhead. The coil moved through the car until it came to rest about 34 feet into the passenger compartment. Three fatalities and five minor injuries among the passengers resulted.

Type of Accident: Highway-rail collision/impact.

Accident Result: The cars remained coupled during the accident, and neither car derailed. No fire occurred in either car.

Type of Train: Commuter Rail.

Type of Equipment: Did not have sleeper cars.

Time of day: 4:31 a.m.–dawn.

Crew Training: Not discussed in the NTSB report.

Crew Incapacitated: No.

Bystanders Involved: No.

Timeliness of Emergency Response: After the impact with the LCV, the engineer moved to the operating cab in the rear of the second car and radioed the dispatcher to inform him, "we had hit a truck at the Midwest rail crossing and for him to get emergency personnel out as quickly as possible." The engineer said he then returned to the first car to attempt to help the injured passengers. On the way, he met the conductor, who was going to the second car. The engineer took the conductor's flashlight and continued into the first car, where he saw the injured NICTD employee. He went back to the second car and called the dispatcher again to let him know that the conductor was safe. He also advised the dispatcher that the coil had come into the car.

A Midwest Steel representative notified the Portage Police Department (PPD) dispatcher of the accident at 4:35 a.m. The PPD dispatcher dispatched Portage police, fire, and emergency medical services personnel at 4:36 a.m. The emergency response personnel arrived at the accident site within about 10 minutes. The 13 remaining passengers and 2 members of the crew exited through the last door on the south side of the second car. By the time they had exited the train, emergency personnel (police) were arriving, and the engineer told them where to find the injured passengers.

The fire chief established incident and medical command and became the incident commander. At this time, the incident commander was advised that three people were inside the first NICTD car; two were dead, and one was alive but severely injured and pinned under the steel coil. The PFD chief immediately requested a crane from Midwest Steel to raise the coil. The assistant PFD chief asked the PPD dispatcher to request a University of Chicago Aeromedical Network helicopter and additional assistance. The assistant chief also contacted the Methodist Hospital, Northlake campus, to request a surgeon. While the additional help was being sought, a paramedic firefighter tried to communicate with, administer oxygen to, and monitor the cardiac status of the severely injured person pinned under the coil. About 10 minutes later, the incident commander was told that the injured person had lost all vital signs.

Training of Emergency Responders: Not discussed in the NTSB report.

Number of Passengers and Crew: 15 passengers, 2 crewmembers, and 1 deadheading railroad employee.

Passenger and Crew Injuries: One railroad employee and 2 passengers sustained fatal injuries, 5 passengers sustained minor injuries, and 2 crewmembers and 8 passengers sustained no injury.

Cause of Death: Crushed by 19 ton steel coil.

Manifest Identified as Issue by NTSB: No.

Other Issues Identified by NTSB: Safety of private grade crossings, and crashworthiness of the rail cars.

Likely Impact of Having a Manifest: None. Despite timely response by emergency responders, despite the fact that all passengers and crew were accounted for, and despite the fact that emergency responders were told the exact location of the entrapped victim, he died shortly after the arrival of the emergency responders due to the nature of his injuries.

Grade Crossing Collision, National Railroad Passenger Corporation with Coastal Transport Tractor-Semitrailer, Jacksonville, Florida, February 5, 1997, NTSB Report Number RAB-01-01, adopted on 10/26/2000.

Synopsis: At approximately 4:45 p.m., Eastern Standard Time, on February 5, 1997, National Railroad Passenger Corporation (Amtrak) train P098, the *Silver Meteor*, while operating over CSXT tracks, struck a tractor-semitrailer combination at Old Kings Road in Jacksonville, Florida. The locomotive and four leading cars derailed. Of the 182 passengers and crew onboard the train, 15 reported injuries. The injured passengers were treated and released the same day. The locomotive engineer and assistant engineer were hospitalized and released after 48 hours with minor injuries. The tractor-semitrailer was destroyed. The truck driver had exited the truck before the collision and was not injured.

Amtrak train P098, with one locomotive, one baggage car, and nine passenger cars, originated in Miami on the day of the accident. Approaching Old Kings Road at MP 631.8 on the CSXT Nahunta Subdivision, the engine crew observed that the crossing gates were down and that a truck was on the track. When he realized that the truck was not moving, the engineer applied the train's emergency brakes. The collision caused the locomotive and the first four cars to derail. The locomotive and baggage car came to rest on their sides. All derailed passenger cars remained upright. The train crew organized an evacuation of passengers, which was accomplished without incident. Police and emergency medical personnel arrived on scene shortly after the accident.

Type of Accident: Highway-rail collision/impact.

Accident Result: The collision caused the locomotive and the first four cars to derail. The locomotive and baggage cars came to rest on their sides. All derailed passenger cars remained upright.

Type of Train: The Silver Meteor is a reserved train.

Type of Equipment: Did have sleeper cars.

Time of day: 4:45 p.m.–dusk.

Crew Training: Not discussed in the NTSB report.

Crew Incapacitated: Engineer and assistant engineer sustained minor injuries.

Bystanders Involved: No.

Timeliness of Emergency Response: Police and emergency medical personnel arrived on scene shortly after the accident.

Training of Emergency Responders: Not discussed in the NTSB report.

Number of Passengers and Crew: 182 passengers and crew.

Passenger and Crew Injuries: 2 crewmembers and 13 passengers sustained minor injuries.

Cause of Death: Not applicable.

Manifest Identified as Issue by NTSB: No.

Other Issues Identified by NTSB: Failure of the truck driver to warn authorities that his vehicle was fouling the tracks.

Likely Impact of Having a Manifest: None. In accidents in which cars have remained upright and in which minimal structural damage to the cars and no passenger ejection has occurred, little danger exists to first responders in searching the cars for all passengers, and little likelihood exists that passengers would be missed in a search of the cars. In this case, the first responders would be reasonably sure that they had not missed any passengers in their search efforts; while an accurate manifest would be nice to have, it would not be essential to their efforts.

Railroad Accident Report Derailment of Amtrak Train 4, Southwest Chief, on the Burlington Northern Santa Fe Railway near Kingman, Arizona, August 9, 1997 (Revision August 7, 2003), NTSB Report Number RAR-98-03, adopted on 8/31/1998.

Synopsis: At approximately 5:56 a.m. on August 9, 1997, Amtrak train 4, the *Southwest Chief*, derailed on the Burlington Northern Santa Fe Railway (BNSF) tracks about 5 miles northeast of Kingman, Arizona. The train was traveling about 89 mph on the eastbound track when the engineer and assistant engineer saw a hump in the track as they approached bridge 504.1S. They stated that they applied the train's emergency brakes. It was later discovered that the ground under the bridge supporting structure had washed away during a flash flood.

Train 4 had a four-unit locomotive, one baggage car, nine passenger cars, and six material handling cars (MHCs). As the train passed over bridge 504.1S, the first three locomotive units uncoupled and separated from the rest of the train and each other, each unit coming to a stop east of the derailed train. The fourth unit remained coupled to the train.

The third and fourth units, including all but the last car, derailed in the upright position. Although some cars were at a slight angle to each other and leaning, all cars remained coupled and generally aligned with the track. The tenth car, a sleeping car, came to rest spanning what had been the track at the location of bridge 504.1S.

Type of Accident: Derailment.

Accident Result: The train came to rest with the last passenger car, sleeping car 32088, bridging the gap of the collapsed bridge 504.1S. The last locomotive unit and the rest of the cars remained coupled. The three locomotive units that uncoupled from the train came to rest with the lead locomotive unit about a mile beyond the rest of the train. All but the first two locomotive units and the last car derailed. All cars derailed upright with the passenger cars at shallow angles to each other.

Type of Train: Train 4, Southwest Chief, is a reserved train.

Type of Equipment: Did have sleeper cars.

Time of day: 5:56 a.m.–dawn.

Crew Training: Although passengers were safely evacuated, statements from the onboard service (OBS) personnel and a review of their training records indicated that the reactions of several of them were based on instinct rather than organized emergency training. NTSB reviewed Amtrak's emergency situation training records for the 18 OBS persons and operating crewmembers involved in this accident. The training time intervals recorded varied between employees. The most recent training that could be identified from the employee records ranged from training taken 2 months before the accident to training taken as much as 7 years before the accident. Eight employees did not have any emergency situation training dates listed in their

training records. These findings are inconsistent with Amtrak's stated policy of scheduling emergency situation training at least every 3 years for OBS attendants.

Train 4's OBS personnel did not use the public address system to communicate evacuation information to the passengers. Although some crewmembers believed that the public address system did not work, they did not attempt to use it even though Amtrak's emergency training procedures, as provided in the Amtrak training manual, call for its use in emergency situations. Wreckage documentation showed that the public address system was inoperable in some of the cars because of the damage sustained by the equipment.

Crew Incapacitated: Of the crew, 1 sustained serious injuries, 9 minor injuries, and 8 no injuries.

Bystanders Involved: No.

Timeliness of Emergency Response: At approximately 5:56 a.m., the BNSF Network Operations (NOC) received a radio communication from the engineer of Amtrak train 4 informing it of the train's derailment and its location. NOC passed the information on to its Resource Operations Center and a BNSF special agent, who notified the Mohave County Sheriff's Department at 6:01 a.m. Also about 5:56 a.m., the Mohave County Sheriff's Department received a 911 call from a local resident reporting a train derailment. Three officers, who were already in the immediate area (searching for people who were reportedly stranded because of flash flooding), were dispatched to the scene and arrived at 6:05 a.m. Later, a Mohave County Sheriff's Department lieutenant arrived on scene and assumed the duties of incident commander. They helped the Kingman Fire Department and emergency services personnel transport passengers and crew to triage areas, searched for train occupants, and secured the scene. They reported that no life-threatening injuries were noted.

The first medical, rescue, and fire units arrived within 20 minutes of the accident. About 5 minutes later, the first of three Arizona Department of Public Safety helicopters arrived on scene. Two military helicopters from Nellis Air Force Base arrived on scene later with a flight surgeon and medical crew. At 6:30 a.m. (35 minutes after the accident), a medical command post was set up next to the treatment and triage area. School buses were used to transport people with minor to moderate (or no) injuries to the local hospital and Kingman Junior High School, which was used as a shelter for passengers and crew.

Approximately 1 hour after the accident, injured people began arriving at the hospital by helicopters, ambulances, and buses. By 8:00 a.m., about 230 people had been transported from the scene. BNSF personnel, emergency medical services personnel, and some passengers helped throughout the response. Shortly after 9:00 a.m., the last person was transported from the scene. The last person was admitted to the hospital at 11:00 a.m.

Training of Emergency Responders: Before the accident, on November 15, 1996, Clark County, Nevada, and Mohave County, Arizona, held a joint full-scale exercise.

On April 29, April 30, and May 1, 1997, a Festival of the Emergency Arts was held in Glendale, Arizona. At this festival, Amtrak's manager of Emergency Preparedness addressed emergency responders about considerations that might affect emergency response procedures involving Amtrak train emergencies, such as railroad operations, equipment familiarization, passenger car construction, railroad right-of-way (ROW) safety precautions, passenger evacuation, forcible entry, locomotive propulsion systems, train crew orientations, electrical and pneumatic hazards, onboard emergency equipment, use of emergency exit doors and windows, hazardous materials, tunnels and bridges, grade crossing accidents, search and rescue, fire suppression, derailments, and other types of incidents.

Although a state representative invited Kingman fire and rescue personnel, the festival attendance sheet did not indicate that anyone from Kingman had attended this training. No evidence was found of the Mohave County Sheriff's Department being invited to or attending the festival.

Number of Passengers and Crew: 294 passengers and 18 crewmembers.

Passenger and Crew Injuries: Of the crew, 1 sustained serious injuries, 9 minor injuries, and 8 no injuries, while 24 passengers sustained serious injuries, 149 minor injuries, and 121 no injuries. *While the NTSB reports no fatalities, the FRA casualty and accident databases attribute one fatality to this accident.*

Cause of Death: The fatality in the FRA data apparently resulted at a later date from injuries incurred during the accident. The victim was not entrapped but apparently injured when thrown from his/her seat during the derailment.

Manifest Identified as Issue by NTSB: Yes. According to the conductor and one assistant conductor, at the time of this accident, they were in the dining car working on tickets. The conductor said that he did not have time to look at the manifest because it was in the dormitory car. He also stated that the manifest contained the number of passengers in coach sections and a complete list of passengers in the sleeping cars. The conductor said that the manifest should have been up-to-date except for tickets taken at Kingman.

During the emergency response to the Kingman accident, the incident commander requested a copy of the train 4 manifest from an Amtrak employee. The conductor told NTSB investigators that a passenger manifest was located in the dormitory car, but he did not have time to obtain it because he was helping passengers. The chief of on board services said that he gave a copy of a sleeping car manifest to a firefighter. It took several days for Amtrak to provide an accurate passenger count of the entire train.

A complete manifest is necessary, in addition to the counts provided by the conductor for the emergency responders to locate people on the train as quickly as possible and be alerted about those people who may need immediate assistance because of injuries or disabilities. Although a complete manifest of train 4 was eventually available, infants and small children were not included on it because Amtrak does not require tickets for infants and small children.

Other Issues Identified by NTSB: Bridge inspection procedures and risk assessment, on board emergency lighting, crew emergency training, inaccuracies in the accident reporting process.

Likely Impact of Having a Manifest: None. According to the NTSB report:
Although no complete manifest was available during the emergency response in this instance, the lack of one did not appear to negatively affect the efficiency of the emergency response.

Railroad Special Investigation Report Derailment of Amtrak Train No. 12 and Sideswipe of Amtrak Train No. 79 on Portal Bridge near Secaucus, New Jersey, November 23, 1996, NTSB Report Number SIR-97-01, adopted on 12/18/1997.

Synopsis: At approximately 6:28 a.m. on Saturday, November 23, 1996, eastbound Amtrak train No. 12 derailed while crossing Portal Bridge, a swing bridge spanning the Hackensack River in Secaucus, New Jersey. When the train derailed, it sideswiped Amtrak train No. 79, which was crossing the bridge in the opposite direction on an adjacent track. All 12 cars of train No. 12 derailed, with both locomotives, 1 material handling car, and the 3 lead passenger coaches coming to rest at the bottom of an embankment at the east end of the bridge. Train No. 79 sustained damage but was able to stop with the entire train intact and on the rails some distance west of Portal Bridge. No fatalities resulted from the accident, but 42 passengers and crewmembers aboard train No. 12 were injured, as was 1 passenger aboard train No. 79.

Type of Accident: Derailment.

Accident Result: Train No. 79 sustained sideswipe damage but stopped with the entire train intact and on the rails. Train No. 12 came to rest with both locomotives, one material handling car, and the first three passenger coaches entirely derailed, but upright and tilted in various positions down the embankment at the east end of the bridge. The remaining eight cars of train No. 12 remained upright and in line, but they were either totally or partially derailed.

Type of Train: Train 79, the Carolinian, is unreserved north of Washington, DC. Train 12 is unknown.

Type of Equipment: Neither train had sleeper cars.

Time of day: 6:28 a.m.–dawn.

Crew Training: Not discussed in the NTSB report.

Crew Incapacitated: Two crewmembers on train No. 12 sustained minor injuries.

Bystanders Involved: No.

Timeliness of Emergency Response: According to telephone tape transcriptions, at approximately 6:36 a.m. (8 minutes after the accident) Amtrak's assistant chief train dispatcher notified Amtrak's National Police Dispatching Center (NPDC) in Philadelphia that train No. 12 had derailed on Portal Bridge over the Hackensack River. The train dispatcher stated that police and emergency personnel would be needed at the scene.

Emergency response to the accident was delayed because of confusion about the accident location. The problem can be traced to the Amtrak police dispatcher who called the appropriate agency, the Secaucus Police Department, but relayed the accident location as Portal Tunnel

instead of Portal Bridge. The dispatcher further confused the issue when he called the North Bergen Police Department and reported the accident location as Portal Tunnel Bridge.

Amtrak's computerized geographical database indicated that the derailment fell within the Secaucus police area. The database also provided the closest access roads. Even with the confusion about the specific accident site, the location of the two nearby roads should have provided enough information to allow either the Secaucus police or the North Bergen police to determine the most likely accident location. This, however, did not occur. One reason may have been that the Secaucus police were apparently unaware that a Portal Bridge was located within their jurisdiction. It was only when a construction worker flagged down a Secaucus police cruiser that had been sent out to investigate and check known bridges in the area that the actual accident location became known.

Shortly after the initial identification of the accident location, the Secaucus police called NPDC and said that the Secaucus police had located the accident site. The caller told NPDC how access had been gained to the site and provided a preliminary assessment of injuries. About 18 minutes elapsed between the time the NPDC was notified of the accident and the time the first police officers arrived on the scene. The first ambulance arrived on the scene about 47 minutes after the initial notification.

Once at the bridge location, emergency responders had difficulty accessing the actual accident site. Some of the emergency vehicles approached the bridge from the west, but because the wreckage was on the east end of the bridge, they had to be rerouted to the other side.

The first police officer on the scene saw that many, if not most, of the passengers had gotten off the train, and he was told that one person was still on the train being treated by train personnel.

Training of Emergency Responders: Full-scale disaster drills and simulated tabletop exercises (without the use of train equipment or mock evacuations) are regularly held in Hudson County and all of its municipalities. Before this accident, the most recent exercise had been held on November 9, 1994, simulating a hazardous materials accident.

Number of Passengers and Crew: Train No. 79 carried 162 passengers and 4 crewmembers, while train No. 12 carried 90 passengers, 3 crewmembers, and 24 deadheading employees.

Passenger and Crew Injuries: On train No. 79, 1 passenger sustained minor injuries, while the other 161 passengers and 4 crewmembers were uninjured. On train No. 12, 2 deadheading employees sustained serious injuries; 2 crewmembers, 17 passengers, and 22 deadheading employees sustained minor injuries, while 1 crewmember and 73 passengers were uninjured.

Cause of Death: Not applicable.

Manifest Identified as Issue by NTSB: No.

Other Issues Identified by NTSB: Amtrak management oversight of the inspection, maintenance, and repair of moveable bridge rail assemblies, and effectiveness of Amtrak's emergency notification procedures

Likely Impact of Having a Manifest: None. In accidents in which cars have remained upright and in which minimal structural damage to the cars and no passenger ejection has occurred, little danger exists to first responders in searching the cars for all passengers, and little likelihood exists that passengers would be missed in a search of the cars. In this case, the first responders would be reasonably sure that they had not missed any passengers in their search efforts; while an accurate manifest would be nice to have, it would not be essential to their efforts.

Collision and Derailment of Maryland Rail Commuter MARC Train 286 and National Railroad Passenger Corporation Train 29 near Silver Spring, Maryland, February 16, 1996, NTSB Report Number RAR-97-02, adopted on 6/17/1997.

Synopsis: On Friday, February 16, 1996, at 5:39 p.m., an eastbound Maryland Rail Commuter (MARC) train 286, operated by CSXT for the Maryland Mass Transit Administration (MTA) collided with the westbound Amtrak passenger train 29, Capitol Limited. The accident occurred during a blowing snowfall at a railroad location, referred to as Georgetown Junction, about 1 mile west of Silver Spring, Maryland. Both trains were operating on the double main tracks owned and maintained by CSXT.

The MARC train 286 was a push-pull commuter train consisting of a locomotive unit on the rear end, two passenger cars, and a passenger coach cab control car in the lead. The engineer was operating the train from the cab control car in the push mode at the time of the collision. The Amtrak train consisted of 2 locomotives and 15 cars.

Amtrak train 29 had been routed onto track 2 from Union Station to Georgetown Junction to pass a stopped westbound CSXT freight train that occupied track 1 east of Georgetown Junction. The engineer of Amtrak train 29 stated he was beginning to negotiate the crossover from track 2 to 1 at Georgetown Junction when the collision occurred.

The left front quadrant of the MARC cab car (the leading passenger car) separated and was destroyed as a result of the collision. The fuel tank of the Amtrak lead locomotive ruptured on impact, and the diesel fuel ignited. Fire engulfed the rear superstructure of the locomotive. Fuel spilled onto the MARC cab car, ignited, and destroyed the car.

On board the Amtrak train were 164 passengers, 13 OBS personnel, 4 operating crew, and 1 mechanical rider. The engineer, assistant engineer, and conductor received minor-to-moderate injuries.

The MARC train had 3 operating crewmembers and 20 passengers on board. Two crewmembers and 7 passengers died of smoke inhalation, and 1 crewmember and 1 passenger died as a result of impact injuries; 11 of the 12 survivors were injured.

Type of Accident: Collision between on track equipment.

Accident Result: MARC Train 286—The cars and locomotive of the train remained coupled and were situated approximately in a linear orientation, derailed but upright. Fuel spilled onto the MARC cab car, ignited, and destroyed the car. Because the running gear and batteries of the coaches were damaged in the derailment, the emergency lighting and public address system were inoperable. Amtrak Train 29—The locomotive units, the 1st, and 4th through 8th cars were all derailed (either one or both axles) but remained upright. The passenger-occupied 9th through 15th cars remained on the track and were not damaged. All Amtrak cars in the consist remained upright and parallel to the track, except for the fifth and sixth cars. No damage was noted to passenger compartments. All emergency lighting had been illuminated immediately after the

collision according to the conductor. The public address system remained operable after the collision and was used by the conductor for emergency broadcasts.

Type of Train: MARC Train 286 was a commuter rail train, while Amtrak Train 29, the Capital Limited, was a reserved train.

Type of Equipment: Amtrak Train 29 did have sleeper cars.

Time of day: 5:39 p.m.–darkness.

Crew Training: CSXT personnel operating MARC passenger trains were not adequately trained to understand and, therefore, execute their responsibilities for passengers in emergencies. The NTSB report did not discuss Amtrak crew training.

Crew Incapacitated: The 3 MARC crewmembers sustained fatal injuries. Two of the Amtrak operating crew sustained serious injures and 2 minor injuries, while one of the other crew sustained serious injures, 2 minor injuries, and 11 were uninjured.

Bystanders Involved: No.

Timeliness of Emergency Response: The CSXT dispatcher was contacted about 5:41 p.m. by the traincrew of CSXT train K951, which was stopped on the adjacent track east of Georgetown Junction, that Amtrak train 29 had derailed while crossing over at Georgetown Junction. At approximately 5:41 p.m., the Montgomery County Fire and Rescue Services (MCFRS) 911 dispatcher received approximately 12 telephone calls reporting the derailment and fire. At 5:44 p.m., the dispatcher contacted the MCFRS to notify it of the accident and was informed that it was already aware of the derailment. About 5:46 p.m. (approximately 7 minutes after the accident) the first units arrived on scene.

At 5:46 p.m., the first firefighter arriving on scene reported a fully engulfed passenger car, which he was unable to enter or open the doors. By 6:15 p.m., an emergency medical services command was established as well.

The last victim was removed from the wreckage by 3:50 a.m. on February 17, and emergency operations were suspended. During the rescue operations, five on-scene triage sites were available for the injured victims, who were later transported to five area hospitals for treatment.

Under Montgomery County Emergency Operations Center (EOC) direction, two nearby schools were used to provide victims with shelter, crisis counseling, and staging for transportation. County, emergency management, and volunteer agencies' officials and members staffed the EOC.

Training of Emergency Responders: Montgomery County simulated a Washington Metropolitan Area Transit Authority (WMATA) train derailment in Rockville in February 1995 during which at least 24 people were transported to hospitals, and shelters were established with county agencies' participation. In October 1995 another WMATA train derailment was

simulated with casualties during a 30-inch snowfall. MCFRS had not participated in any disaster drills that involved MARC, Amtrak, or CSXT and in any disaster training or familiarization training with any freight or passenger railroad that provides service in Montgomery County.

Number of Passengers and Crew: Three operating crewmembers and 20 passengers were on board the MARC train. The Amtrak train had 164 passengers, 13 OBS personnel, 4 operating crew, and 1 mechanical rider on board.

Passenger and Crew Injuries: Three MARC crewmembers sustained fatal injuries, while 8 passengers sustained fatal injuries, 3 serious injuries, 8 minor injuries, and 1 uninjured. Two of the Amtrak operating crew sustained serious injures and 2 minor injuries, 1 of the other crew sustained serious injures, 2 minor injuries, and 11 were uninjured, 8 passengers sustained minor injuries, and 156 were uninjured.

Cause of Death: All fatalities were on MARC train 286. Two crewmembers and 7 passengers died of smoke inhalation, and 1 crewmember and 1 passenger died as a result of impact injuries.

Manifest Identified as Issue by NTSB: No.

Other Issues Identified by NTSB: Performance and responsibility of MARC crewmembers, Federal oversight of commuter rail operations, lack of positive train separation control systems, crashworthiness of locomotive fuel tanks, adequacy of passenger car safety standards, and emergency preparedness.

Likely Impact of Having a Manifest: None. Even though MCFRS personnel responded promptly to the emergency, they could do nothing to save any of the accident victims because passenger coach cab control car 7752 was already completely engulfed in flames when the first firefighter arrived on scene.

The first firefighters to reach cab control car 7752 reported that the car was fully involved in fire and that they did not observe any survivors. They made several attempts to enter the cab control car. The fire was extinguished within 10 minutes, after which the firefighters were able to enter the car. They were later assisted by members of the Montgomery County Police Department in the recovery of 11 victims for coordinating the identification and notification process with the Maryland medical examiner. At 3:50 a.m. on Saturday, February 17, 1996, the last victim was recovered.

The emergency egress of passengers was impeded because the passenger cars lacked readily accessible and identifiable quick-release mechanisms for the exterior doors, removable windows, kick panels in the side doors, and adequate emergency instruction signage. The exterior emergency door release handles for the MARC cars were either not in place or accessible to firefighters because no requirements for their maintenance or accessibility exist.

The NTSB report notes:

> Amtrak reported to Safety Board investigators that about 6:15 p.m. one of its officers made four attempts within 10 minutes to provide the passenger list and other information to the MCFRS personnel at the command center in the adjacent parking lot. He was finally told that the information was not needed and he should wait.

Amtrak Train 87 Derailment after Colliding with Intermodal Trailer from CSXT Train 176 Selma, North Carolina, May 16, 1994, NTSB Report Number RAR-95-02, adopted on 3/21/1995.

Synopsis: At 4:46 a.m. on Monday, May 16,1994, the southbound National Railroad Passenger Corporation (Amtrak) train 87, *Silver Meteor*, struck the intermodal trailer REAZ232980 on the northbound CSXT 176, on the CSXT Florence Division at Selma, North Carolina. Amtrak train 87 consisted of a 2-unit locomotive and 18 cars (1 material handling car, 2 baggage cars, 10 coach cars, 2 lounge cars, 1 buffet car, 1 sleeper car, and 1 dining car). CSXT 176, consisting of a 3-unit locomotive and 52 cars, was a trailer-on-flat-cat/container-on-flat-car train.

After the collision, both Amtrak units and the next 17 cars derailed. (The second unit and all cars remained upright.) The lead unit broke free from the second unit, rolled over 270 degrees, and came to rest on the assistant engineer's side. The locomotive fuel tank ruptured during the accident sequence, and fire ignited outside the cab compartment from the spilled diesel fuel. On Amtrak train 87, the assistant engineer was killed, the engineer sustained serious injuries, and 1 OBS crewmember and 119 passengers received minor injuries. (The fire was outside the cab compartment of the unit and did not contribute to the assistant engineer's death or the engineer's injuries.) The operating crew on CSXT 176, the 3 other Amtrak operating crewmembers, 17 other OBS crewmembers, and 296 passengers sustained no injuries.

Type of Accident: Collision between on track equipment.

Accident Result: Both locomotives and 17 of 18 cars derailed, the lead locomotive overturned, and all other derailed equipment remained upright. The lead locomotive's fuel tank ruptured, and fire ignited outside the cab compartment.

Type of Train: Train 87, the Silver Meteor, is a reserved train.

Type of Equipment: Did have sleeper cars.

Time of day: 4:36 a.m.–darkness.

Crew Training: Not discussed in the NTSB report.

Crew Incapacitated: The assistant engineer was killed, the engineer sustained serious injuries, and 1 OBS crewmember received minor injuries.

Bystanders Involved: No.

Timeliness of Emergency Response: After the collision, the conductor attempted to call the engineer, received no response, and then contacted the CSXT 176 crew using a handheld radio to summon help. At the same time, an assistant conductor exited the train and used a cellular telephone to contact emergency services. At 4:42 a.m. (6 minutes after the accident), the Johnston County Emergency Communications Center received a 911 call from an unidentified person reporting the train accident. The Johnston County dispatcher immediately notified fire, rescue, police, and emergency medical services units. The Smithfield Fire Department arrived on scene within 6 minutes of the 911 call and immediately commenced evacuating passengers from Amtrak train 87. A staging area was established at 4:55 a.m. in a parking lot adjacent to the accident site, and a command post was established at 5:00 a.m. An incident command system was implemented to coordinate all fire and rescue activities at the accident site, and the chief of the Smithfield Fire Department assumed the duties of incident commander. At that time, the Johnston County disaster plan was put into effect. The CSXT dispatcher in Jacksonville, Florida, had been notified by the CSXT 176 crew and then contacted the Johnston County authorities about the accident at 4:46 and 4:47 a.m., respectively.

In several passenger cars, the emergency windows, the fire extinguishers, and the first aid kits had been removed. No intrusions occurred in the passenger cars. The fixed emergency lighting systems were not operating inside several passenger cars. Batteries and the wiring connecting the batteries to the lights were damaged as a result of the derailment. Three of the injured passengers, interviewed after the accident, reported difficulty exiting the passenger cars because they could not see the emergency exit windows in the darkness. When they were finally able to escape through the doors leading outside, they said that they were not sure how far they were above a surface, which may not have been solid ground, because they could not see below the steps of the car.

The transport of injured passengers and Amtrak crewmembers to the two hospitals was executed expeditiously. The hospitals were notified immediately after the accident and instituted their disaster plans for receiving heavy casualties.

Training of Emergency Responders: The Johnston County Office of Emergency Management conducted a disaster preparedness exercise in January1994, which simulated the evacuation of residents during a woodlands fire that spread into an urban area.

Amtrak provided training to Johnston County fire and rescue agencies in January 1995 (after the accident). The 3-hour training session included familiarization with Amtrak equipment, location of emergency gear, avoidance of high voltage electrical equipment after an accident, and evacuation of passengers from Amtrak trains.

Number of Passengers and Crew: 415 passengers, 5 operating crewmembers, and 18 OBS crewmembers.

Passenger and Crew Injuries: On Amtrak train 87, the assistant engineer was killed, the engineer sustained serious injuries, and 1 OBS crewmember and 119 passengers received minor

injuries. The operating crew on CSXT 176, the 3 other Amtrak operating crewmembers, 17 other OBS crewmembers, and 296 passengers sustained no injuries**.**

Cause of Death: Not applicable.

Manifest Identified as Issue by NTSB: No.

Other Issues Identified by NTSB: The loading, securement, and inspection of intermodal trailers onto railroad flatcars, locomotive operating compartment crashworthiness, locomotive fuel tank crashworthiness, and failure of the emergency lighting system.

Likely Impact of Having a Manifest: None. In accidents in which cars have remained upright and in which minimal structural damage to the cars and no passenger ejection has occurred, little danger exists to first responders in searching the cars for all passengers, and little likelihood exists that passengers would be missed in a search of the cars. In this case, the first responders would be reasonably sure that they had not missed any passengers in their search efforts; while an accurate manifest would be nice to have, it would not be essential to their efforts.

Derailment of Amtrak Train 49 on Conrail Trackage near Batavia, New York, on August 3, 1994, NTSB Report Number RAR-96-02, adopted on 7/11/1996.

Synopsis: Train 49, the Lake Shore Limited, was a regularly scheduled westbound train that traveled from New York, New York, to Chicago, Illinois. The train consisted of 2 locomotive units, 2 MHCs, 1 baggage car, 12 passenger cars (3 sleepers), and 1 baggage/dormitory car.

At approximately 3:42 a.m., it reached the point where the initial derailment occurred. The train continued west and passed the head end of a Conrail freight train. The freight train on the adjacent track was also moving west. According to the Conrail train engineer and conductor, sparks and gravel were coming from the underside of either the second or third car behind the locomotive units of train 49. The crew of the freight train attempted to alert the crew of train 49 by radio.

No response was received from the initial attempt. Train 49 responded to the second attempt, but the general derailment occurred almost simultaneously. At the time, train 49 had a clear (proceed) signal indication and was traveling, according to the event recorder, about 79 mph. The event recorder data strip also indicated that the emergency brakes were initiated by a train line separation after the general derailment had occurred. Fourteen cars of the 18-car consist had derailed. A signal bridge was struck in the derailment, and the bridge fell onto two of the cars.

Type of Accident: Derailment.

Accident Result: The locomotives and four cars did not derail, five derailed cars remained upright within the track structure, three cars remained upright but were tilted, and five cars were overturned.

Type of Train: Train 49, the Lake Shore Limited, is a reserved train.

Type of Equipment: Did have sleeper cars.

Time of day: 3:44 a.m.–darkness.

Crew Training: Not discussed in the NTSB report.

Crew Incapacitated: Three operating crewmembers and seven service crewmembers sustained minor injuries.

Bystanders Involved: No.

Timeliness of Emergency Response: The general derailment occurred near a Conrail police unit that was doing a routine check of Conrail construction equipment. The Conrail police officer notified the Conrail dispatcher, who advised the Genesee County Emergency Communication Center (GCECC) of the derailment at 3:46 a.m. The GCECC dispatcher immediately sent a sheriff's deputy to the accident scene and at 3:55 a.m. informed the Batavia town and city fire departments, as well as at least 11 other emergency services.

The fire chief arrived at the accident scene within 15 minutes of the accident, assumed command, and requested additional ambulances and helicopters. The New York State (NYS) police were notified at 4:03 a.m. and responded. GCECC arrived on scene at 4:08 a.m. and called for every available ambulance, rescue unit, and extrication tool. Staging areas for ambulances, helicopters, and fire and rescue equipment were established at a nearby plant and on the south side of the tracks, respectively.

An emergency shelter was established at 5 a.m. in the town of Batavia fire hall. The NYS police, who were in charge of transporting the train passengers by bus, listed the names of the injured passengers before taking them to the emergency shelter, where their need for hospitalization was evaluated. During this evaluation, several more passengers asked to be taken to hospitals. Seriously injured passengers had been removed from the accident scene by 5 a.m., and the last passenger left the scene at 6:15 a.m.

Some passengers reported that they had no difficulty in evacuating the cars; others, however, said that the evacuation was difficult. Several passengers in the cars that had turned on their sides stated that they had trouble reaching the exposed side windows. Other passengers said that they could not open the heavy car-end doors. Darkness, the steep embankment, and the awkward position of the cars were other reasons attributed to a difficult evacuation.

Training of Emergency Responders: The last disaster drill, according to GCEMC, had been in September 1993 and simulated a hazardous material spill accident in which five fatalities and two injuries occurred at a rest stop on an interstate highway.

In October 1994 (after the accident) at the NYS Fire Academy, Amtrak presented to emergency response agencies its 3-hour training course, which includes how emergency responders should interact with Amtrak crewmembers, what emergency responders should know about Amtrak equipment, and how to evacuate Amtrak trains. Genesee County emergency response agencies participated in this training. In April and May 1995, Amtrak provided passenger cars for use in disaster drills in five communities near the site of the Batavia derailment.

Number of Passengers and Crew: 320 passengers, 5 operating crewmembers, and 14 OBS crewmembers.

Passenger and Crew Injuries: 25 passengers sustained serious injuries, 3 operating crewmembers, 7 service crewmembers, and 83 passengers sustained minor injuries, while 2 operating crewmembers, 7 service crewmembers, and 212 passengers were uninjured.

Cause of Death: Not applicable.

Manifest Identified as Issue by NTSB: No.

Other Issues Identified by NTSB: Lack of guidelines related to flattened rail head conditions and integrity of passenger car seats.

Likely Impact of Having a Manifest: None. In accidents in which cars have overturned and suffered structural damage a possibility exists for passenger ejection and/or entrapment. In this case, passenger ejection/entrapment was not an issue. The potential safety benefits of having an accurate manifest in terms of improving passenger survivability are minimized by the fact that counting evacuated passengers takes hours.

Collision of Amtrak Train No. 88 with Rountree Transport and Rigging, Inc., Vehicle on CSXT, Railroad near Intercession City, Florida, November 30, 1993, NTSB Report Number HAR-95-01, adopted on 5/16/1995.

Synopsis: On November 30, 1993, a 184-foot long vehicle consisting of a truck-tractor and modular transporter was en route to deliver an 82-ton turbine to a Kissimmee Utility Authority (KUA) electricity generating plant under construction near Intercession City, Florida. The private access road to the plant facility crosses over a single railroad track owned by CSXT. Because of the configuration of the truck and the profile of the roadway, the cargo deck of the transporter began to bottom out on the roadway surface as the vehicle moved across the tracks and began down the descending grade. At approximately 12:40 p.m., after the truck's crew had finished raising the cargo deck and were preparing to move the vehicle, the lights and bells at the grade crossing activated. The crossing gates descended, striking the turbine. Seconds later, National Railroad Passenger Corporation (Amtrak) train No. 88, the *Silver Meteor*, carrying 89 passengers, struck the side of the cargo deck and the turbine. The locomotive and the first four cars of the eight-car consist derailed, carrying the turbine and parts of the vehicle with them.

No deaths resulted from this accident. Responders evacuated 59 people to 5 local hospitals, where 15 were admitted for further treatment. Six people sustained serious injuries, and 53 suffered minor injuries, mostly abrasions, lacerations, and contusions.

Type of Accident: Highway-rail collision/impact.

Accident Result: The locomotive and the first four cars of the eight-car consist derailed. The derailed cars were tilted but did not overturn.

Type of Train: The Silver Meteor is a reserved train.

Type of Equipment: Did have sleeper cars.

Time of day: 12:40 p.m.–daylight.

Crew Training: Amtrak personnel records indicate that OBS crewmembers had received training in emergency evacuation procedures. Two employees took the training in August 1993, one in January 1985, and one in May 1987. The personnel file for the fifth employee did not indicate a training date.

Crew Incapacitated: Two of the train crew sustained serious injuries, three of the train crew sustained minor injuries, while five of the train crew were uninjured.

Bystanders Involved: No.

Timeliness of Emergency Response: At 12:45 p.m., a resident called the Osceola County Communications Center and reported a "train derailment at 6030 Old Tampa Highway." Eight rescue and fire units initially responded. The Osceola battalion fire chief assumed responsibility

as incident commander and established a command post and triage area near Old Tampa Highway when he arrived on scene within 12 minutes of the collision. He radioed area hospitals to activate their disaster plans and requested medical evacuation (Medivac) helicopters. He directed responders to begin efforts to extricate the crewmembers trapped in the locomotive and to conduct a sweep of each railroad car to identify, classify, and tag patients. No fire resulted from the accident.

Responders evacuated all passengers from the train within an hour of the accident. Osceola Fire Rescue personnel had to remove the roof hatch of the overturned locomotive to extricate the trapped engineer and assistant engineer. Within 2 ½ hours of the accident, response personnel had transported 59 injured to area hospitals, where 15 were admitted for further treatment. Most of the injured were transported by ambulance or bus to area hospitals, where they were treated for minor abrasions, lacerations, and contusions. Two air ambulance helicopters evacuated five of the six seriously injured.

Passengers were able to use the exits from most coaches. However, after the train came to rest, several coaches were tilted, which precluded using the step devices that OBS personnel usually place on station platforms to facilitate exit from the train. Responders stacked railroad ties at some coaches to form steps at the exits. Other coaches were so tilted that emergency response personnel had to lower several passengers from the windows.

Training of Emergency Responders: Not discussed in the NTSB report.

Number of Passengers and Crew: 89 passengers and 10 crewmembers.

Passenger and Crew Injuries: Two of the train crew and 3 passengers sustained serious injuries, 3 of the train crew and 50 passengers sustained minor injuries, while 5 of the train crew and 36 passengers were uninjured.

Cause of Death: Not applicable.

Manifest Identified as Issue by NTSB: No.

Other Issues Identified by NTSB: Coordination of oversize vehicle moves, and pipeline hazard identification, notification, and avoidance.

Likely Impact of Having a Manifest: None. In accidents in which cars have remained upright and in which minimal structural damage to the cars and no passenger ejection has occurred, little danger exists to first responders in searching the cars for all passengers, and little likelihood exists that passengers would be missed in a search of the cars. In this case, the first responders would be reasonably sure that they had not missed any passengers in their search efforts; while an accurate manifest would be nice to have, it would not be essential to their efforts.

Derailment of Amtrak Train No. 2 on the CSXT Big Bayou Canot Bridge Near Mobile, Alabama, September 22, 1993, NTSB Report Number RAR-94-01, adopted on 9/19/1994.

Synopsis: On September 22, 1993, at approximately 2:45 a.m., barges that were being pushed by the towboat MAUVILLA in dense fog struck and displaced the Big Bayou Canot railroad bridge near Mobile, Alabama. At approximately 2:53 a.m., Amtrak train No. 2, the *Sunset Limited*, with 220 persons on board, struck the displaced bridge and derailed. The three locomotive units, the baggage and dormitory cars, and two of the six passenger cars fell into the water. The fuel tanks on the locomotive units ruptured, and the locomotive units and the baggage and dormitory cars caught fire. Forty-two passengers and 5 crewmembers were killed; 103 passengers were injured**.**

Type of Accident: Derailment.

Accident Result: The three locomotive units came to rest on the east side of the bayou. Part of the lead unit was buried in about 46 feet of mud, and the part protruding above the embankment burned. The second unit also burned. The baggage car and dorm-coach, also on the east side of the bayou, were gutted by fire. About half of the first coach, which rested against the bridge after the accident was submerged, and the second coach was almost totally submerged. The last four cars, a coach, lounge, diner, and sleeper, remained on the bridge. All passenger cars were double-decker cars.

Type of Train: Train 2, the Sunset Limited, is a reserved train.

Type of Equipment: Did have sleeper cars.

Time of day: 2:53 a.m.–darkness.

Crew Training: Unknown.

Crew Incapacitated: Of the operating crew, three sustained fatal injuries, two minor injuries, and one was uninjured, while two of the OBS crew sustained fatal injuries, six minor injuries, and four were uninjured.

Bystanders Involved: Yes. At approximately 3:19 a.m. (26 minutes after the accident), the captain of the MAUVILLA called and advised the Coast Guard that he had his barges under control. He further stated that he would try to render assistance to survivors. The MAUVILLA's deckhands launched the towboat's skiff, which was near the wreckage on the east side of the river, and one deckhand rowed to people in the water and pulled them aboard. He returned several times to pick up additional survivors.

At approximately 3:59 a.m. (over 1 hour after the accident), the towboat SCOTT PRIDE, approached the accident site. The crew of the SCOTT PRIDE pulled 20 people out of the water. The crew of the MAVILLA rescued 17 people from the water.

Timeliness of Emergency Response: At approximately 2:56 a.m., train No. 2's assistant conductor made a "Mayday, Mayday" transmission over the railroad-designated radio that was heard by CSXT train 579, whose crew repeated it to the yardmaster at the Sibert Yard, Mobile. Also at about 2:56 a.m., the assistant terminal trainmaster at Sibert Yard heard train No. 2 transmitting Mayday over the radio. The yardmaster at Sibert Yard notified the train dispatcher in Jacksonville, Florida, at 2:57 a.m. and the Mobile Police Department's 911 operator about 3 a.m. that Train 2 had derailed. The telephone number for the Coast Guard in the Mobile telephone directory was incorrect, and both the yardmaster and the CSXT representative in Mobile did not succeed in their first attempts to contact the Coast Guard.

The bridge tender at the Mobile River Bridge and the train engineer of Train 579 also radioed the train dispatcher in Jacksonville at approximately 2:56 a.m. that train No. 2 was transmitting a Mayday call. Immediately thereafter, the train dispatcher tried to contact train No. 2 but was unsuccessful. Train 579's engineer advised the dispatcher that train No. 2 had derailed at the Mobile River Bridge, which is where the assistant conductor said he thought the train was when he made his Mayday call, and was on fire. The Mobile River Bridge is about 3.2 miles north of the actual accident site.

Between 3:02 and 3:05 a.m., the Mobile Police Department's 911 operator contacted the Mobile Fire Department and the Coast Guard. Police, fire, and Coast Guard personnel began notifying other emergency responders; more than 60 local departments eventually responded. Train No. 2's OBS supervisor, using a cellular telephone, called the Mobile 911 operator about 3:05 a.m. and provided additional information about the accident location and what was taking place at the site. The OBS supervisor, however, did not know the exact location of the derailment. For about 18 minutes—from 3:02 to 3:20 a.m.—confusion ensued as the Mobile, Saraland, and Chickasaw 911 operators tried to locate the accident site. Exactly where train No. 2 had derailed was unclear, and no roads lead into the area, which is heavily wooded swampland. Before they knew they would have to respond by water or rail, the emergency responders searched by land for the accident site.

The Mobile fireboat RAMONA DOYLE arrived about 4 a.m. (over 1 hour after the accident) and, after determining that no other people remained in the water, started fighting the fire.

At approximately 4:25 a.m., the Coast Guard's rigid-hull inflatable boat arrived and started assisting passengers. Coast Guard helicopters arrived on scene about 5:20 a.m. and started assisting passengers. The MAUVILLA transported the survivors it had rescued to a triage area at the Scott Paper Company pier in Chickasaw. Coast Guard, local emergency medical services personnel, and other towboats that responded to the distress call also took survivors to the two triage sites established at the Scott Paper Company in Chickasaw. The last survivors were treated and transported to local hospitals or hotels by 8:30 a.m.

Training of Emergency Responders: Although the Mobile County Emergency Management Agency (MCEMA) held drills to simulate transportation accidents before this accident, those drills did not include simulations of an accident involving railroad operations. Amtrak representatives had to show divers searching the submerged cars the layout of cars that remained on the bridge because the divers were not familiar with the train equipment. Since the accident,

floor plans and videotape describing Amtrak's emergency procedures have been provided to the Mobile Fire Department.

Number of Passengers and Crew: The ticket count on the day after the accident indicated that 189 passengers and 18 employees (6 operating and 12 OBS) were on board the Sunset Limited. Rescuers recovered 3 unticketed infants, bringing the passenger and crew count to 210. An Amtrak representative later told NTSB investigators that, after the accident, 10 additional people reported that they had been passengers on the train. Because passengers board and exit at various stops and because some passengers purchase tickets on board instead of making reservations, Amtrak could not determine whether these 10 people were on train No. 2 during the derailment. Nonetheless, they have been included in the passenger and crew count, bringing the total to 220.

Passenger and Crew Injuries: Of the operating crew, 3 sustained fatal injuries, 2 minor injuries, and 1 was uninjured, while 2 of the OBS crew sustained fatal injuries, 6 minor injuries, and 4 were uninjured. Of the passengers, 42 sustained fatal injuries, 4 serious injuries, 99 minor injuries, and 57 were uninjured.

Cause of Death: Autopsy reports show that 42 passengers died from asphyxia due to drowning. Three locomotive engineers died as a result of asphyxia and blunt force trauma while inside the lead locomotive unit cab that became filled with mud. Two OBS crewmembers in a section of the dorm-coach that sustained major structural damage died as a result of smoke inhalation.

Manifest Identified as Issue by NTSB: Yes.

Other Issues Identified by NTSB: Towboat operator training and evaluation, bridge risk assessment, bridge identification, portable emergency lighting, procedures for apprising passengers of safety features, train recorder crashworthiness, inadequate emergency response training related to passenger train accidents

Likely Impact of Having a Manifest: None. The first emergency responders did not arrive until 1 hour after the accident. The 42 passengers who drowned died within minutes of the cars entering the water. Fellow passengers, the surviving train crew, and the crew of the towboat that had struck the bridge and another towboat that was in the vicinity rescued passengers.

During rescue activities on the day of the accident, an Amtrak representative provided the incident commander with a partial passenger and crew list and told him that about 200 people were on board. A list compiled later the next day showed 207 people. The delay in providing the exact count caused problems because the incident commander had to assign personnel to spend a day counting tickets to help develop a passenger list. In addition, emergency responders did not know when to discontinue operations because the count changed frequently. The railroad was not aware that three infants were on board because they were not ticketed.

Since most OBS crewmembers were asleep in the dorm-coach and since the train attendants were in the cars on the bridge, passengers in the submerged cars had to make decisions on their own and evacuate without assistance.

According to passengers in the totally submerged car (coach 34068), the lower level and front section of the car filled with water in seconds, limiting the time passengers in those sections had to evacuate. The center and rear sections on the upper level remained out of the water for about 10 minutes, and passengers evacuated through the open rear door and window exits on the upper level.

The assistant conductor told passengers atop the coach that was partially submerged and sinking (coach 34083) to swim to the east bank toward the rear of the train. Passengers inside this coach stated that the lower level and rear of the car filled with water in seconds, limiting the evacuation time for passengers in those sections. Bridge timbers held the upper level and front of the car out of the water; passengers in those sections evacuated through the window exits on the upper level in about 30 minutes.

The OBS supervisor and three OBS crewmembers (the other eight OBS crewmembers were in the dorm-coach, which was burning on the east side of the bayou) began evacuating the cars that remained on the bridge. They evacuated them to the tracks at the rear of the train.

The assistant conductor set up a relay system in the water with passengers who could swim. The assistant conductor instructed passengers participating in the relay to space themselves "about 20 yards apart" and to "swim out and meet these elderly people [who were evacuating from submerged cars] and swim them to the next guy and so forth, on up to the bank." The relay passed people from the middle of the waterway to the west bank of the bayou.

Six OBS crewmembers evacuated from the dorm-coach, which was on fire. They entered the water, were rescued by the crew of the towboat MAUVILLA, and then helped passengers out of the water.

When the towboats and traincrew had rescued most of the people from the water, the conductor and assistant conductor began taking a head count of the passengers and passed out blankets and pillows. The OBS supervisor distributed cushions, and the assistant conductor informed the passengers that a train would take them back to Mobile.

After emergency responders arrived at the accident site, they began rescue operations, recovery of bodies, triage, and firefighting activities. The Coast Guard on-scene commander provided assistance and resources, including planes, helicopters, boats, and manpower, throughout the emergency. The MAUVILLA's crew, SCOTT PRIDE personnel, train crewmembers, and volunteers were all instrumental in rescuing people from the water and evacuating passengers from the train immediately following the accident.

Appendix E. Emergency Preparedness Guidelines for Passenger Trains

CFR Part 239–*Passenger Train Emergency Preparedness*–became effective May 4, 1998. These regulations attempt to address many of the issues raised in various NTSB reports.

CFR Part 239 prescribes minimum standards for the preparation, adoption, and implementation of emergency preparedness plans by railroads operating passenger trains. FRA must approve plans.

Plans shall include the following elements:

(1) Communication
(2) Employee training and qualification
(3) Joint operations
(4) Special circumstances
(5) Liaison with emergency responders
(6) Onboard emergency equipment
(7) Passenger safety information

CFR Part 239 indicates that Amtrak is required to conduct a full-scale emergency simulation during each calendar year. Further, Amtrak is required to conduct a debriefing and critique session within 60 days of the emergency simulation or an actual passenger train emergency situation.[3] Amtrak is required to maintain records of these debriefings for 2 calendar years and make them available to FRA for inspection and copying.

CFR Part 239 seems to be loosely based on a 1993 Volpe study for FRA, *Recommended Emergency Preparedness Guidelines for Passenger Trains.*[4] Relevant highlights from that report are provided below.

"An understanding of the types of emergencies, which could occur, and their related hazards is necessary for effective emergency preparedness planning and specific protocol and procedure development. Typical emergency scenarios include illness or injury, stalled train, sudden stop of train, suicide/other collision with a person, collision/derailment, fire, collision/derailment and

[3] Emergency or emergency situation means an unexpected event related to the operation of passenger train service involving a significant threat to the safety or health of one or more persons requiring immediate action, including:

(1) A derailment
(2) A fatality at a grade crossing
(3) A passenger or employee fatality, or serious illness or injury to one or more passengers or crewmembers requiring admission to a hospital
(4) An evacuation of a passenger train
(5) A security situation (e.g., a bomb threat)

[4] Markos, Stephanie H., *Emergency Preparedness Guidelines for Passenger Trains* ,Report No. DOT/FRA/ORD-93/24, prepared for Federal Railroad Administration, Office of Research and Development, John A. Volpe National Transportation Systems Center, Cambridge, December 1993.

fire, collision/derailment with water immersion, severe weather conditions/natural disasters, and security situations (e.g., bombings, bomb threats, hijackings, civil disorders, and acts of terrorism). It is quite possible that an emergency could involve a combination of these scenarios." (p. 2-2)

"Many serious injuries and damage to train equipment may occur as a result of a train derailment and/or collision. Persons may be injured from impact forces or being trapped by mangled or twisted car body or interior components. The priority for the train crew, if a derailment/collision occurs which does not involve fire or other immediate danger, is to notify the Train Dispatcher/Control Center personnel who will inform the appropriate emergency response organization(s). Stabilization of train equipment to reduce hazards may be necessary. Removing electrical power from downed or damaged power lines and the third rail must be arranged. If a person suffers a life threatening injury, first aid from the train crew or fellow passengers may help. Rapid evacuation is generally secondary to immediate treatment by emergency response organization personnel, unless staying on the train is itself life-threatening. Once injured passengers are medically stabilized, they will be removed and transported to a medical facility." (p. 2-8)

"The occurrence of a train or facility fire/smoke situation is a potentially life-threatening event which may require rapid evacuation of all individuals from the affected cars or area to avoid casualties resulting from burns, or toxic gas inhalation. Fire often causes panic and confusion; smoke may decrease visibility, making it difficult for passengers, train crew, and other passenger train system operating organization and emergency response personnel to find emergency exits (and access points)." (p. 2-9)

"A train derailment/collision that involves fire or smoke is one of the most serious emergency scenarios, which could occur. Spilled or leaking fuel can ignite. The hazards of the fire/smoke scenario are aggravated by the possibility that the train crew and many passengers may sustain injury during a collision or derailment and may require immediate medical treatment. This combination of events makes it more difficult than for either condition separately, yet evacuation is even more imperative. Immediate evacuation of injured passengers takes precedence over medical treatment." (p. 2-9)

"A derailment/collision that results in passenger cars and/or motive power units being immersed in water is another situation in which evacuation is critical. Passengers and crew may drown, whether injured or not in the initial accident, unless other crew or passengers aid them until emergency response personnel arrive. Fire caused by ignited fuel oil, which has spread onto the water surface, is an added hazard. As in the previous scenario, immediate evacuation of injured persons takes precedence over treatment." (p. 2-10)

"However, train location, the time of day, day of week, season of the year, and weather could affect the ability of the appropriate emergency response organization to take action or gain access to the site of the emergency. Personnel may also be unavailable or may be unable to respond immediately because they do not possess sufficient information or must perform other duties (e.g., all personnel could be responding to another emergency)." (p. 2-19)

"Due to the magnitude of the emergency or its isolated location, it may be difficult to notify the Train Dispatcher/Control Center. Moreover, due to the lack of (or delay in) emergency response organization notification or due to the location of the emergency, emergency response organization personnel may not immediately reach the emergency site. The train crew should assess the situation and, if uninjured, provide the necessary initial response until emergency personnel arrive, particularly if a life-threatening situation makes it necessary to evacuate passengers. This response should include making PA announcements by one of the train crew or onboard service employees, under the direction of the conductor, to keep passengers informed and provide directions. All individuals traveling on board the passenger train should be accounted for (particularly car compartments) so as to expedite evacuation, if necessary, and to avoid needless efforts to search for "missing" persons." (p. 3-12)

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

Once the incident officer-in-charge has completed the assessment and has requested the necessary further assistance, that person should appoint certain individuals to control hazards, other individuals to maintain support operations, and others to locate victims. As mentioned previously, all individuals should be accounted for (particularly in sleeping car compartments) in order to expedite evacuation and to avoid efforts to search for "missing" persons. Some passengers may have already been removed from the train and/or right-of-way/wayside facility by passersby or may have wandered from the scene." (p. 3-13)

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

If no emergency response personnel are on the scene during a life-threatening situation, if their arrival time is unknown or delayed and if the train is located in an isolated area, it may be necessary for the train crew, onboard service employees, or other passenger train operating system operator personnel, or "Good Samaritans" to take some type of extrication and removal action to avert major injuries to or death of individuals who are trapped." (p. 3-19)

"If passengers are on a disabled train but are not injured or face no imminent danger, they could safely await the arrival of trained personnel with appropriate evacuation equipment. However, in a serious emergency involving smoke or fire, passengers may have to evacuate the train before emergency response personnel arrive. Thus, passenger train system operators should take steps to increase passenger awareness about the train system and basic evacuation procedures and equipment. Since passengers could inadvertently jeopardize their safety, it is appropriate for them to take the initiative only if the train crew or onboard service employees are incapacitated." (p. 4-25)

Appendix F. Amtrak Injury/Fatality Accidents by Type of Service

Table 13. Amtrak Accidents Resulting in Passenger Injury/Fatality Sleeper Trains

Year	Month	Day	Event	Train Name	Location	St	Passengers Killed	Passengers Injured
1993	February	23	Derailment	City of New Orleans	Memphis	TN	0	1
1993	March	17	Highway-rail collision/impact	Silver Meteor/Palm/Star	Fort Lauderdale	FL	0	2
1993	May	21	Derailment	Silver Meteor	Miami	FL	0	4
1993	August	3	Highway-rail collision/impact	Southwest Chief	Lamar	CO	0	2
1993	September	22	Derailment	Sunset Limited	Akka	AL	42	90
1993	November	30	Highway-rail collision/impact	Silver Meteor	Russell	FL	0	18
1993	December	21	Highway-rail collision/impact	Three Rivers	Hammond	IN	0	2
1994	March	3	Highway-rail collision/impact	California Zephyr	Platteville	CO	0	1
1994	May	16	Collision-between on track equipment	Silver Meteor	Selma	NC	0	13
1994	August	3	Derailment	Lake Shore Limited	Batavia	NY	0	33
1995	May	2	Highway-rail collision/impact	Silver Star	Fairfax	SC	0	28
1995	October	9	Derailment	Sunset Limited	Gillespie	AZ	0	25
1996	March	5	Highway-rail collision/impact	Southwest Chief	Albuquerque	NM	0	1
1996	March	24	Collision with obstacle on track	Empire Builder	Spokane	WA	0	1
1997	January	18	Highway-rail collision/impact	Crescent	Rapidan	VA	0	6
1997	February	5	Highway-rail collision/impact	Silver Meteor	Jacksonville	FL	0	7
1997	February	13	Highway-rail collision/impact	Crescent	Leeds	AL	0	1
1997	July	8	Derailment	Silver Palm/Star	Alexandria	VA	0	1
1997	August	9	Derailment	Southwest Chief	Kingman	AZ	1	37
1997	September	29	Highway-rail collision/impact	Silver Star	Raleigh	NC	0	2
1997	October	9	Highway-rail collision/impact	Silver Star	Savannah	GA	0	7
1997	October	31	Derailment	Empire Builder	Chicago	IL	0	1
1997	December	30	Highway-rail collision/impact	Coast Starlight	Morgan Hill	CA	0	2

Table 13. Amtrak Accidents Resulting in Passenger Injury/Fatality
Sleeper Trains (continued)

Year	Month	Day	Event	Train Name	Location	St	Passengers Killed	Passengers Injured
1998	March	10	Highway-rail collision/impact	Silver Star	Winter Haven	FL	0	1
1998	April	13	Derailment	Three Rivers	Baden	PA	0	9
1998	April	21	Highway-rail collision/impact	Coast Starlight	King City	CA	0	1
1998	May	28	Highway-rail collision/impact	California Zephyr	Yuma	CO	0	1
1998	August	4	Highway-rail collision/impact	Crescent	Tyler	MS	0	2
1998	July	11	Highway-rail collision/impact	Coast Starlight	Moorpark	CA	0	4
1998	December	20	Derailment	Texas Eagle	Arlington	TX	0	1
1999	March	15	Highway-rail collision/impact	City of New Orleans	Bourbannais	IL	11	32
1999	July	8	Highway-rail collision/impact	Sunset Limited	Eagle Lake	TX	0	1
1999	September	20	Collision-between on track equipment	Capitol Limited	Cumberland	MD	0	8
1999	October	22	Derailment	Sunset Limited	Palm Springs	CA	0	1
1999	November	4	Highway-rail collision/impact	Coast Starlight	Salinas	CA	0	1
1999	December	10	Highway-rail collision/impact	Crescent	Russell	MS	0	1
2000	January	6	Derailment	Empire Builder	Essex	MT	0	1
2000	January	29	Derailment	Capitol Limited	Stewarton	PA	0	2
2000	March	15	Derailment	Southwest Chief	Carbondale	KS	0	30
2000	April	29	Highway-rail collision/impact	Coast Starlight	Castroville	CA	0	1
2000	May	19	Highway-rail collision/impact	Palmetto	Fort Lauderdale	FL	0	1
2000	August	21	Derailment	Silver Meteor	Lake City	SC	0	24
2001	February	4	Highway-rail collision/impact	Southwest Chief	Macksville	KS	0	1
2001	February	15	Highway-rail collision/impact	Three Rivers	Gary	IN	0	1
2001	March	17	Derailment	California Zephyr	Nodaway	IA	1	34
2001	July	15	Highway-rail collision/impact	Coast Starlight	Newark	CA	0	1
2001	July	29	Derailment	Texas Eagle	Annapolis	MO	0	9
2001	September	11	Collision-between on track equipment	Texas Eagle	Hallsville	TX	0	10
2001	September	13	Collision-between on track equipment	California Zephyr	Wendover	UT	0	14

Table 13. Amtrak Accidents Resulting in Passenger Injury/Fatality
Sleeper Trains (continued)

Year	Month	Day	Event	Train Name	Location	St	Passengers Killed	Passengers Injured
2002	February	17	Struck against object	Southwest Chief	Raton	NM	0	2
2002	March	19	Highway-rail collision/impact	Crescent	Birmingham	AL	0	1
2002	April	18	Derailment	Auto Train	Crescent City	FL	4	107
2002	May	14	Highway-rail collision/impact	Silver Meteor	Ridgeland	SC	0	13
2002	June	17	Collision-between on track equipment	Palmetto	Baltimore	MD	0	5
2002	July	29	Derailment	Capitol Limited	Kensington	MD	0	61
2002	July	29	Highway-rail collision/impact	Coast Starlight	Castroville	CA	0	1
2002	July	30	Highway-rail collision/impact	Silver Star	Haines City	FL	0	3
2002	August	21	Derailment	Coast Starlight	Hayward	CA	0	2
2002	October	10	Derailment	Empire Builder	Chicago	IL	0	1
2003	April	23	Collision-between on track equipment	Coast Starlight	Castella	CA	0	1
2003	May	6	Highway-rail collision/impact	Silver Star	McIntosh	GA	0	16
2003	August	28	Highway-rail collision/impact	Crescent	Bristow	VA	0	7
2003	November	26	Highway-rail collision/impact	Texas Eagle	Leeper	MO	0	2
Total Sleeper			63				59	699

Table 14. Amtrak Accidents Resulting in Passenger Injury/Fatality
Reserved Trains

Year	Month	Day	Event	Train Name	Location	St	Passengers Killed	Passengers Injured
1993	June	28	Highway-rail collision/impact	State House	Alton	IL	0	13
1993	August	24	Highway-rail collision/impact	Lake Cities	Kalamazoo	MI	0	1
1994	June	6	Highway-rail collision/impact	International	Kalamazoo	MI	0	6
1995	September	6	Highway-rail collision/impact	San Joaquin	Merced	CA	0	2
1997	August	31	Highway-rail collision/impact	San Joaquin	Madera	CA	0	7
1997	September	15	Highway-rail collision/impact	Pere Marquette	Gary	IN	0	1
1998	June	18	Highway-rail collision/impact	Carolinian	Durham	NC	0	4
1998	September	29	Highway-rail collision/impact	State House	Wilmington	IL	0	1
1998	November	5	Highway-rail collision/impact	San Joaquin	Pittsburg	CA	0	1
1999	August	30	Highway-rail collision/impact	San Joaquin	Fresno	CA	0	1
2000	August	27	Derailment	San Joaquin	Fresno	CA	0	1
2001	February	5	Collision-between on track equipment	Empire	Syracuse	NY	0	37
2001	May	4	Highway-rail collision/impact	San Joaquin	Planada	CA	0	3
2001	August	30	Highway-rail collision/impact	Illini	Centralia	IL	0	1
2002	April	10	Derailment	Kentucky Cardinal	Jeffersonville	IN	0	3
2002	May	26	Highway-rail collision/impact	Illini	Danforth	IL	0	1
2002	June	4	Collision/impact-auto, truck, bus, etc.	San Joaquin	Wasco	CA	0	1
2002	September	5	Highway-rail collision/impact	Cascade	Everett	WA	0	1
2003	March	27	Highway-rail collision/impact	San Joaquin	Fresno	CA	0	1
Total Reserved			19				0	86

Table 15. Amtrak Accidents Resulting in Passenger Injury/Fatality
Unreserved Trains

Year	Month	Day	Event	Train Name	Location	St	Passengers Killed	Passengers Injured
1993	January	1	Highway-rail collision/impact	Pacific Surfliner	Ponto	CA	0	3
1997	February	20	Highway-rail collision/impact	Pacific Surfliner	San Juan Capistrano	CA	0	5
2000	November	4	Highway-rail collision/impact	Pacific Surfliner	Moorpark	CA	0	4
2001	November	23	Highway-rail collision/impact	Pacific Surfliner	Camarillo	CA	0	1
2002	September	28	Collision/impact-auto, truck, etc.	Pacific Surfliner	San Juan Capistrano	CA	0	1
2003	December	14	Struck object on tracks	Capital	Rodeo	CA	0	1
Total Unreserved			6				0	15

Table 16. Amtrak Accidents Resulting in Passenger Injury/Fatality
Unknown Train Type

Year	Month	Day	Event	Train Name	Location	St	Passengers Killed	Passengers Injured
1993	November	23	Derailment	Unknown	Boise	ID	0	3
1994	April	15	Collision-between on track equipment	Unknown	Old Saybrook	CT	0	4
1997	January	13	Derailment	Unknown	Granite	WY	0	7
1996	November	23	Derailment	Unknown	Newark	NJ	0	13
Total Unknown			4				0	27

Appendix G. Amtrak Route Characteristics by Route

Table 17. Selected Characteristics–Overnight/Sleeper Routes

Route Number	Route Name	Ridership	Percent	Trains/Week (Both Ways)	Percent
06	Federal (Twilight Shoreliner)[5]	168,362	0.7%	14	0.8%
16	Silver Star	262,753	1.1%	14	0.8%
17	Three Rivers	146,739	0.6%	14	0.8%
18	Cardinal	78,942	0.3%	6	0.3%
19	Silver Meteor	300,687	1.3%	14	0.8%
25	Empire Builder	440,891	1.9%	14	0.8%
26	Capitol Limited	168,523	0.7%	14	0.8%
27	California Zephyr	341,770	1.5%	14	0.8%
28	Southwest Chief	289,852	1.2%	14	0.8%
30	City of New Orleans	191,361	0.8%	14	0.8%
32	Texas Eagle	230,246	1.0%	14	0.8%
33	Sunset Limited	112,006	0.5%	6	0.3%
34	Coast Starlight	456,269	1.9%	14	0.8%
45	Lake Shore Limited	276,397	1.2%	14	0.8%
52	Crescent	263,875	1.1%	14	0.8%
63	Auto Train	199,804	0.9%	14	0.8%
	Total	**3,928,477**	**16.7%**	**208**	**11.4%**

All data are for 2003

[5] In 2004, the Federal was replaced by an all reserved Regional without sleeper service.

Table 18. Selected Characteristics–Reserved Routes

Route Number	Route Name	Ridership	Percent	Trains/Week (Both Ways)	Percent
1	Metroliner/Acela Express	3,002,451	12.8%	214	11.8%
4	Vermonter	258,899	1.1%	14	0.8%
9	Downeaster	257,801	1.1%	8	0.4%
20	Chicago-St. Louis	106,284	0.5%	28	1.5%
22	Chicago-Pontiac	344,107	1.5%	42	2.3%
23	Illini	105,879	0.5%	14	0.8%
24	Illinois Zephyr	107,250	0.5%	14	0.8%
29	Heartland Flyer	49,033	0.2%	14	0.8%
36	Cascades	589,913	2.5%	70	3.8%
39	San Joaquins	783,096	3.3%	84	4.6%
40	Adirondack	131,250	0.6%	14	0.8%
41	International	83,530	0.4%	14	0.8%
48	Palmetto (Silver Palm)	204,577	0.9%	14	0.8%
54	Hoosier State (Kentucky Cardinal)	19,248	0.1%	14	0.8%
56	Kansas City-St. Louis	239,429	1.0%	28	1.5%
65	Pere Marquette	75,606	0.3%	14	0.8%
66	Carolinian	323,481	1.4%	14	0.8%
67	Piedmont	41,310	0.2%	14	0.8%
	Total	**6,723,144**	**28.7%**	**628**	**34.5%**

All data are for 2003

Table 19. Selected Characteristics–Unreserved Routes

Route Number	Route Name	Ridership	Percent	Trains/Week (Both Ways)	Percent
13	Clocker Service	1,553,696	6.6%	36	2.0%
14	Keystone	1,250,345	5.3%	106	5.8%
21	Hiawathas	424,318	1.8%	96	5.3%
35	Pacific Surfliner	2,228,042	9.5%	162	8.9%
37	Capitols	190,110	0.8%	156	8.6%
57	Pennsylvanian	148,841	0.6%	14	0.8%
	Total	**5,795,352**	**24.7%**	**570**	**31.3%**

All data are for 2003

Table 20. Selected Characteristics–Mixed Reserved/Unreserved Routes[6]

Route Number	Route Name	Ridership	Percent	Trains/Week (Both Ways)	Percent
5	Unreserved NE Direct/Acela Regional	4,800,953	20.5%	219	12.0%
5	Reserved NE Direct/Acela Regional	1,052,264	4.5%	48	2.6%
3	Ethan Allen Express	109,858	0.5%	14	0.8%
7	Maple Leaf	174,958	0.7%	14	0.8%
15	Unreserved Empire Service	704,464	3.0%	92	5.1%
15	Reserved/Mixed Empire Service	167,234	0.7%	28	1.5%
	Total	**7,009,731**	**29.9%**	**415**	**22.8%**

All data are for 2003

[6] NE Direct/Acela Regional operates a mix of reserved/unreserved trains. In 2003, 18 percent of trains were reserved.

The Ethan Allen Express is reserved north of Albany. In year 2003, 32.5 percent of traffic was reserved.

The Maple Leaf currently operates as an unreserved train from New York to Albany and as a reserved train from Albany to Toronto. In year 2003, 75.4 percent of traffic was reserved.

Only two Empire trains/day operate from New York to Niagara Falls. About 6-7 trains/day operate from New York to Albany. All trains are unreserved from New York to Albany. Two trains operate as reserved trains from Albany to Niagara Falls. In year 2003, 19.2 percent of traffic was reserved.

Table 21. Staffed/Unstaffed Amtrak Stations–Sleeper Routes

Route Number	Name	Stations Served				
		Total	Staffed	Percent	Unstaffed	Percent
06	Federal[7]	20	20	100%	0	0%
16	Silver Star	33	24	73%	9	27%
17	Three Rivers	20	11	55%	9	45%
18	Cardinal	34	16	47%	18	53%
19	Silver Meteor	33	24	73%	9	27%
25	Empire Builder	45	24	53%	21	47%
26	Capitol Limited	15	6	40%	9	60%
27	California Zephyr	35	17	49%	18	51%
28	Southwest Chief	32	15	47%	17	53%
30	City of New Orleans	19	8	42%	11	58%
32	Texas Eagle	40	18	45%	22	55%
33	Sunset Limited	40	10	25%	30	75%
34	Coast Starlight	29	20	69%	9	31%
45	Lake Shore Limited	25	15	60%	10	40%
52	Crescent	32	18	56%	14	44%
63	Auto Train	2	2	100%	0	0%

[7] In 2004, the Federal was replaced by an all reserved Regional without sleeper service.

Table 22. Staffed/Unstaffed Amtrak Stations–Reserved Routes

Route Number	Name	Stations Served				
		Total	Staffed	Percent	Unstaffed	Percent
01	Metroliner/Acela Express	18	18	100%	0	0%
04	Vermonter	26	15	58%	11	42%
09	Downeaster	9	2	22%	7	78%
20	Chicago-St. Louis	11	6	55%	5	45%
23	Chicago-Pontiac	15	8	53%	7	47%
23	Illini	11	4	36%	7	64%
24	Illinois Zephyr	10	3	30%	7	70%
29	Heartland Flyer	7	1	14%	6	86%
36	Cascades	16	12	75%	4	25%
39	San Joaquins	16	9	56%	7	44%
40	Adirondack	19	10	53%	9	47%
41	International	20	7	35%	13	65%
48	Palmetto (Silver Palm)	35	26	74%	9	26%
54	Hoosier State (Kentucky Cardinal)	6	2	33%	4	67%
56	Kansas City-St. Louis	20	7	35%	13	65%
65	Pere Marquette	6	1	17%	5	83%
66	Carolinian	25	17	68%	8	32%
67	Piedmont	8	4	50%	4	50%

Table 23. Staffed/Unstaffed Amtrak Stations–Mixed Reserved/Unreserved Routes

Route Number	Name	Stations Served				
		Total	Staffed	Percent	Unstaffed	Percent
03	Ethan Allen Express	12	8	67%	4	33%
05	NE Direct/Acela Regional	35	27	77%	8	23%
07	Maple Leaf	22	17	77%	5	23%
15	Empire Service	16	13	81%	3	19%

Table 24. Passenger Boardings by Station Type–Sleeper Routes

Route Number	Name	Passenger Boardings				
		Total	Staffed	Percent	Unstaffed	Percent
06	Federal[8]	168,362	168,362	100%	0	0%
16	Silver Star	262,753	240,332	91%	22,421	9%
17	Three Rivers	146,739	131,469	90%	15,270	10%
18	Cardinal	78,942	61,483	78%	17,459	22%
19	Silver Meteor	300,687	271,532	90%	29,155	10%
25	Empire Builder	440,891	388,898	88%	51,993	12%
26	Capitol Limited	168,523	150,932	90%	17,591	10%
27	California Zephyr	341,770	304,575	89%	37,195	11%
28	Southwest Chief	289,852	246,165	85%	43,687	15%
30	City of New Orleans	191,361	169,361	89%	22,000	11%
32	Texas Eagle	230,246	214,881	93%	15,365	7%
33	Sunset Limited	112,006	92,196	82%	19,810	18%
34	Coast Starlight	456,269	424,521	93%	31,748	7%
45	Lake Shore Limited	276,397	261,619	95%	14,778	5%
52	Crescent	263,875	235,833	89%	28,042	11%
63	Auto Train	199,804	199,804	100%	0	0%
	Total	**3,928,477**	**3,561,965**	**91%**	**366,512**	**9%**

[8] In 2004, the Federal was replaced by an all reserved Regional without sleeper service.

Table 25. Passenger Boardings by Station Type–Reserved Routes

Route Number	Name	Passenger Boardings				
		Total	Staffed	Percent	Unstaffed	Percent
01	Metroliner/Acela Express	3,002,451	3,002,451	100%	0	0%
04	Vermonter	258,899	229,003	88%	29,896	12%
09	Downeaster	257,801	184,988	72%	72,813	28%
20	Chicago-St. Louis	106,284	98,704	93%	7,580	7%
23	Chicago-Pontiac	344,107	320,659	93%	23,448	7%
23	Illini	105,879	91,552	86%	14,327	14%
24	Illinois Zephyr	107,250	60,084	56%	47,166	44%
29	Heartland Flyer	49,033	19,091	39%	29,942	61%
36	Cascades	589,913	554,117	94%	35,796	6%
39	San Joaquins	783,096	724,991	93%	58,105	7%
40	Adirondack	131,250	116,916	89%	14,334	11%
41	International	83,530	59,449	71%	24,081	29%
48	Palmetto (Silver Palm)	204,577	189,804	93%	14,773	7%
54	Hoosier State (Kentucky Cardinal)	19,248	15,949	83%	3,299	17%
56	Kansas City-St. Louis	239,429	155,125	65%	84,304	35%
65	Pere Marquette	75,606	37,228	49%	38,378	51%
66	Carolinian	323,481	294,245	91%	29,236	9%
67	Piedmont	41,310	34,107	83%	7,203	17%
	Total	**6,723,144**	**6,188,464**	**92%**	**534,680**	**8%**

Table 26. Passenger Boardings by Station Type–Partially Reserved Routes

Route Number	Name	Passenger Boardings				
		Total	Staffed	Percent	Unstaffed	Percent
03	Ethan Allen Express	109,858	96,528	88%	13,330	12%
05	NE Direct/Acela Regional	5,853,217	5,806,114	99%	47,103	1%
07	Maple Leaf	174,958	169,382	97%	5,576	3%
15	Empire Service	871,698	810,287	93%	61,411	7%
	Total	**7,009,731**	**6,882,310**	**98%**	**127,421**	**2%**

Table 27. Station Intervals (in miles)–Sleeper Routes

Route Number	Name	All Stations		Staffed Stations Only	
		Average	Maximum	Average	Maximum
06	Federal[9]	24.1	69	24.1	69
16	Silver Star	43.4	106	60.4	203
17	Three Rivers	47.8	137	90.8	464
18	Cardinal	34.7	69	76.4	279
19	Silver Meteor	43.4	109	63.1	196
25	Empire Builder	58.8	148	112.4	296
26	Capitol Limited	54.6	88	152.8	283
27	California Zephyr	71.7	263	152.4	594
28	Southwest Chief	72.8	173	173.5	493
30	City of New Orleans	51.4	124	132.3	221
32	Texas Eagle	69.9	218	160.5	604
33	Sunset Limited	70.9	218	345.5	622
34	Coast Starlight	49.6	121	73.1	324
45	Lake Shore Limited	48.3	108	82.7	187
52	Crescent	44.4	100	81.0	202
63	Auto Train	855.0	855	855.0	855

[9] In 2004, the Federal was replaced by an all reserved Regional without sleeper service.

Table 28. Station Intervals (in miles)–Reserved Routes

Route Number	Name	All Stations		Staffed Stations Only	
		Average	Maximum	Average	Maximum
01	Metroliner/Acela Express	26.9	69	26.9	69
04	Vermonter	24.2	68	40.4	251
09	Downeaster	14.5	34	116.0	116
20	Chicago-St. Louis	28.4	39	56.8	87
23	Chicago-Pontiac	21.7	38	38.0	89
23	Illini	31.0	53	103.3	181
24	Illinois Zephyr	28.7	56	86.0	134
29	Heartland Flyer	34.3	65	206.0	206
36	Cascades	31.1	58	42.4	82
39	San Joaquins	24.2	48	40.3	81
40	Adirondack	21.2	45	42.3	199
41	International	26.4	89	83.7	161
48	Palmetto (Silver Palm)	40.9	143	55.6	143
54	Hoosier State (Kentucky Cardinal)	39.2	65	196.0	196
56	Kansas City-St. Louis	29.8	64	94.5	283
65	Pere Marquette	35.2	61	176.0	176
66	Carolinian	29.3	98	44.0	114
67	Piedmont	24.7	47	57.7	89

Table 29. Station Intervals (in miles)–Partially Reserved Routes

Route Number	Name	All Stations		Staffed Stations Only	
		Average	Maximum	Average	Maximum
03	Ethan Allen Express	21.9	40	30.1	63
05	NE Direct/Acela Regional	18.9	55	24.8	101
07	Maple Leaf	26.0	80	34.1	80
15	Empire Service	30.7	80	38.4	80

Appendix H. Cost Estimate Assumptions for System Improvements

H.1 General Cost Considerations

In general, introducing any automated ticket collection system, including those proposed in Section 7 of this report, will include many, if not all, of the following types of cost elements:

- System design and development effort (i.e., staff and/or consultant time), including specifications for equipment, and ticket media
- Procurement and installation of fare collection and dispensing equipment and related software (e.g., card accepting devices and application software and card dispensing machines)
- Procurement and installation of station- and central-computer system (including software)
- Installation or modification of the communications infrastructure and system
- Purchase or production of fare media
- Day-to-day administration
- Maintenance and repair
- Marketing (promotion and education of customers)
- Sales and distribution
- Revenue accounting
- Training (e.g., maintenance, operations, customer service, and revenue and finance)[10]

Fare collection equipment tends to be a customized product. No typical cost exists; rather, a range of costs can be estimated, keeping in mind that many conditions and assumptions may be involved in the estimate. Unit costs are generally developed for each type of equipment based on the supplier quotations, equipment characteristics, experience with recent purchases, and appropriate multipliers to allow for economies of scale and escalation for the time value of money. In addition, costs for engineering and support services depend on the purchasing experience of the agency, the local contracting environment, and the skills available within the agency's personnel—and whether the agency is purchasing this type of equipment for the first time or it is a new generation replacing old equipment. It should also be kept in mind that in many cases, fare collection equipment is largely built in response to individual orders. Each agency's requirements invariably impose different performance features, even if major modules or subassemblies are the same among several orders. Final configurations of even very similar equipment for different agencies are rarely alike.

The price for any type of equipment is therefore sensitive to such factors as the following:

[10] Fleishman, Daniel, *Multipurpose Transit Payment Media, T C R P Report 32*, Transportation Research Board, National Research Council, National Academy Press, Washington, DC, 1998.

- The equipment specifications for the individual agency, including performance requirements and features; this affects the amount of customization required for a product, and this customization can represent a substantial portion of the overall price.
- The quantities of the particular equipment being ordered.
- The extent to which the new equipment will have to interface with existing equipment (i.e., that is not being replaced).
- The nature of the vendor selection and negotiation process (e.g., type of contract: low bid, two step, or negotiated).
- The timing of the procurement (relative to the procurement of similar equipment by other agencies and therefore the extent of refinement of the technology).
- Growth potential (e.g., opportunities for new/extended lines).
- Warranty terms: warranties are generally for 1 year, but this period can be extended based on other clauses associated with equipment performance.
- Documentation requirements (i.e., striking a balance between what is offered as manufacturer's standard and degree of customization for the agency).
- Software requirements: some software customization is expected, but requests for additional functions, features, and reports will be considered extra and will increase the cost.
- Vehicle/station/facility modifications: the cost of modifications to vehicles, stations, or other facilities must also be considered.
- Americans with Disabilities Act (ADA) requirements: fare collection equipment must address ADA requirements; these include accommodation of wheelchairs in turnstiles, compliance with height requirements for buttons on automated vending machines, and accommodation of needs of blind riders in purchasing and using fare media.[11]

Cost components for the various alternative systems considered would include:

Vehicle-Related Costs

Stand-alone smart card processing unit
Application software (smart card units)
Data communications system to/from train
Onboard computer hardware and software
Portable (handheld) ticket scanner with ticket issue capability

Station-Related Costs

Ticket vending machine (TVM)
Booking office machines (BOM)
Bidirectional fare gate (contactless card)
Station hardware/software
Central hardware/software
Communications infrastructure linking station computers and CNOC

[11] *Fare Policies, Structures and Technologies: Update, T C R P Report 94*, Transportation Research Board, National Research Council, National Academy Press, Washington, DC, 2003.

Variable System Costs

Spare Parts
Support services, including training, documentation, revenue testing, and warranties
Installation
Nonrecurring engineering and software costs (equipment development and testing)
Contingency
Equipment maintenance costs (labor and material, shop facilities, and vehicle fleet for maintainers)
Software licenses/system support
Revenue handling costs

Fare Media Costs

Contactless cards (paper)
Other ticket media

Section 7 indicated the specific cost components for each of the alternative systems considered, and the cost estimates were based on the information in this appendix.

H.2 Estimated Quantities

Quantities of the various components used in each of the alternative systems were estimated using the methods described below.

Onboard Door Readers–Amtrak operates 2,141 railroad cars, including 168 sleeper cars, 760 coach cars, 126 first class/business class cars, 66 dormitory crew cars, 225 lounge/café/dinette cars, and 92 dining cars. Baggage cars make up the remainder of the fleet.[12] Of this fleet it is assumed that 1,054 cars (168 sleeper cars, 760 coach cars, and 126 first class/business class cars) would be equipped with door readers. Passengers would not board through dormitory crew cars, lounge/café/dinette cars, or dining cars. This figure represents an upper bound on the number of cars that must be equipped with door readers since all of the coach cars are not used on reserved trains. It was not possible, however, to determine whether coach cars were permanently assigned to specific reserved or unreserved trains, and Amtrak might decide to adopt many elements of a new system for the unreserved trains.

It was assumed that each car would be equipped with two readers. Sleeper cars, coach cars, and first class/business class cars have either two or four doors for passenger boarding exclusive of the doors at each end, which allow passage from one car to another.[13] On those cars having four doors, passenger boarding would have to be restricted to doors equipped with readers, or additional costs incurred to equip all doors. This results in an estimated requirement for 2,108 door readers.

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[12] *Inside Amtrak, Government Affairs, Amtrak Facts*, http://www.amtrak.com.

[13] Superliner I, Superliner II, and Viewliner sleepers have two doors per car. Superliner I, Superliner II, Talgo, Heritage, and Amfleet II coaches have two doors per car, while Horizon, California, Amfleet I, and Metroliner coaches have four doors per car. Talgo and Acela Express first class/business class cars have two doors per car, while other Acela Express first class/business class cars have four doors per car.

Onboard Computers and Communication Devices–In 2003, Amtrak operated 265 trains per day on average. It was assumed that Amtrak would not maintain separate ticketing systems for reserved and unreserved trains. Each alternative was assumed to be implemented system-wide.

It was assumed that each train would be equipped with an onboard computer and a data communications system. With a 10 percent spares allowance this results in an estimated minimum requirement for 291 onboard computers and train-to-station data communications systems. This assumes portable equipment and that each of 336 lounge/café/dinette/dining cars (including Acela trainsets) is outfitted with a docking station for the portable equipment. All of Amtrak's reserved (and many unreserved) trains operate with one or more of these cars.

If built-in computer and train-to-station data communications systems are assumed, then each of the 336 lounge/café/dinette/dining cars would have to be equipped. This is necessary to ensure that trains would not be cancelled because of a malfunction, such as air conditioning, in the car containing the built-in computer. If built-in computer and train-to-station data communications systems are assumed, a need to modify cars may exist to provide for a conductor's office area.

For systems based on satellite/cellular communications technology, it was assumed that each Amtrak locomotive would be equipped with the train-to-CNOC data communications system. This is to provide the system redundancy noted above. Satellite/cellular communications technology would most likely require a locomotive mounted exterior antenna. Amtrak operates 425 locomotives and 19 Acela trainsets[14] for a requirement of 444 satellite/cellular communications systems.

Handheld Ticket Scanning/Issuing Devices–Trains of more than seven revenue cars require three conductors; those with less than seven cars generally have two but could have three under certain circumstances, such as close station spacing or heavy traffic loads.[15]

Information on individual train staffing was not available. It was assumed that there would be an average of 2.5 conductors for each of 265 trains each day. This would lead to a requirement for 662 handheld devices for scanning and issuing tickets on board. With a 10 percent allowance for spares, the requirement becomes 728 handheld devices. If instead each Amtrak conductor were issued a handheld device, even more would be required, so this is a conservative estimate.

Station Computers and Station-to-Train Communication Devices–Amtrak provides service at 211 staffed stations and 304 unstaffed stations with reserved and unreserved trains. This indicates a need for 515 station computers and 515 train-to-station communication devices.

Ticket Vending Machines–Of the staffed stations, 55 also have a Quik-Trak TVM, while 17 unstaffed stations are equipped with a Quik-Trak TVM. It was assumed that all stations having a Quik-Trak would also have a TVM under the proposed alternative system. In addition, all

[14] *Inside Amtrak, Government Affairs, Amtrak Facts*, http://www.amtrak.com.

[15] Telephone conversation with Dave Nogard, Amtrak, April 5, 2004.

unstaffed stations would have a TVM under two of the alternatives. This leads to a requirement for 359 TVMs.

Passenger boarding volumes at unstaffed stations currently without a TVM range from 23,500 per year (64 per day) to 65 per year (less than 1 per day). Passenger boarding volumes at unstaffed stations currently with a TVM range from 21,180 per year (58 per day) to 2,390 per year (7 per day). Using this last figure as the minimum passenger volume for a TVM at an unstaffed station reduces the requirement for TVMs by 162 to 197. However, these 162 unstaffed station locations would have to be provided with a means of issuing tickets to passengers before boarding. This could be accomplished by establishing arrangements with local banks or retail establishments to issue Amtrak tickets on a commission basis. These establishments would have to be provided with a type of BOM for recording reservation and payment information and issuing tickets.

Booking Office Machines–All currently staffed stations would also have to be provided with new BOMs for issuing the new type of tickets. It was assumed that requirements for ticket windows and BOMs would vary as a function on passenger boardings per day. An average transaction time of 2 minutes was assumed.[16] This resulted in the following guidelines for estimating purposes:

< 240 passengers per day	- 1 window
241–480 passengers per day	- 2 windows
481–720 passengers per day	- 3 windows
721–960 passengers per day	- 4 windows
961–1200 passengers per day	- 5 windows
> 1200 passengers per day	- 6 windows

Applying these criteria to the average daily station boarding volumes for currently staffed stations results in a requirement for 310 BOMs (169 stations with 1 window, 21 stations with 2 windows, 5 stations with 3 windows, 4 stations with 4 windows, 4 stations with 5 windows, and 8 stations with 6 windows).

Ticket Reading Gates–Gate requirements at staffed stations were estimated based on the average boarding volume per train for the route having the maximum boarding volume per train at each individual station and an assumed gate throughput rate. Passenger boarding volumes per train at staffed stations range from 2 to 573. The gate throughput rate assumed was 20 passengers per minute.[17] It was assumed that passengers would be prohibited from passing through the gates

[16] The Ernst & Whitney study for New Jersey Transit Corporation provided data on ticket sales per station and number of ticket agents per station for a commuter rail operation. This data indicated that a single ticket window was capable of handling up to 400 ticket sales per day. It was assumed that these transactions would be relatively simple in comparison to the typical Amtrak ticket sale; thus a reduced processing rate was used for this analysis.

[17] Jeffreys, Dennis C., et al., *Evaluation of Automatic Fare Collection Technology–Volume II–Technology Assessment,* prepared for New York Metropolitan Transportation Authority, Arthur D. Little, Inc., Cambridge, September 1984, p.4-1.

and entering the platform area until 5 minutes before the train's arrival. To provide a measure of redundancy in the event of gate malfunction, it was further assumed that the minimum number of gates per station would be two.

Applying these assumptions to the boarding volumes per train for currently staffed stations results in a requirement for 443 gates (198 stations with 2 gates, 8 stations with 3 gates, 4 stations with 4 gates, and 1 station with 7 gates).

Station Modifications–To estimate the cost of station modifications required to accommodate a gated system at all currently staffed stations, stations were classified either as high, moderate, or low cost stations. This classification was based on daily passenger volumes. It was assumed that stations with less than 100 passengers/day (135 stations) would require low cost modifications, stations with 100 to 500 passengers per day (56 stations) would require moderate cost modifications, and stations with over 500 passengers per day (20 stations) would require high cost modifications.

Ticket Stock–The estimated number of smart card tickets required was based on Amtrak's annual ridership in 2003. Amtrak carried approximately 24,000,000 passengers in 2003.[18] It was assumed that this figure includes revenue and non-revenue passengers, although it was not possible to determine this from the detailed ridership data. It was also assumed that most passengers made a round trip, thus implying the need for about 24,000,000 one-way or approximately 12,000,000 round-trip smart card/tickets.

The annual ridership figures, however, include Amtrak monthly and multiride passholders. The following Amtrak Routes offer Multi-ride Ticketing Options: Regional (reserved and unreserved), Clocker Service (unreserved), Keystone Service (unreserved), Downeaster (reserved), Empire Service (unreserved), Wolverine (reserved), Ann Rutledge (reserved), Missouri Mules (reserved), State House (reserved), Hiawatha (unreserved), Cascades (reserved), San Joaquin (reserved), Capitol Corridor (unreserved), and Surfliner (unreserved).

The number of monthly passes issued per year used on these routes was assumed to equal the number of monthly pass holders times 12. The number of monthly pass holders was estimated as the ridership on each route that was listed as other divided by 2 (round trips/year) divided by 12 (round trips/month) divided by 20 (round trips/day). While other generally accounts for data processing errors in the train-specific, origin/destination data, experience indicates that Amtrak accounts for passholders in this category. For example, 332,000 out of 2,228,000 one-way trips (15 percent) fall into the other category on the Pacific Surfliners. In total (based on the other figures for all services on which Amtrak passes can be used), it was estimated that 830,000 one-way trips were made by passholders, resulting in an estimated need for 21,000 smart card passes per year. These figures were used to reduce the number of single-use tickets required.

The report noted that, while the Japanese have achieved rates of up to 65 to 75 passengers per minute per gate with smart cards, ADL was using a rate of 25 passengers per minute per gate to allow for out-of-service equipment. This was further reduced for this analysis to allow for the added impedance of accommodating passengers with luggage.

[18] *Inside Amtrak, Government Affairs, Amtrak Facts,* http://www.amtrak.com.

The final estimated requirement for smart card tickets was estimated as 23,170,000 one-way smart card tickets per year or 11,585,000 round-trip smart card tickets per with an additional 21,000 smart card passes per year in either case.

H.3 Unit Costs

Unit costs used in the order of magnitude cost estimates for each alternative system described in the following section were based on those available in the literature. Much of this work is derived from urban transit system applications of automatic fare collection technology and other Intelligent Transportation Systems Applications (ITS), as well as historical commuter rail operations.[19] Equipment, such as station computers, ticket readers, and gates, would be similar to those that would be used in an Amtrak application. Costs for station modifications needed to accommodate a gated entry/exit system were taken from a feasibility study for an automatic fare collection system for New York's Metropolitan Transportation Authority, which considered a gated entry/exit system for the Long Island Railroad and Metro North Commuter Railroad.[20]

Historic costs were adjusted to 2004 dollars using various industry and commodity components of the Bureau of Labor Statistics' Producers' Price Index.[21]

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[19] Balaban, Dan, "Wave of the Future?", *Card Technology*, January 2002, p.18.

Burger, Todd O., et al., *Evaluation of Automatic Fare Collection Technology–Volume IIIB–Evaluation of System Concepts: Commuter Rail*, prepared for New York Metropolitan Transportation Authority, Arthur D. Little, Inc., Cambridge, Massachusetts, November 1984.

Bushnell, William R., *Smart Cards for Transit: Multi-Use Remotely Interrogated Stored-Data Cards for Fare and Toll Payment*, Report FTA-MA-26-0020-95-1, prepared for Federal Transit Administration, Volpe National Transportation Systems Center, Cambridge, Massachusetts, April 1995.

Commuter Rail Fare Collection, A Comprehensive Strategy for Improvements, prepared for New Jersey Transit Corporation, Ernst & Whitney, December 1982.

Fare Policies, Structures and Technologies: Update, TCRP Report 94, Transportation Research Board, National Research Council, National Academy Press, Washington, DC, 2003.

TTC Fare Collection Study, Toronto Transit Commission, October 2000.

http://www.benefitcost.its.dot.gov/ITS/benecost.nsf.

[20] Grenzeback, Lance R., and Tomasz M. Wiktor, *Evaluation of Automatic Fare Collection Technology–Volume IVB–Station and Vehicle Modifications: Commuter Rail*, prepared for New York Metropolitan Transportation Authority, Arthur D. Little, Inc., Cambridge, Massachusetts, November 1984.

[21] The indices used included communication and related equipment (WPU1176), electronic components and accessories (WPU1178), applications software (PCU5112105112102), non-residential buildings (PCUBBLD), and electronic computers and computer equipment (WPU115). http://www.bls.gov/data/home.htm.

Table H-1 indicates unit costs for the various system components. These costs were applied to the quantities noted in the previous section to develop capital and annual operating cost estimates for each of the alternatives considered in Section 7.

Table 30. Unit Costs, 2004 Dollars

Cost Element	Cost (dollars)		Nature of Cost	
	Low	High	One-Time	Ongoing
Stand-alone smart card processing unit	1,000	6,800	X	
Central computer facility equipment–hardware with backup		1,024,500	X	
Central computer and station software (proprietary) c/w design and development		1,734,400	X	
Station hardware/software per station	6,400	9,200	X	
System integration, communications equipment, and data lines network per station		13,200	X	
TVM	29,000	58,100	X	
Fare gate (magnetic/contactless card)	19,400	33,900	X	
Booking Office Machine		11,800		
Portable (handheld) smart card validator	1,900	3,900	X	
Station preparation cost–does not include the cost of the gates				
High cost station		1,037,100	X	
Moderate cost station		581,200	X	
Low cost station		185,500	X	
Encoded paper fare media	0.02	0.04		X
Contactless cards (paper)	0.3	1		X
Variable System Costs				
Spare Parts (% of equipment cost)	10	15	X	
Support services, including training, documentation, revenue testing, and warranties (% of equipment cost)	10	15	X	
Installation (% of equipment cost)	3	10	X	
Nonrecurring engineering and software costs (% of equipment cost)	0	30	X	
Contingency (% of equipment/operating cost)	10	15	X	X
Equipment maintenance costs (% of equipment cost)	5	7		X
Software licenses/system support (% of systems/software cost)	15	20		X
Revenue handling costs (% of annual cash revenue)	5	10		X

APPENDIX I. Excerpts from Amtrak's FY 2005–2009 Strategic Plan[22]

Transportation–Support Systems–Program Goals

A major focus of Amtrak's capital plan is to provide real-time train status information throughout Amtrak operations. Enhancements to existing systems and the purchase of new technologies will increase accuracy and provide operating personnel and passengers with better information on the status of trains and services. Communications with trains, identification of equipment locations, and adherence to schedules will be implemented using GPS technology. This will allow CNOC to monitor train status and communicate directly with train crew and passengers.

Transportation–Support Systems–Project List

Arrow Enhancements for Transportation–Improvements to Arrow/reservation system to increase accuracy of train time reporting, allow creation of new train schedule displays, make seats available for sale immediately, provide better equipment and inventory management, and increase accuracy of train manifests.

Train Communications Project–Provide state of the art system for real-time communications with trains.

Marketing and Sales–Program Goals

The Marketing and Sales department is challenged with antiquated hardware and software platforms and out-of-date ticketing processes. Many mission critical systems are at the end of their useful life cycle. Equipment failures and downtime are increasing, and potential efficiencies from new technology are unrealized.

The State of Good Repair program replaces and upgrades aging distribution channel infrastructure and will reduce failures and improve efficiency. The program will implement call center labor tracking, replace telephony infrastructure, directly connect travel agents to the booking system, reduce travel agency costs, and expand voice response capabilities.

The FY05 to FY09 capital plan upgrades and modernizes the sales process by investing in e-ticketing, creating opportunities for targeted marketing, and creating user friendly graphical interfaces. These projects will reduce expenses, increase revenue opportunities, and improve customer service through improved response time and customer handling.

[22] *Amtrak Strategic Plan FY 2005-2009*, June 29,2004.

Marketing and Sales–Project List

*E-Ticketing***–**Replace the ticket lift process with boarding pass/seat check system. Revenue recognition occurs at issuance, reducing back-office costs, and improving manifest accuracy.

*Internet: Customized Access***–**Creates a new Web site that will allow travel agents to book directly with Amtrak, replacing obsolete travel agent reservation systems, and thus substantially reducing $ 5.5 million in annual systems contract expenses.

*Reservation System Enhancements***–**Replaces existing, older generation system interface (c. 1998) with a new graphical user interface for Call Centers and Station Agents that will reduce training costs and improve customer service.

*Centralized Customer Database(s)***–**Replaces multiple, disconnected databases with a centralized data store to support all sales-related functions.