RAILROAD ACCIDENT REPORT

LONG ISLAND RAIL ROAD COMPANY
DOOR ACCIDENT
HUNTINGTON STATION, NEW YORK
DECEMBER 1, 1974

TRANSPORTATION SAFETY BOARD

NATIONAL TRANSPORTATION SAFETY BOARD
Washington, D.C. 20594
REPORT NUMBER: NTSB-RAR-75-5

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15. Supplementary Notes

This report contains Railroad Safety Recommendations R-75-23 and R-75-24.

16. Abstract At 9:48 a.m., e.s.t., December 1, 1974, a man was killed as a Long Island Rail Road commuter train departed Huntington Station, N.Y. The victim had attempted to exit the standing train, but he was initially trapped between two sliding doors as they closed on him. This kept the doors open far enough for the door power-interlock to prevent the engineer from starting the train. When the man succeeded in moving the upper part of his body to the outside, the doors closed and locked on his right ankle, enabling the train to start. Since none of the crewmembers had observed the victim's entrapment, the conductor gave the "all clear" signal, and the engineer started the train.

The victim was dragged backward along and off the platform; then, he contacted the third rail and was electrocuted. The conductor, who was alerted by a person outside the train and by a passenger, signaled the engineer, who stopped the train after it had traveled approximately 180 feet.

The National Transportation Safety Board determines that the probable cause of this accident was the design of the sliding doors which permitted the train to be moved without a positive means for detecting the presence of a person caught between the doors. Contributing to the cause were:

a. Absence of procedures that required the conductor to monitor visually all doors.

b. The lack of knowledge on the part of passengers in regard to the means available to respond to the emergency.

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FOREWORD

The accident described in this report was designated a major accident by the National Transportation Safety Board under the criteria established in the Safety Board's regulations. The report is based on facts from an investigation conducted by the Safety Board in cooperation with the Federal Railroad Administration. The conclusions, the determination of probable cause, and the recommendations herein are those of the Safety Board.

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SYNOPSIS

At 9:48 a.m., e.s.t., December 1, 1974, a man was killed as a Long Island Rail Road commuter train departed Huntington Station, N. Y. The victim had attempted to exit the standing train, but he was initially trapped between two sliding doors as they closed on him. This kept the doors open far enough for the door power-interlock to prevent the engineer from starting the train. When the man succeeded in moving the upper part of his body to the outside, the doors closed and locked on his right ankle, enabling the train to start. Since none of the crewmembers had observed the victim's entrapment, the conductor gave the "signal to proceed" and the engineer started the train.

The victim was dragged backward along and off the platform; then, he contacted the third rail and was electrocuted. The conductor, who was alerted by a person outside the train and by a passenger, signaled the engineer who stopped the train after it had traveled approximately 180 feet.

The National Transportation Safety Board determines that the probable cause of this accident was the design of the sliding doors which permitted the train to be moved without a positive means for detecting the presence of a person caught between the doors.

Contributing to the cause were:

a. Absence of procedures that required the conductor to monitor visually all doors.

b. The lack of knowledge on the part of passengers in regard to the means available to respond to the emergency.

FACTS

The Accident

About 9:45 a.m. on December 1, 1974, Long Island Rail Road (LIRR) Train No. 5613 was standing in the Huntington Station awaiting the arrival of the connecting Port Jefferson train. Because a single platform had to be used to accommodate both trains, the first 2 1/2 cars of the 8-car train of No. 5613 were beyond the platform and their doors were closed and locked. The remaining doors were in the passenger-release mode, which allowed early-arriving passengers to open car doors by operating a "passenger-release button" on the outside of the car.

While the train was waiting, the crew inspected the train and checked the brakes. No exceptions were found other than a partially inoperative public-address system.

When the connecting train arrived, the conductor and two crewmen of train No. 5613 were located at the back of the platform watching the passengers board. Each crewman was responsible for watching the doors of two cars. A witness to the accident saw the victim enter car No. 9757 at 9:46 a.m. (See Figure 1.) Shortly thereafter, the two crewmen stood by the doors of their assigned cars, and the conductor entered the control station at the east end of car No. 9758 to prepare for a 9:48 departure.

At 9:48, the conductor received the "all clear" hand signal from his trainmen, he put his head out of the car window, and he looked in both directions. He saw no passengers and, therefore, operated the door-closing controls.

Witnesses who were located both inside and outside of the car stated that as the doors were closed, the victim started out of the car and was caught between the closing doors. Those witnesses expected the doors to reopen to release his right ankle, but the doors did not reopen.

The door indicator lights in the car in which the conductor was stationed and in the four cars to the rear were not lit, which indicated the doors were closed. The conductor could not see the doorway through which the victim attempted to exit because that car was located

around a curve in the track. The conductor signaled the engineer to proceed. The engineer also had a green light which indicated that all the doors were closed. The door bypass switch was in the down (off) position. With the switch in this position, the engineer could not have started the train if a door had been open.

Almost immediately after the train started, the conductor was alerted to the emergency and signaled the engineer with the communicating buzzer to stop the train. Before the train could be stopped, the victim was dragged off the end of the platform and electrocuted by the third rail. The conductor then proceeded to car No. 9757 to find out what had happened. He reported the accident to the Movement Bureau, requested medical assistance, returned to car No. 9757, and opened the door so that the victim's body could be lowered. Medical assistance arrived at about 10 a.m.

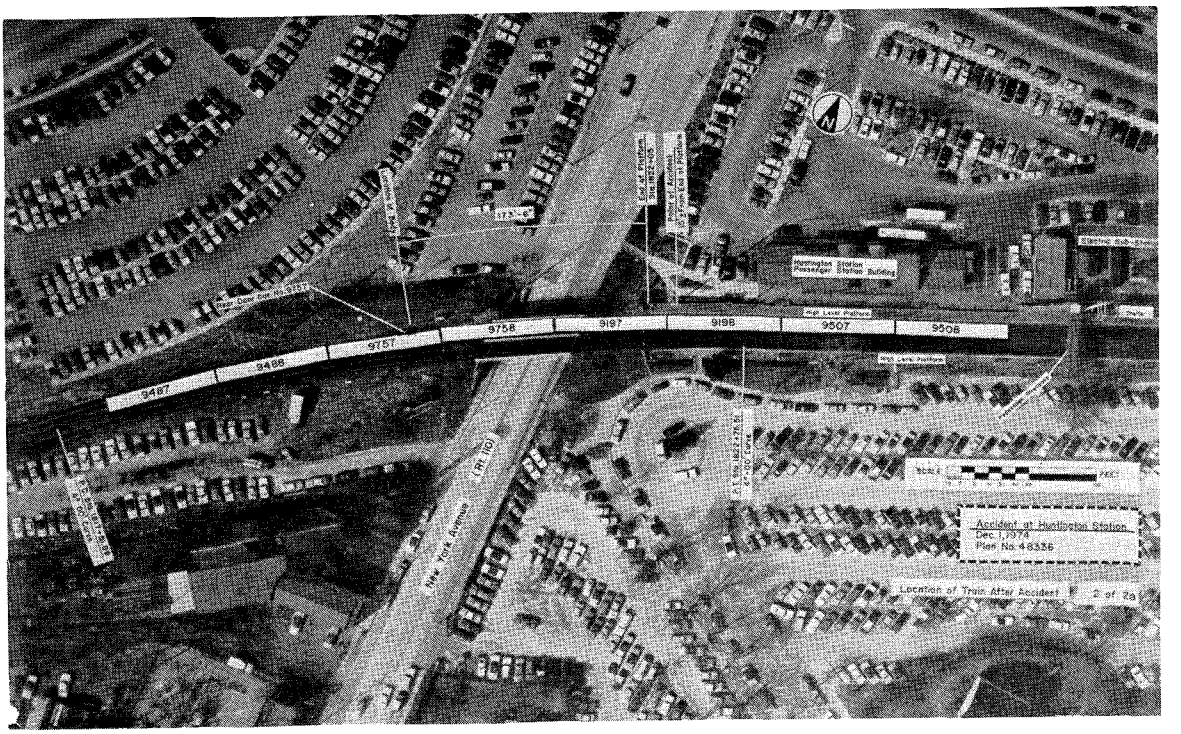
The Accident Site

The track at Huntington Station, on which train No. 5613 was standing, has a slight curvature at the west end of the platform which caused the east doorway of car No. 9757 to be out of view of the conductor from his operating position in the east end of car No. 9758. (See Figure 1 for aerial view of position of train No. 5613 before the accident. See Figure 2 for position of train No. 5613 after the accident.)

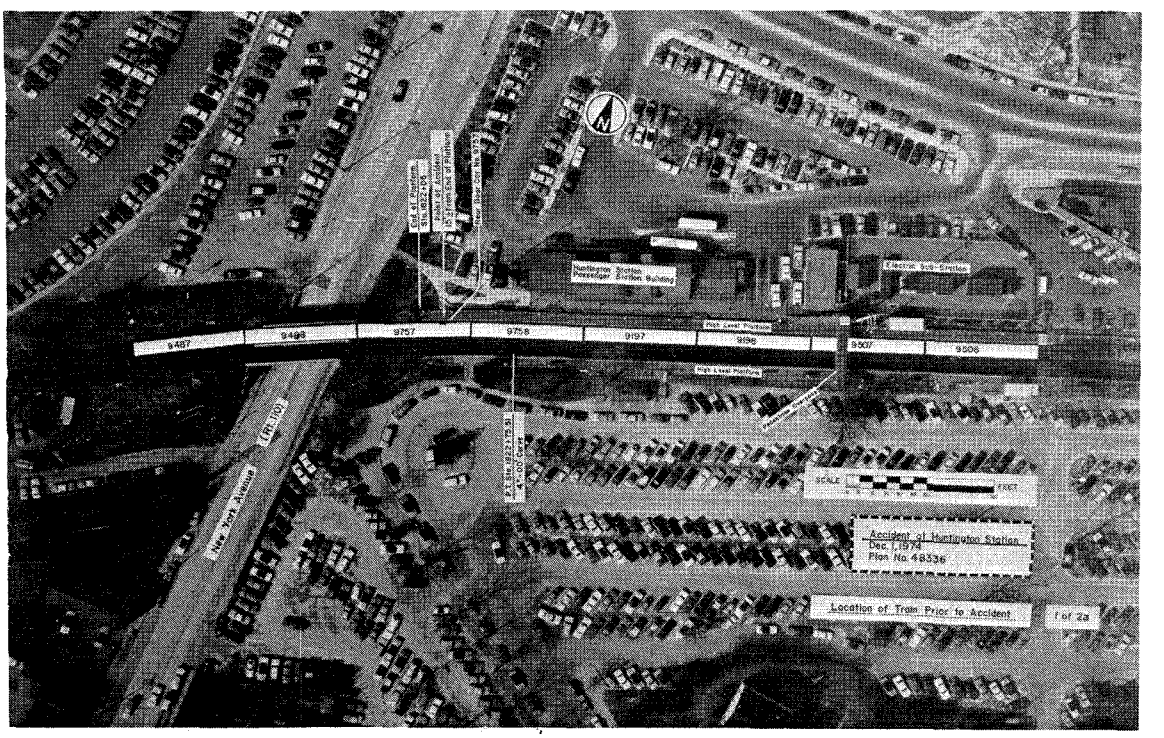
Train Equipment

This accident occurred on an M-1 car manufactured by the General Electric Company and equipped with doors made by the Vapor Corporation. The doors were designed with two protective interlocks to assure safety of passengers during train operation. One interlock prevents the engineer from starting the train if doors are not closed and locked. The second interlock prevents the doors from opening while the train is moving. After the accident, both of these features functioned normally.

The engineer has a door-interlock bypass switch on his console which permits him to move the train if the door-open interlock circuit fails. For normal operation, the switch must be in the "down" (off) position.



Figures 1 and 2. Site and position of train No. 5613 before and after the accident.



Before the conductor operates the doors, he puts his head out a dropsash window so that he can see the doors of his train just before the train starts.

The doors on the M-1 cars are biparting and open so that the space between is 50 inches. The conductor opens and closes the doors by inserting a key in the control panel before activating the door controls. Before the doors begin to close, a warning chime sounds twice in about 1 second. After a 2-second delay, the door begins to close and shuts in about 2 seconds.

The specification forces applied by the door-operating mechanism on the door and speed of travel during closing cycle are:

	Force	Speed
Door fully open	55 lbs.	0.7 ft./sec.
At mid level	25 lbs.	1.0 ft./sec.
One inch before the door is fully closed	65 lbs.	0.2 ft./sec.

The doors close and mechanically lock when the metal edges are within 3 inches of each other. The gap is closed with a rubber weatherproof moding on the leading edge of each door. In addition to the interlocking circuits, signal lights at the engineer's and the conductor's control panels indicate whether or not the doors are closed. Further, exterior lights above the doors, which automatically illuminate, indicate an open door (see Figure 3 for door-indicator light locations). An inspection of the doors on car No. 9757 revealed that the door and door system operated as required by the specification.

The M-1 cars have "passenger door open" push buttons on the outside and inside of the cars at each door. See Figure 4. Operation of these controls by the passenger is at the discretion of the conductor, who may elect to use these controls during inclement weather. Only train crewmembers can close doors opened by passengers. The "passenger door open" mode was used by Train No. 5613 when it was at the Huntington Station. While both these controls exist, only the outside button is used, because the LIRR has deactivated the inside control.

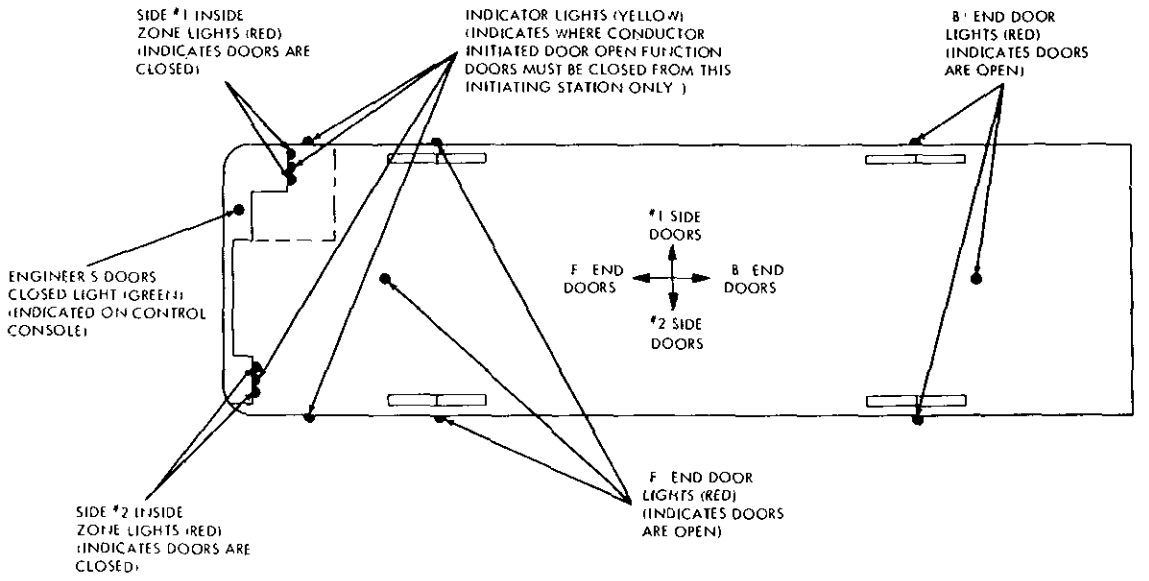


Figure 3. Door-indicator light locations.

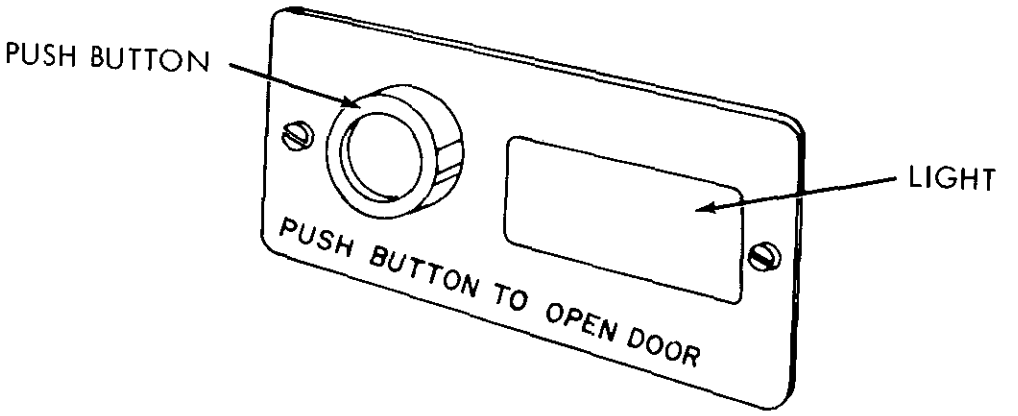


Figure 4. Interior passenger door controls.

Each door-operating mechanism has a manual release for opening a door in case of an emergency. A hinged, unmarked door panel encloses the door-operating mechanism. Therefore, the existence of this control is generally not known to passengers.

The M-1 cars are equipped with a public-address system (PA) which permits the crew to make announcements to passengers. Two-way communication between crewmembers and dispatchers is accomplished through the train radio. Additionally, one-way communication from wayside stations to passengers through the radio PA is available. All of these systems were operable on the day of the incident except as noted previously. The communication system is not used to announce door openings or closings.

The M-1 cars are also equipped with a continuously energized buzzer system. Buzzers are located at the conductor's stations. In addition, each car has four buzzers located on the center line of the ceiling of each car. These six buzzers permit the conductor to signal the engineer as required. The signal buzzers are readily accessible to the passengers but are not identified in any way.

A conductor's emergency brake valve or handle is located at each end of the car in the corner above the end door. It has a red handle and is marked "Danger Do Not Touch Brake."

Personnel Involved

The traincrew consisted of an engineer, a conductor, and two brakemen. The engineer had been employed 7 years by the LIRR and had been qualified as an engineer since 1970. The conductor was qualified in 1969. The two brakemen had served the LIRR for 21 months and 38 months, respectively. All of the crew met the requirements for rest and had received the required indoctrination for M-1 crews. Evidence indicated that they performed their duties in the prescribed manner.

Witnesses

There were three persons in car No. 9757 at the time of the accident--the victim's son, his friend, and a woman passenger. The victim's son attempted to forcibly open the doors and pressed the "door open button." His friend ran to the next car and alerted

the conductor, and the woman thought to pull the emergency cord but did not know where it was. The woman passenger and two observers on the outside saw the victim get caught between the doors, chest to back. They observed that he extricated himself from between the edges of the door with the exception of his ankle (see Figures 5a, b, and c).

The Victim

The victim of this accident was a well-developed 44-year old, 6 ft. 2 in., 244 pound, male physician. The coroner found no evidence of disability that might have contributed to the accident.

History of Losses, LIRR

The Long Island Rail Road experienced 22 door incidents with M-1 cars involving train movement from January 1, 1969, through November 30, 1974. In 14 cases a foot or an ankle was caught; in 6 cases a hand, a wrist, or an arm was caught, and in 1 case a passenger's neck was caught between doors. All of those passengers involved were injured slightly. There were no fatalities.

From January 1971 through November 1974, the LIRR experienced 115 door incidents in which there was no train movement. All parts of the body, including the neck, were involved.

These incidents happened at 37 different stations of the LIRR. The highest frequency of occurrence was at Penn Station (21 percent) and Jamaica Station (21 percent). These are the most crowded locations, have numerous platforms, and have slight bends at the ends of some of the platforms. Six locations had four to eight incidents (3 to 6 percent). Three of these had curved tracks. The remaining 29 had 1 to 3 incidents. All but three of these locations had straight track at the platform.

History of Losses at Other Commuter Transit Systems

At the request of the Safety Board, the American Public Transit Association (APTA) solicited its membership to provide data on door incidents, the design and operating characteristics of the doors, and operating procedures and practices.

Figures 5a and 5b.
Views a and b illustrate conditions of entrapment which afford sufficient door-edge separation to prevent train movement.

Figure 5c.
View c is the simulated condition experienced by the victim of the accident.

The APTA data indicated that all transit systems had door incidents. Only the New York City Transit Authority and the LIRR have had serious injuries and deaths. There is a considerable difference between the various designs in regard to closing characteristics. The metal-to-metal gap in some doors is as small as 0.1 inch and in others the metal-to-metal separation is 6 inches.

The data are insufficient, however, to establish a relationship between door design and accident frequency because of the different alerting, surveillance, and passenger information practices employed by the various systems. See Appendices A, B, and C of this report for a summary of the accident experience, the door operating characteristics, and the operating practices of the transit systems responding to the APTA request for information.

ANALYSIS

There are no Federal requirements that specify the design characteristics of rail-car doors. The LIRR, in cooperation with the Metropolitan Transportation Authority of New York (MTA) and the car designer, thoroughly reviewed their own experience and that of existing transit systems in developing the M-1 door design.

Further, the LIRR established operating, training, and management practices which had demonstrated utility in handling large numbers of passengers with little likelihood of injury from door incidents.

The LIRR had every reason to expect that the door would be significantly safer than pre-M-1 cars. The infrequent occurrence -- .07 incidents per million passenger miles -- seemed to justify their expectation. The potential for serious injury or death from closing doors was not recognized until this accident.

This accident occurred because the design of the door allowed a 3-inch metal-to-metal separation when the door was locked. It is evident from the 22 dragging accidents the LIRR has experienced that if a passenger catches a part of his body, such as a foot, between the door edges, he cannot remove it until the door is opened (see Figure 5c).

It may not be practical, for a high-density transit system which operates on short time intervals between trains, to provide absolute assurance that passengers cannot get caught by the doors. However, it is entirely practical and necessary to assure that the effects of getting caught in a door are minor. The obvious solutions are to provide for the immediate opening of the door, to prevent the movement of the train, or at least to stop it promptly.

This accident probably would not have resulted in death if the door the victim used had been visible to the conductor or one of the trainmen. Clearly, where such conditions exist and are not correctable by practical design alterations, the door should not be used for boarding and detraining passengers. It appears equally evident that if the M-1 cars had recycling doors, passengers caught by the doors would readily escape before train movement was possible. Most transit operators argue, however, that recycling systems are impractical on high-density transit operations because this would interfere with the scheduled movement of trains. It is for such reasons that transit operators, except for automatic systems such as the Bay Area Rapid Transit (BART), have employed nonrecycling doors and have depended on crew surveillance to minimize the probability of accidents.

In systems that depend on crew surveillance it can be anticipated that, in spite of careful surveillance and monitoring of the doors, a trapped passenger may not be seen by the crew. Even under such circumstances, the result would not be catastrophic if the victim or other passengers, or both, had known about and used any one of the available emergency mechanisms. In this accident, for instance, the victim would have been uninjured if he had not attempted to extricate himself to the platform since the doors would have remained far enough apart to prevent train movement. He would probably have survived if any of the three passengers who saw the incident could have stopped the train by pulling the emergency handle which was close at hand. (See Appendix C.) In at least 3 of the 22 dragging incidents the LIRR experienced, the train was stopped because a passenger pulled the emergency brake handle. The proper signal on the communicating buzzer also could have stopped the train; however, passengers generally are not acquainted with the use of the buzzer. In view of the fact that the M-1 cars accelerate rapidly, the longer reaction time involved in the use of the buzzer system to stop a train suggests that the more direct "Emergency Brake Handle" is the preferred alternative.

The M-1 cars are required by MTA specifications to run a mile from a standing start in 70 seconds or less. They are also capable of stopping from a speed of 50 miles per hour at the rate of 3 miles per hour per second. Based on this information and the location of the involved doors when the train was stopped, it was calculated that the conductor signaled the engineer to stop the train about 10.86 seconds after the train started. At that time it was moving at 15.96 miles per hour and had traveled 126.16 feet. It took the train 5.3 seconds to stop, during which time it moved an additional 62 feet.

To have stopped the train before the victim reached the end of the platform would have required initiation of braking within 3 seconds after startup. The speed of the train at that movement would have been approximately 4.5 miles per hour and it would have traveled 10 feet.

If braking had been initiated 5 seconds after startup, the train would have reached a speed of 7.7 miles per hour. It would have been stopped just short of the third rail, which was 30 feet east of the end of the platform.

These calculations support the general observation that relatively little time is available for action before the speed of the train and the distance traveled are appreciable.

The 3 and 5 seconds required to stop before the end of the platform or short of the third rail are sufficient time to initiate emergency braking if no decision time is required and the emergency brake control is near at hand.

The passengers in car No. 9757 were unacquainted with the characteristics of the doors and the location of the emergency brake which precluded the possibility of a successful response. This might not have been the case if the LIRR had provided its passengers with guidance regarding door emergencies or provided information on how to stop the trains. The LIRR believes that such knowledge would encourage the unnecessary use of the emergency controls.

Informing passengers about safe door practices does not seem to be an unreasonable answer to the door problem, at least until the door-closing problem can be more thoroughly examined and a "safer" solution devised by the FRA in cooperation with industry. Perhaps when the alternatives for safe door operation are more completely analyzed, passenger indoctrination will emerge as the least expensive and most effective way to cope with the problem.

CONCLUSIONS

1. The train was operated in accordance with current LIRR operating rules and special instructions.

2. The crew met all requirements of the LIRR and performed their duties in the prescribed manner.

3. The doors operated in accordance with specifications.

4. The traincrew could not see the doors in which the victim was caught from their operating stations before departure.

5. The M-1 door design prevented the victim from withdrawhis foot after the door had locked, which permitted the train to move.

6. There are significant differences in the door-closing forces, the metal-to-metal separation of doors when locked, the passenger alerting systems, and obstruction-sensing methods used by the different transit systems.

7. Some passengers believe that the doors on LIRR will recycle as do elevator doors, but they do not.

8. Some passengers are unaware that when the LIRR M-1 car doors are fully closed,they are locked and cannot be forced apart.

9. The large differences in the reported frequency of door incidents experienced by the transit industry suggest that different reporting criteria are being used.

10. The label on the "passenger door open" button is misleading since it implies that it could be used to open a train door in an emergency.

11. There are no Federal regulations applicable to door-operating safety characteristics.

12. The train would not have started and the victim would not have been hurt if he had not attempted to extricate himself after the doors closed on him.

13. The victim probably would not have lost his life if a passenger had reacted immediately by operating the emergency brake.

14. The likelihood that the emergency brake would have been used in a timely manner by a passenger would have been greater if the passengers had been indoctrinated in the appropriate emergency response.

PROBABLE CAUSE

The National Transportation Safety Board determines that the probable cause of this accident was the design of the sliding doors which permitted the train to be moved without a positive means for detecting the presence of a person caught between the doors.

Contributing to the cause were:

a. Absence of procedures that required the conductor to monitor visually all doors.

b. The lack of knowledge on the part of passengers in regard to the means available to respond to the emergency.

RECOMMENDATIONS

The National Transportation Safety Board recommends that the Department of Transportation require:

1. The Long Island Rail Road to (Class I Urgent Followup):

   a. Establish procedures to insure that a train does not move if a person is caught in the doors.

b. Establish a program to inform passengers on the operation of door mechanisms, the actions to take if caught, and how and when to use the emergency brake.

c. Modify the passenger door release label "Push Button to Open Door" so that it does not suggest or indicate that the button has an emergency use. (Recommendation R-75-23)

2. The Federal Railroad Administration to promulgate regulations for rail transit operators which will (Class II Priority Followup):

a. Prevent or reduce the incidence of and the probability of serious injury to persons entering or leaving rapid transit cars.

b. Specify the information passengers should be furnished to assure their safety when entering or leaving transit cars.

c. Require a standard door incident reporting system so that the effectiveness of various door systems and operating practices can be evaluated. (Recommendation R-75-24)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JOHN H. REED
Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ LOUIS M. THAYER
Member

/s/ ISABEL A. BURGESS
Member

/s/ WILLIAM R. HALEY
Member

April 30, 1975

APPENDIX A

RAPID TRANSIT - DOOR ACCIDENT HISTORY

System	Injuries Last 5 years	Deaths	Claims	Rate per million passenger	Dragging
Bart	2 years 98	0	34	?	?
Toronto	69 - 73 minor	0	?	20	?
Chicago Trans. Authority	69 - 73 853	0	?	1.20	?
Mass. Bay Transit Authority	?	0	?	?	?
Cleveland Transit System	?	0	88	?	?
Port Authority N.Y./N.J.	Minor ?	0		.13	?
Morgantown PRT	No Experience				
Ill Central Gulf R. R.	0 None to date	0	0	0	0
S. E. Penn. Trans. Authority	529 Minor injury	0	?	1.0	?
Montreal Transit Comm.	Minor	0	?	.2	?
Port Auth. Transit Corp. Penn/N.J.	94	0	?	1.5	0
MARTA	No Experience				
MTA	2410	3	?	.37	206
LI RR	122	1	13	.073	22

APPENDIX B

OPERATING CHARACTERISTICS OF RAIL TRANSIT SYSTEM DOORS

System	Locking Distance in.	Force lbs. Midpoint	Closing Time-Secs.	Interlock	Emergency Release Door	Door Recycle	Bypass Sealed
BART	Less 3/8	30	1.5-2.5	Yes	Yes	Yes	Yes
Toronto Transportation	Unknown Spring back 11	30	2 -2.60	Yes	Yes	No	Yes
Chicago	Completely closed	20	2	Yes	Yes	Yes	No
Mass. Bay Tr. Auth.	3 1/8	?	?	Yes	?	No	Yes
Cleveland Transit System	?	?	?	Yes	Yes	No	No
Port Auth. N.Y./N.J.	1/2 1.5 in. Spring back	30	2 -3.5	Yes	?	No	No
Illinois Central	?	?	?	Yes	Yes	Yes	No
S.E. Penn. Tr. Auth.	?	?	2.5-3.5	No	?	No	No
LI RR	3	35	2 -3	Yes	Yes	No	No
Montreal	2.5	?	?	Yes (3.5 mph)	Yes	No	No
Port Auth. Transit Corp. Penn./N.J	1	20	1.5-3	Yes	?	No	Yes
Morgantown PRT (Not in Oper.)	1/4	15-35	?	Yes	Yes	Yes	No

APPENDIX B (Cont'd.)

System	Locking Distance in.	Force Lbs. Midpoint	Closing Time-Secs.	Interlock	Emergency Release Door	Door Recycle	Bypass Sealed
MARTA (Not in Oper)	1	30	1.5-2.5	Yes	Yes	Yes	NA
MTA	Various 1 1/16 Spring back 3-4 in	36	2.5	Yes	Yes	No	No

APPENDIX C

PROCEDURES AND PASSENGER ALERTING

Operator	Surveillance	Pass. Alerting	Pass. Indoc.	Communications	Emergency Brake	Emergency Door Release
BART	Oper views from cab window	Audio Tone	None	Pass. can talk to operator	Yes	Yes-Enclosed-Sealed
Toronto	Obs platform one car length of travel Close doors 1 dir then another	2 Whistle blasts	None	None	Yes 1-3	?
Chicago	Obs. platform Head out of window at door control. Keep head out for 1 car length of movement.	PA System Announcement	None required-doors recycle		Extends down from the area above each door-Marked/Sign	Yes-well marked, accessible
Mass.	View actions of pass. Use mirrors hung from ceiling in subway stations Assisted by Station Guards - 1 guard each 2 car units.	None	None	None		Yes
LI RR	Look out window Conductor observation Lights	Chime	None	None	Ends of each car	Yes - Not avail. to pass., no signs
Cleveland	Close 1/2 hr next observation by conductor	Police Whistle	None		1 near each door	?
Port Authority Penn./N.J Patco	1 man train operator Dir observation Lights Look out window	Alarm bell - 3 sec. advance modified to immediate before close PA Announcement	News bulletin does not recognize objects smaller than 1 inch - do not say anything about not escaping No spec. info. on being trapped.		1 near each door	?
Boeing	Closed Circuit TV Monitoring at central control area				Yes	Provided on outside and inside of each car; Marked

APPENDIX C (Cont'd.)

Operator	Surveillance	Pass. Alerting	Pass. Indoc.	Communications	Emergency Brake	Emergency Door Release
Ill. Central	Use of interior and exterior lights	Announcement on PA System and continuous bell ring during closing	None Sensitive - Recycling door	None		Provided with manual emergency control at each door; Marked
S.E. Pa.	Close 1 section of doors at a time; Lights; Looks alongside of train on departure.	Conductors call out "Watch the Doors"	None	None	Break the glass emergency switch at doors of all cars	Yes - Available to conductor
Montreal	Guard at end of train	None	None	None	4 per car	
MARTA		Train operator will make announcement. Audible door signal	None required - doors recycle	None		1 near each door, enclosed and sealed
MTA	1) Observation by conductor 2) Use of mirrors 3) Signal lights 4) Observation during movement of at least 3 car lengths.	1) Thru PA System 2) Station PA System 3) Chimes on newer cars 4) Platform guards	Deleted by MTA	None	Prominently display emergency cords in each car	Yes - by authorized personnel