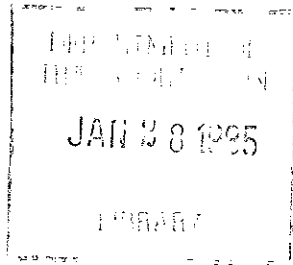
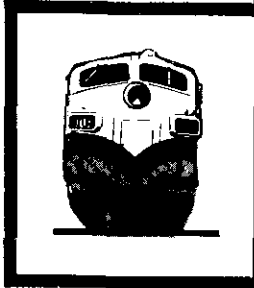


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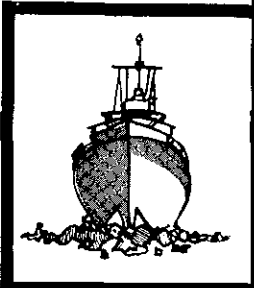
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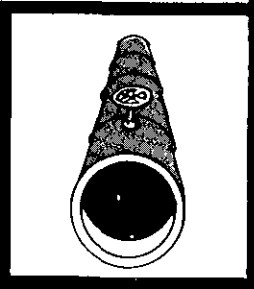


WASHINGTON, D.C. 20594



RAILROAD ACCIDENT REPORT

REAR-END COLLISION OF
NEW YORK CITY TRANSIT AUTHORITY
SUBWAY TRAINS 142NL AND 132NL
BROOKLYN, NEW YORK
JULY 3, 1981



NTSB-RAR-82-2

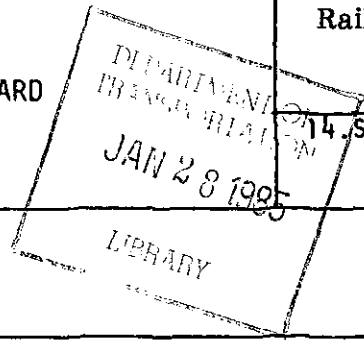


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TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. ✓ NTSB-RAR-82-2. ✓		2. Government Accession No. PB82-916302		3. Recipient's Catalog No.	
4. Title and Subtitle Railroad Accident Report, Rear-End Collision of New York City Transit Authority Subway Trains 142NL and 132NL, Brooklyn, New York, July 3, 1981		5. Report Date May 14, 1982		6. Performing Organization Code	
		7. Author(s)		8. Performing Organization Report No.	
9. Performing Organization Name and Address National Transportation Safety Board Bureau of Accident Investigation Washington, D.C. 20594		10. Work Unit No. 3306B		11. Contract or Grant No.	
		12. Sponsoring Agency Name and Address NATIONAL TRANSPORTATION SAFETY BOARD Washington, D. C. 20594		13. Type of Report and Period Covered Railroad Accident Report July 3, 1981	
15. Supplementary Notes		14. Sponsoring Agency Code			
16. Abstract <p>About 1:45 p.m. on July 3, 1981, New York City Transit Authority (NYCTA) train 142NL struck the rear of NYCTA train 132NL north of the Sutter Avenue Station in Brooklyn, New York. The collision was preceded by a signal failure in the area at 11:12 a.m. which the NYCTA command center was not aware of. Trains were continually dispatched into the failure area at other than scheduled times, without being warned about the inoperative signals, until 1:37 p.m. During this time, signal department employees were flagging trains by the inoperative signals while attempting to determine the cause of the failure. The motorman of train 142NL was killed, and 140 passengers and crewmembers on the trains were injured. Estimated damage was \$543,200.</p> <p>The National Transportation Safety Board determines that the probable cause of this accident was the failure of the motorman of train 142NL to maintain a diligent lookout ahead and stop short of a collision with the rear of train 132NL, and the failure of the New York City Transit Authority to provide effective operating and maintenance procedures which would protect trains when the signal system was malfunctioning. Contributing to the cause of the accident was the NYCTA's tolerance of unsafe operating and maintenance practices and inadequate training of operating employees regarding the functional differences of its two signal systems.</p>					
17. Key Words rear-end collision; subway train; automatic block signal system; signal system; trip arm protection; command center; trainmaster; operator		18. Distribution Statement This document is available to the public through the National Technical Information Service Springfield, Virginia 22161			
19. Security Classification (of this report) UNCLASSIFIED	20. Security Classification (of this page) UNCLASSIFIED	21. No. of Pages 30	22. Price		



CONTENTS

SYNOPSIS	1
INVESTIGATION	1
The Accident	1
Injuries to Persons	7
Damage to Equipment	7
Crewmember Information	7
Train Information	7
Track Information	9
Signal and Train Control System	9
Method of Operation	13
Meteorological Information	15
Medical and Pathological Information	15
Survival Aspects	15
Tests and Research	16
ANALYSIS	17
Signal Failure	17
Train Dispatching	18
Operating Rules	19
The Accident	20
Training	20
Safety Oversight	21
Survival Aspects	22
CONCLUSIONS	22
Findings	22
Probable Cause	23
RECOMMENDATIONS	23
APPENDIXES	25
Appendix A—Investigation	25
Appendix B—Personnel Information	26
Appendix C—Sight Distance Test Results	28

**NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594**

RAILROAD ACCIDENT REPORT

Adopted: May 14, 1982

**REAR-END COLLISION OF
NEW YORK CITY TRANSIT AUTHORITY
SUBWAY TRAINS 142NL and 132NL
BROOKLYN, NEW YORK
JULY 3, 1981**

SYNOPSIS

About 1:45 p.m. on July 3, 1981, New York City Transit Authority (NYCTA) train 142NL struck the rear of NYCTA train 132NL north of the Sutter Avenue Station in Brooklyn, New York. The collision was preceded by a signal failure in the area at 11:12 a.m. which the NYCTA command center was not aware of. Trains were continually dispatched into the failure area at other than scheduled times, without being warned about the inoperative signals, until 1:37 p.m. During this time, signal department employees were flagging trains by the inoperative signals while attempting to determine the cause of the failure. The motorman of train 142NL was killed, and 140 passengers and crewmembers on the trains were injured. Estimated damage was \$543,200.

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the motorman of train 142NL to maintain a diligent lookout ahead and stop short of a collision with the rear of train 132NL, and the failure of the New York City Transit Authority to provide effective operating and maintenance procedures which would protect trains when the signal system was malfunctioning. Contributing to the cause of the accident was the NYCTA's tolerance of unsafe operating and maintenance practices and inadequate training of operating employees regarding the functional differences of its two signal systems.

INVESTIGATION

The Accident

At 11:12 a.m. on July 3, 1981, on the Interborough Rapid Transit (IRT) line of the New York City Transit Authority (NYCTA), a power department operator at power substation No. 23 detected the momentary deenergizing of the signal power transmission line and restored power to it immediately. The failure indicated that there was a ground in the line between Saratoga Avenue and Nostrand Avenue on the New Lots extension in Brooklyn, New York. (See figure 1.) The operator immediately notified the power system operator 1/ located at the power department control center at 53rd Street of the problem. The power system operator then notified a foreman of the NYCTA signal department at signal department substation No. 3 at Stillwell Avenue of the ground in the signal power transmission line. None of these persons notified the NYCTA command center of the failure in the signal system, nor were they required to by NYCTA operating rules.

1/ A supervisor of the power department responsible to coordinate with the operators of the manually operated substations.

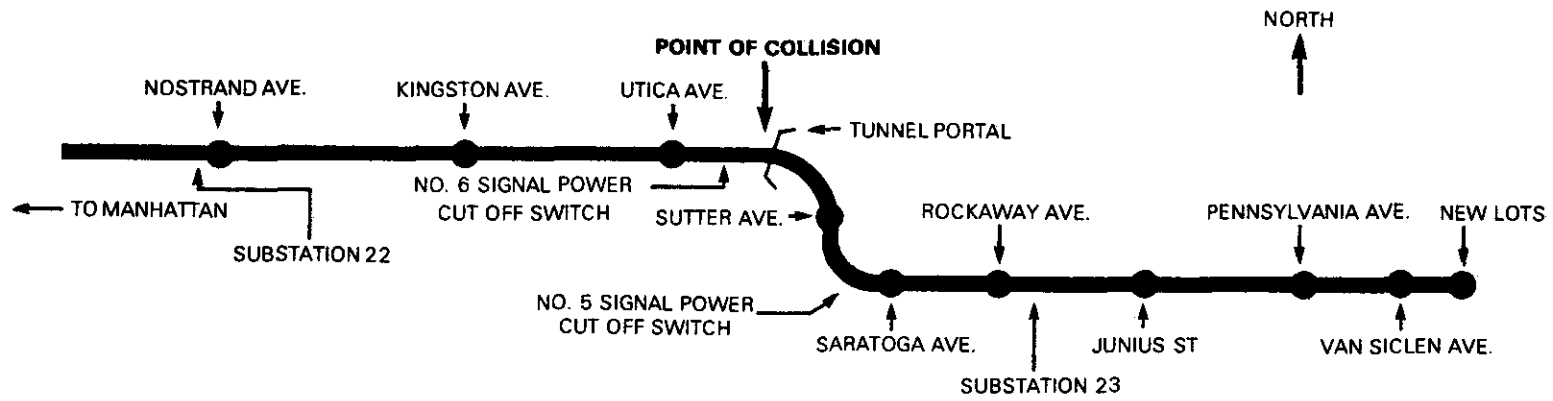


Figure 1.—IRT line from New Lots Avenue to Nostrand Avenue.

The signal department foreman at substation No. 3 dispatched a signal maintainer and helper from the New Lots Avenue Station to check the transmission line from New Lots Avenue north 2/ to Saratoga Avenue, and a signal foreman and signal maintainer were dispatched from Flatbush Avenue to the Utica Avenue Station to start looking for the source of the ground from Utica Avenue south to Saratoga Avenue. When the signal foreman arrived at signal power cutoff switch No. 6 at 12:10 p.m., he cut it off to determine if the ground was toward substation Nos. 22 or 23. (See figure 1.) He determined that the ground was toward substation No. 23. When he arrived at the Saratoga Avenue Station, he sent the signal maintainer and helper from New Lots Avenue back to their headquarters while he and the signal maintainer with him continued to investigate the problem in the signal system. During their efforts to locate the problem, the signals were functioning intermittently due to the signal foreman cutting switches in and out and switching signal transmission power from either substation Nos. 22 or 23. Only the signal transmission line was involved in the problem. The third-rail power remained constant and trains could continue to operate although they required slowing and stopping because of the intermittent functioning of the signals.

The signal foreman remained at Saratoga Avenue, and at 1:30 p.m. his office notified him that substation No. 23 had lost power because of a short in a circuit. About the same time, a northbound IRT train stopped at the Saratoga Avenue Station, and its motorman advised the signal foreman that he had experienced signal problems before arriving at the station. The signal foreman said that he instructed the motorman to proceed with caution. The signal foreman cut off signal power cutoff switch No. 5 again, and signal power between Saratoga Avenue and substation No. 23 was restored. Switch No. 5 was then cut on, but substation No. 23 once again lost power.

At 1:38 p.m., the operator at substation No. 22 could not restore power to the affected area due to a loss of power because of the circuits being grounded. The signal foreman instructed the signal maintainer to remain at Saratoga Avenue while he returned to switch No. 6. At this time the signals on the north and south ends of the Saratoga Avenue Station were red and the signals north of the station to Nostrand Avenue were not illuminated (dark). The foreman said that while he was en route to signal power cutoff switch No. 6, northbound train 142NL went by him and it appeared that the motorman had his head out the window.

A few minutes earlier, at 1:34 p.m., the motorman of train 122NL, 3/ a 10-car train northbound from New Lots Avenue to White Plains Road, had radioed to the command center that the signals were dark at the Utica Avenue interlocking. This was the command center's first indication of the signal problem. At 1:36 p.m., the motorman of train 132NL, also a 10-car subway train northbound from New Lots Avenue, had reported by radio that the signals were dark as the train moved from Saratoga Avenue to Utica Avenue. (See figure 1.) The motormen of trains 122NL and 132NL said later that they were flagged through the Saratoga Avenue Station by signal department employees. At the time of the 1:36 p.m. report, train 132NL was stopped and standing at the first signal inside a tunnel which began 1,100 feet north of the Sutter Avenue Station. (See figure 2.)

2/ NYCTA designates the direction of travel to be north leaving New Lots and south going toward New Lots even though the geographical orientation of the New Lots extension is east and west.

3/ Designates that this train was scheduled to depart New Lots Avenue at 1:22 p.m.

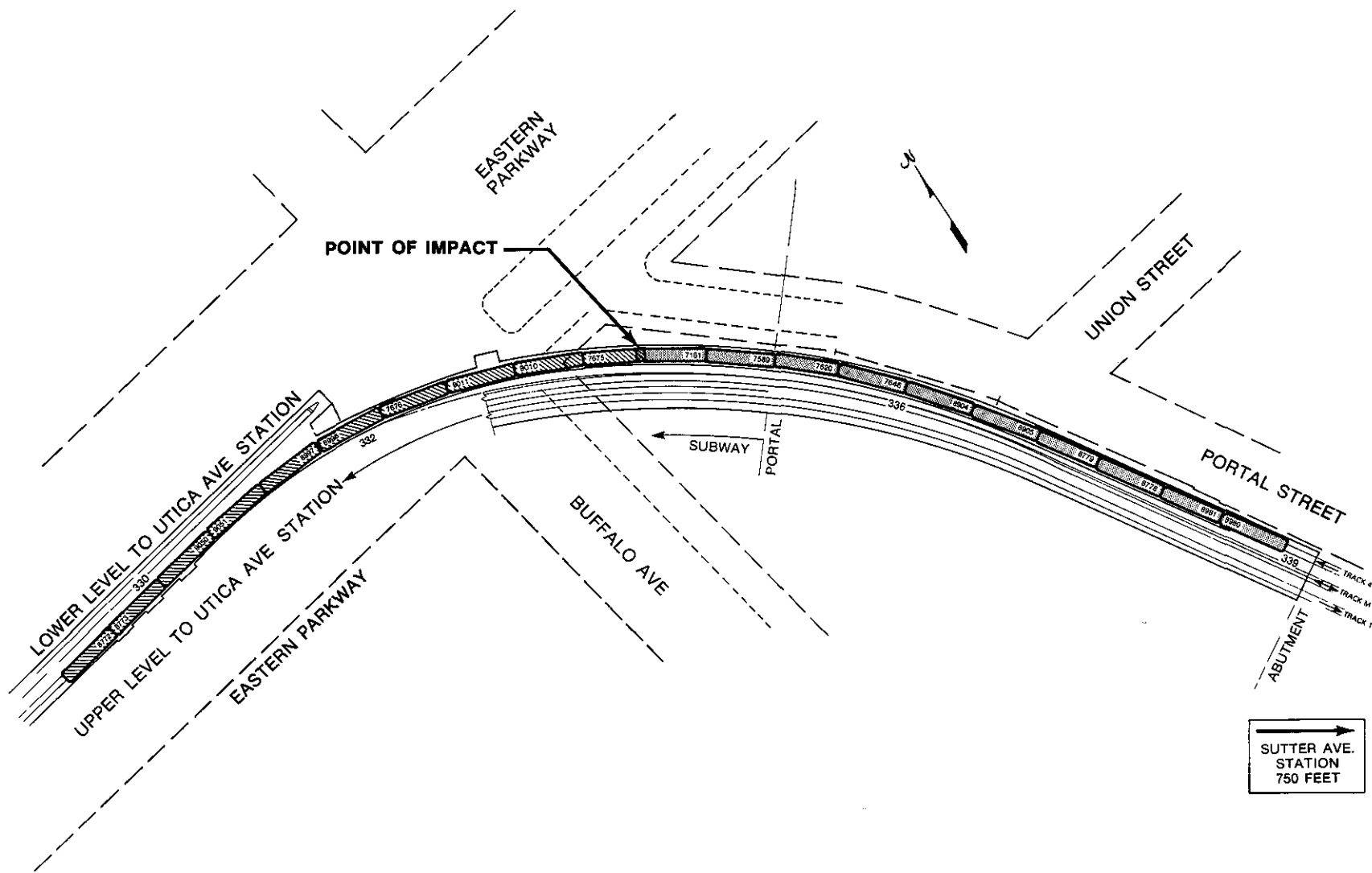


Figure 2.--Plan view of accident site.

The motorman could see the rear of train 122NL ahead, which was also stopped. The rear of train 132NL was 88 feet inside the tunnel entrance. The command center train dispatcher broadcast on the radio at 1:37 p.m., "Hello motormen all trains, 122NL, 132NL, stop and stay in stations where you are please, we have signal trouble until further notice." At 1:41 p.m., the trainmaster at the command center announced by radio:

All right, this is the Command Center trainmaster, all southbound No. 2 and No. 3 ^{4/} trains be advised we have an AC power failure south of Nostrand Junction to somewhere south of Utica. Key by automatic ^{5/} according to rules, operate with extreme caution, expect to find people on tracks, they're trying to find fault in the signal cables. Motormen on that New Lots line southbound and northbound operate with extreme caution. You have Command Center permission to key by automatic signals. Nostrand Junction signals are working. You key by the Nostrand Junction, you have your problems.

The command center did not order suspension of train service departing New Lots Avenue at that time.

The train sheet of the train dispatcher at the New Lots Avenue Station indicated that train 142NL, a northbound 10-car subway train, departed at 1:42 p.m. The conductor of train 142NL said that, after departing New Lots Avenue, the train was moving slower than usual. He said that the train made several unscheduled short stops. One such stop was made south of Saratoga Avenue, after which the train moved into the Saratoga Avenue Station and stopped. After passengers had boarded, the motorman waited 15 or 20 seconds before proceeding. (See figure 3.) Train 142NL next stopped at the Sutter Avenue Station and picked up passengers. The train departed the Sutter Avenue Station and began to descend from the elevated portion of track toward the subway tunnel portal. A passenger who was standing in the first car and looking forward through the window in the front door said that the operator's cab door was closed and that she did not see the motorman. The passenger said that, as the train entered the tunnel, she saw white lights on a train ahead. Seconds later, and without any brakes having been applied, train 142NL struck the rear car of standing train 132NL.

The motorman of train 142NL was killed, and 140 of the approximate 1,600 passengers and crewmembers on the trains were injured as a result of the collision. The motorman of train 132NL notified the command center at 1:45 p.m. that the rear of his train had been struck by a following train. After walking back through his train to assess the situation, the motorman of train 132L at 1:51 p.m. notified the command center that train 142NL had run into the back of his train, that the motorman was hurt, and that assistance was needed.

^{4/} Trains No. 2 operate in 7th Avenue express service from New Lots Avenue, Brooklyn to 241st Street, Bronx. Trains No. 3 operate in 7th Avenue express service from Flatbush Avenue, Brooklyn to 148th Street, Manhattan.

^{5/} Term used to describe method of activating the trip arm on the track to a down position so that a train can operate past the signal without the trip arm causing an automatic application of the brakes.

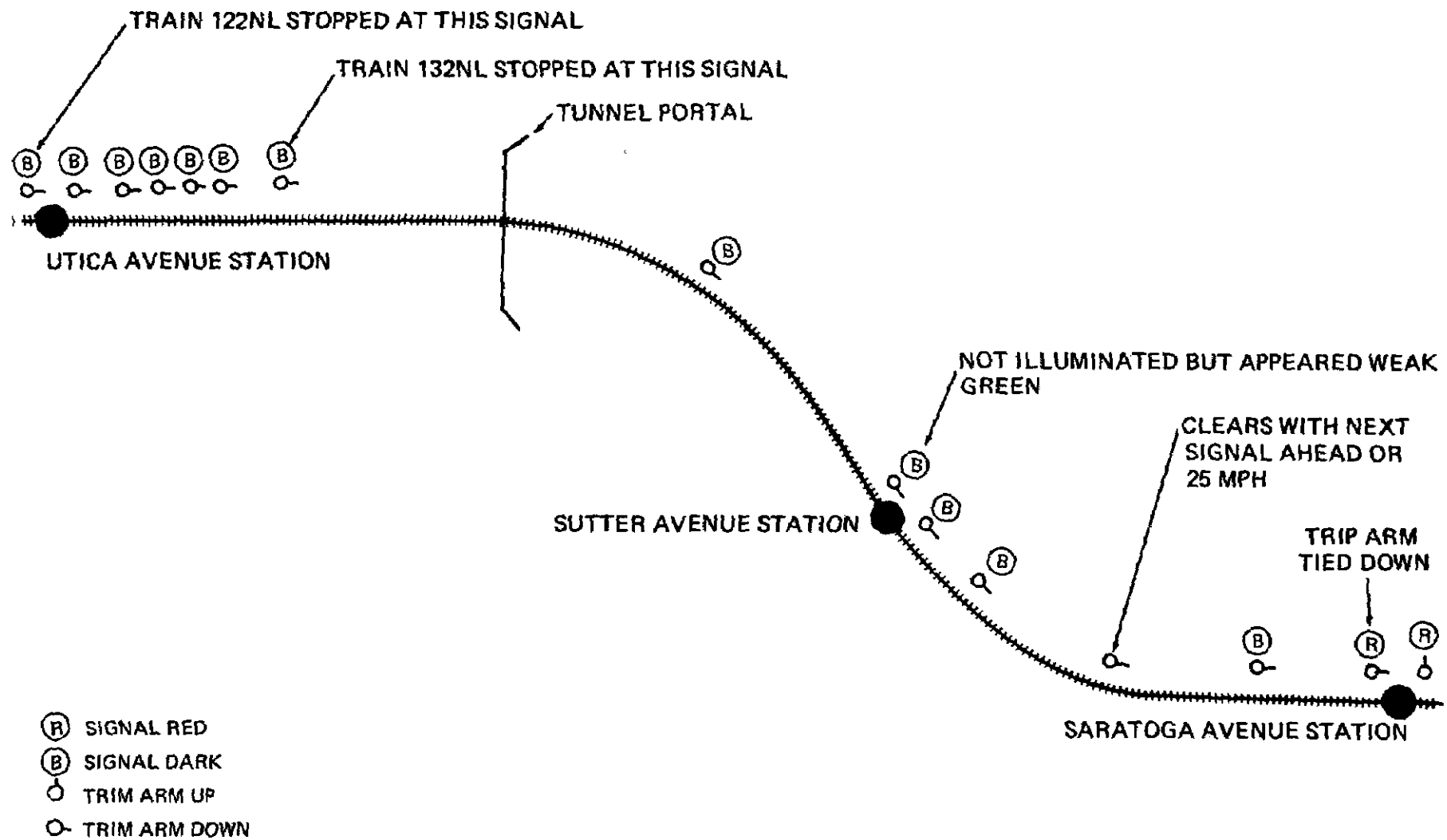


Figure 3.—Display of signals and position of trip arms as train 142NL was traveling from Saratoga Avenue Station.

Injuries to Persons

<u>Injuries</u>	<u>NYCTA crewmembers</u>	<u>Passengers</u>	<u>Total</u>
Fatal	1	0	1
Nonfatal	0	7	7
Minor	0	133	133
None	3	1,460	1,463
Total	4	1,600	1,604

Damage to Equipment

The first and second cars of train 142NL were destroyed. The front end of the first car of train 142NL was crushed inward 89 inches as a result of the collision and the overriding by the rear car of train 132NL. The operating cab, which was approximately 58 inches deep and 48 inches wide, was destroyed. Also, 12 inches of the roof of the car was buckled downward and to the rear. The front end of the second car of train 142NL was crushed 21 inches inward when it was overridden by the first car.

The rear car of train 132NL was destroyed. It was crushed inward 29 inches, and 84 inches of the car's roof was buckled when it struck the ceiling of the tunnel. Four other cars in train 132NL incurred minor damage.

Three couplers and three link bars were bent between cars on train 142NL; two couplers were bent on the cars in train 132NL. The distance between coupled cars at the anticlimbers was 4 inches; most of the anticlimbers showed evidence of contact.

Estimated damage to equipment was \$543,200.

Crewmember Information

The crew of train 142NL consisted of a motorman and conductor. Both were qualified under NYCTA operating rules. They had been off duty 16 hours 14 minutes before reporting for duty at 7:11 a.m. on July 3, 1981. They had completed one round trip between 241st Street and New Lots Avenue and were completing their second round trip, their last trip of the day, at the time of the accident.

The IRT trainmaster at the command center was qualified under NYCTA operating rules. His regular duty hours are from 7 a.m. to 3 p.m. He had been on duty 6 hours 45 minutes when the accident occurred.

The IRT train dispatcher at the command center and the train dispatcher at the New Lots Avenue Station were both qualified under NYCTA operating rules. Their hours of service are from 7 a.m. to 3 p.m. (See appendix B.)

Train Information

The cars of trains 132NL and 142NL were selfpropelled electric subway cars with four-wheel trucks. The cars were equipped with third-rail shoes for electrical power pickup from a wayside third rail. The cars involved were single-unit cars designated R-21 and R-22 and semipermanently coupled car pairs designated R-29 and R-33. Each vehicle was 51 feet 1/2 inch end to end over the anticlimbers, was 8 feet 9 inches wide, and had a maximum height of 11 feet 10 5/8 inches.

On the NYCTA system, each single car is equipped with an operating cab on each opposite end, and the semipermanently coupled car pairs have one operating cab on each car. Each operating cab is equipped with a brake valve and handle and a master controller. The brakes on each car are electropneumatic and are controlled by the motorman in the operating cab functioning as the controlling cab. A camshaft in the brake valve operates the various contacts and valves as the brake valve handle is rotated through its various positions by the motorman. The brake valve handle positions are:

- o Release - Used to release the train brakes during pneumatic brake operation with the electropneumatic brake inoperative.
- o Running - Used to release the train brakes when the electropneumatic brake is operative.
- o Service - Used to apply the brakes. The degree of braking is determined by how far the brake valve handle is moved toward the full service position.
- o Full Service - Used to give a full service brake application.
- o Emergency - Used to vent the brake pipe with maximum flow to produce an emergency brake application.
- o Handle Off - Used when the handle is to be removed from the brake valve.

The master controller operated by the motorman in the controlling operating cab controls the power-operated reverser which determines the direction of motion of the car. After car doors have been closed, the master controller automatically closes the contacts necessary for the operation of the control circuits required for simultaneous control of all power and braking functions on each car in the train. The master controller handle incorporates an emergency pilot valve which activates whenever the master controller handle is not fully depressed against pressure exerted by an internal spring and causes the train brakes to be applied in emergency. Therefore, the master controller handle must be depressed at all times to override the emergency feature unless the brakes are being applied through the brake valve handle. Otherwise, the "dead man" feature will apply full emergency brakes.

The lead car of an NYCTA subway train has two sealed-beam headlights, and two lights at the top adjacent to an illuminated route number and destination sign. The last car in the train has two red rear lights, and two lights at the top adjacent to an illuminated route number and destination sign. When a train is in the tunnel at the location where the accident occurred, the interior lights of the train's rear car also can be seen through the car's end door window.

The cars are designed to sustain a buff load of 200,000 pounds when applied at the anticlimbers. The cars are not equipped with speed-o-meters or speed recording devices. The cars were made by the St. Louis Car Company. Car type R-21 was placed in service in October 1956, type R-22 in November 1957, type R-29 in April 1962, and type R-33 in November 1962. Each car was designed for the maximum practical capacity of 180 passengers. The lead car of train 142NL was not air-conditioned. A motorman testified that a nonair-conditioned motorman's cab can become extremely hot in warm weather and that they have a doorstop to put on the cab door to hold it open 2 or 3 inches

and a window on the right side of the cab that can be opened for ventilation. He further stated that at the time of year this accident happened, many motormen have the door open all the time.

Track Information

The New Lots extension is on an elevated structure that extends from New Lots Avenue to the portal of the subway tunnel 1,100 feet north of the Sutter Avenue Station. There are six stations in the 2 1/3 miles from the New Lots Avenue Station to the tunnel portal. A northbound train leaving the Sutter Avenue Station descends from the elevated structure and while approaching the tunnel portal enters a 9°52' right-hand curve, and then enters the tunnel on a 9°22' left-hand curve. The collision occurred in the tunnel on the 9°22' left-hand curve. (See figure 2.)

Signal and Train Control System

The NYCTA uses two different types of train control systems with an automatic block signal system to direct the movements of trains. One system is the original equipment, and the other system is being used where modernization work has been completed. The system on the portion of the New Lots line where the accident occurred has the original IRT train control system constructed in 1912. The signals are a three-color light type displaying green, which indicates proceed; yellow, which indicates approach; and red, which indicates stop. The train control is an automatic train stop system that makes use of a trip arm located outside the rail adjacent to the signal. When a signal is red, indicating stop, the trip arm raises. (See figure 4.) If a train fails to stop at a red signal, its lead car strikes the raised trip arm of the signal system and the train's brakes apply automatically in emergency.

The original IRT train control system was designed so that when a portion of the system became deenergized, the two signals immediately before the deenergized area would display red and the trip arms would raise. The third signal before the deenergized area would display yellow. In the deenergized portion, the signals would be dark, but the trip arms adjacent to the signals would not necessarily be in the raised position; rather they would remain in the position, either up or down, that they were in immediately before the loss of power. (See figure 5.) The modernized train control system, designated by the NYCTA as the prevalent TA train control, is used on the major portion of the NYCTA subway system. As portions of the original IRT train control system are replaced, the prevalent TA train control system is being installed. The prevalent TA train control system is similar to the original IRT train control system except that (1) when a portion of the system is deenergized, only the signal immediately before the deenergized portion is red--with the trip arm up, and (2) in the deenergized portion all the signal lights are dark and all the trip arms raise to the stop position. (See figure 6.) The signal color light aspects and signal indications are the same on the New Lots to White Plains Road line even though both the original IRT train control system and the prevalent TA train control system are used on various sections of this line.

A motorman operating a train traveling the 25.78 miles from New Lots Avenue to White Plains Road encounters both train control systems in different portions of the trip. The original IRT train control system is in place in the 5.45 miles from New Lots Avenue to Bergen Street. From Bergen Street to East 180th Street, 15.76 miles, the prevalent TA train control system is in place. At East 180th Street, the original IRT train control system begins again to White Plains Road, a distance of 4.57 miles.

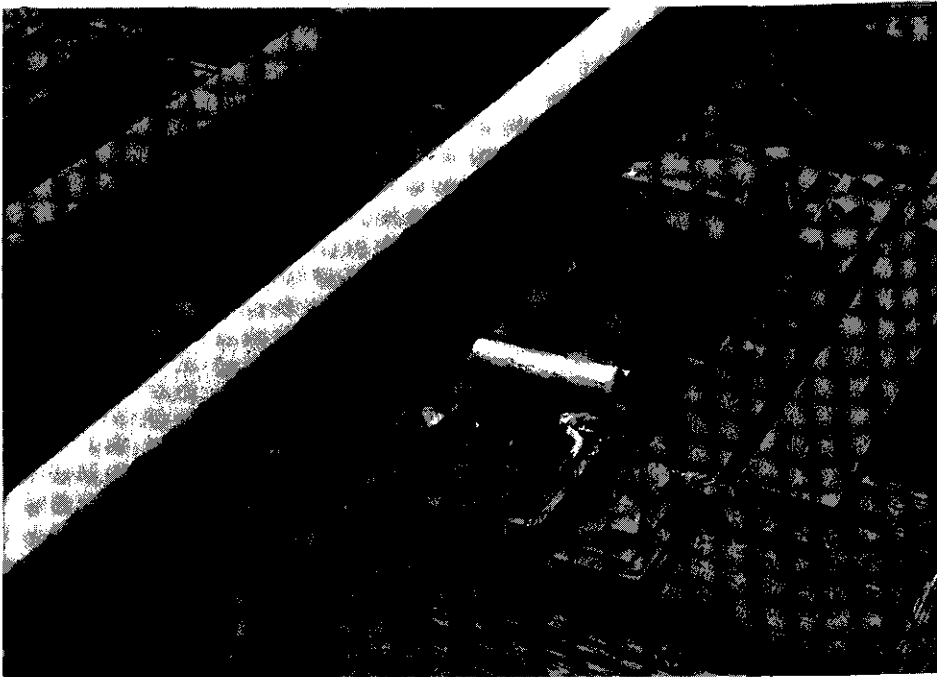
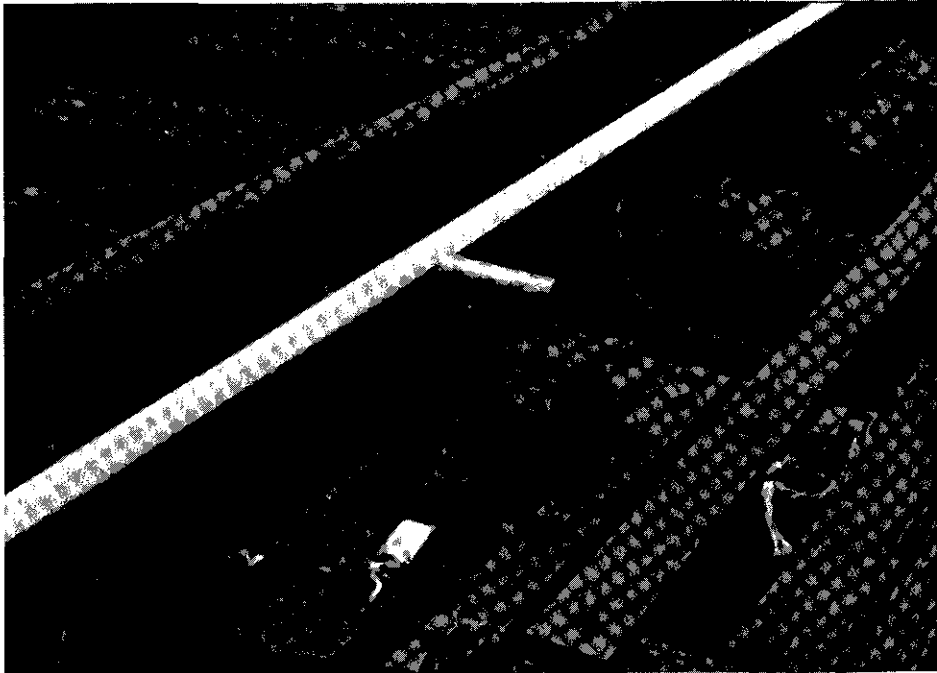
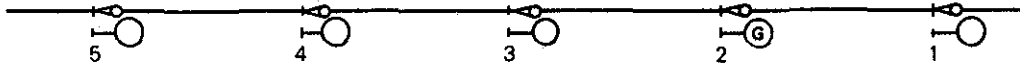
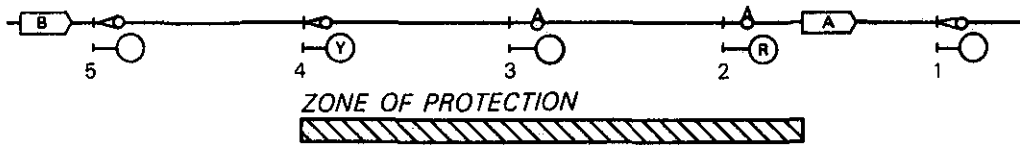


Figure 4.—Trip arm in automatic train stop system shown in up, stop position (above) and down, clear position (below).

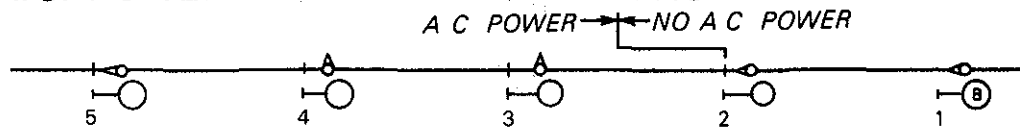
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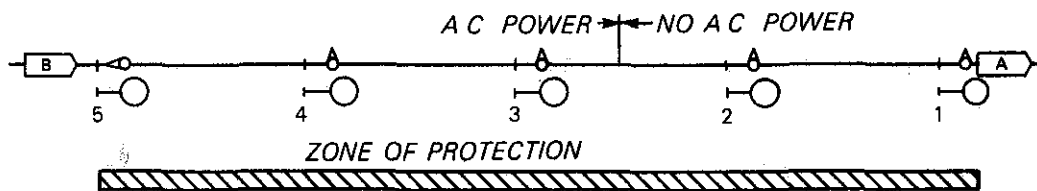
FOLLOWING TRAIN PROTECTION



A.C. POWER OFF - WITH NO TRAINS



A.C. POWER OFF - WITH TRAINS IN AREA



A.C. POWER OFF - TRAIN B 'KEYS-BY' IN AREA

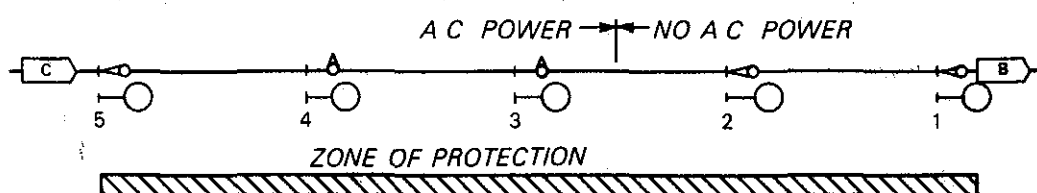
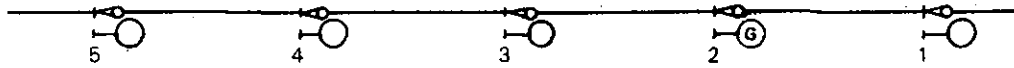
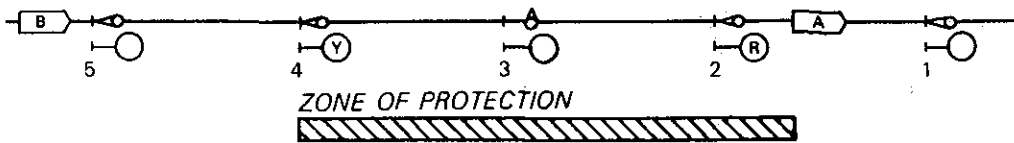


Figure 5.—Original IRT train control signal system and trip arm diagram.

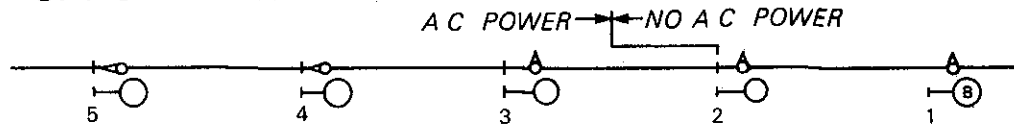
WITH NO TRAINS



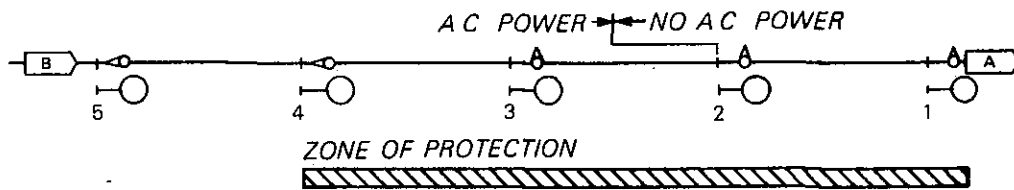
FOLLOWING TRAIN PROTECTION



A.C. POWER OFF - WITH NO TRAINS



A.C. POWER OFF - WITH TRAINS IN AREA



A.C. POWER OFF - TRAIN B MUST HOOK STOPS 1 & 2

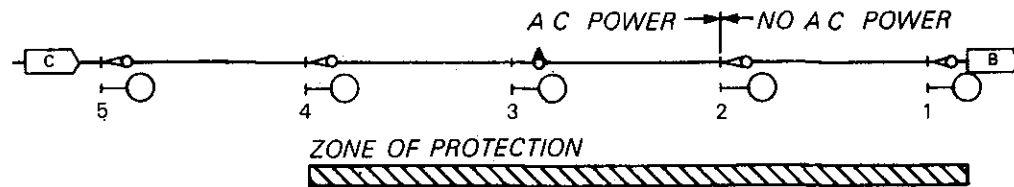


Figure 6.—Prevalent TA train control signal system and trip arm diagram.

The trip arms of both train control systems are equipped with hooks that, when applied, prevent the trip arm from raising when it would otherwise raise. In the accident area, each of the trip arms also had a rope attached which, when tied, prevents the trip arm from raising. Tying the trip arm down insures that the trip arm will stay down even if vibration dislodges the trip arm hook.

Interviews with the train crewmembers and command center personnel indicated that they did not know that, because of the design of the original system, it was possible that all trip arms in the area of the accident would not move to the up or stop position when the signals were deenergized. The NYCTA engineering department is aware of the differences in the two systems and has an ongoing modernization plan to replace the original IRT system. The NYCTA superintendent of signals testified on August 5, 1981, at the public hearing held in connection with this accident that the portion of the New Lots line from New Lots Station to Sutter Avenue Station is being modernized and the work should be completed in 1983. He also said that the new signal system for the portion of the New Lots line where this accident occurred was in the design stages, and that he believed funding would be requested in the fiscal year 1983 capital budget. If this occurred, the work could begin in 1983. The modernization program described at the public hearing indicates that the northern portion of the line from 180th Street through the White Plains area would be planned for completion in the year 2001 or 2002.

Method of Operation

NYCTA subway trains are operated by the signal indication of the automatic block signal system, timetables, and "Rules and Regulations Governing Employees Engaged in the Operation of the New York City Transit System."

NYCTA rules and regulations provided that:

Rule 37(e) A train must stop at a missing, unlit or wrongly lit signal. This must be reported immediately to the desk trainmaster.

* * *

Rule 37(m) A motorman must stop for a red automatic signal. He must stop about 15 feet short of the signal, or at the yellow marker on the 3rd rail protection board. He must not move until the light turns to yellow or green unless:

1. The signal has an "AK" sign, or
2. The signal is on a storage track or in yard, or
3. An employee whom the motorman knows is permitted to do so gives a signal to go ahead which the motorman knows is meant for him, or
4. He calls the desk trainmaster by radio and is told to do so.

* * *

Rule 37(b) When he is permitted to move past a red automatic signal, the motorman must pull up to the signal, stop and make sure that the stop arm goes down. If the

signal has a "k" sign, he must use the lever, button or special key to make the stop arm go down. He must then go with restricted speed and extreme caution to the next signal, not exceeding a speed that will permit stopping within one-half his range of vision.

* * *

NYCTA Definition "Restricted speed with extreme caution." When you read this expression in any rule it means: Do not go faster than 10 miles per hour; stop your train at least 2 car lengths short of a visible object on the roadway; be ready to make a fast stop; watch rails and switches for the route and look for anything on the road that is unsafe to move past, prepared to stop within one-half your range of vision.

* * *

Rule 36(f) Trains must run as shown on the timetable unless otherwise ordered by printed instructions or a supervisor.

* * *

Rule 33(a) The timetable is the authority for the movement of regular trains in passenger service, subject to the rules and special instructions.

* * *

Duties and Responsibilities of Train Dispatchers:

Rule 103(b) They are responsible for the expeditious and correct dispatch and safe movement of trains within the limits assigned to them and will have supervision of all employees in train and yard service in their respective sections.

* * *

Rule 103(e) They must report at once to the desk trainmaster all unusual intervals between trains with a view to regulating train movements so as to provide intervals in accordance with the current timetable.

NYCTA Standard Operating Procedure 6.1 states, "The command center is the New York City Transit Authority's centralized location at 370 Jay Street, Brooklyn, New York, Room 300, where all train movements are directed and coordinated."

Instructions are given by train dispatchers and the command center to motormen on trains en route by radio. The command center employees talk with train dispatchers by telephone or by radio.

The authorized speed for trains entering the tunnel and through the accident area is 25 mph.

The NYCTA has five departments directly involved in the operation of trains: transportation, car maintenance, maintenance of way, power, and station. Each of the departments is headed by an Assistant General Superintendent who is responsible to the General Superintendent Rapid Transit.

The NYCTA establishes its own operating rules and safety programs. No agency has safety oversight over the NYCTA.

Meteorological Information

The National Weather Service reported that at 1:52 p.m. the temperature was 78°, there was a light overcast, the wind was from the south at 10 knots, and visibility was 7 miles.

Medical and Pathological Information

An autopsy of the motorman of train 142NL indicated that he died as a result of injuries sustained in the accident. There was no indication of any physical problems at the time of the accident that would have impaired his ability to perform as a motorman. A toxicology examination indicated the presence of cannabinoids. 6/ The Chief Medical Examiner for New York City testified that there is no conclusion that can be reached that the motorman was in any way impaired at the time of the accident by the presence of the cannabinoids.

Survival Aspects

The collision occurred in a subway tunnel. The first and second cars of train 142NL were fully in the tunnel after the collision occurred. The remaining eight cars were on the incline that extends from the elevated structure to the tunnel entrance. The rear car of train 132NL raised up when it was struck, overrode the lead car of train 142NL, and struck the tunnel ceiling. The overriding car crushed and tore away the front section of the lead car of train 142NL, including the operator's cab. The operating cab was extensively damaged and the motorman of train 142NL, who was in the operating cab, was trapped in the cab and was fatally injured. Rescue personnel, using jacks and saws, worked to free the motorman; however, he died of his injuries before he was removed from the cab at 5:35 p.m., 3 hours 50 minutes after the accident occurred.

A passenger, standing in the first car of train 142NL looking ahead through the end door window was thrown forward and through a hole in the front end of the car that was torn away at the time of impact. She sustained injuries to her left ankle, and lacerations and bruises to her face and legs. Another passenger, who was seated behind the motorman's cab at the time of collision, received neck and head injuries in the collision. Other passengers were injured when they were thrown out of their seats and struck the upright posts and handrails at the end of each set of seats throughout the cars. Most of these injuries were lacerations and contusions to the face and head. In addition, many passengers sustained contusion-type injuries to their shoulders, neck, ribs, and back.

6/ Marijuana constituents.

Approximately 6 minutes after the collision, when the motorman of 132NL reported the extent of the train damage and injuries to passengers, the command center notified rescue personnel. Fire department personnel arrived at the accident site about 10 minutes later. However, a deputy chief of the New York City Fire Department indicated that rescue personnel were not aware of the type of emergency when they first responded, and had to call for additional equipment after they arrived. It took the first fire department unit about 6 minutes after arriving to get to the train because of its location and to start evacuating passengers through the emergency exit from the tunnel. As additional units arrived, they began putting ladders up from the street to the elevated portion of the track where the rear eight cars of train 142NL were located and began removing passengers from the tracks and cars. All passengers had been evacuated by 1 hour after the accident.

Tests and Research

A postaccident inspection by NYCTA personnel revealed that the signals were dark from the Saratoga Avenue Station to Nostrand Avenue. They did note that the signal on the north end of the Sutter Avenue Station appeared to be displaying a dim green indication. The signal was opened and the lamp was found to be not illuminated. It was determined that the green lens was reflecting sunlight. Subsequent to the accident the NYCTA signal department applied a longer sunshield to this signal. This postaccident inspection also found that the trip arm at the north end of the Saratoga Avenue Station was tied down.

The brake valve handle in the operating cab of the first car of train 142NL was found in the running position. The master controller handle was in the second position, a power position. A postaccident inspection of the rail behind train 142NL did not reveal any sliding marks to indicate that the train brakes had been applied.

A test of the rear lights of the last car of train 132NL found that the left lightbulb was not illuminated at the time the collision occurred.

On July 11, 1981, a test train was assembled for a test run to observe site conditions and stopping distances. The weather on the day the test train was operated was bright and sunny as compared to a light overcast on the day of the accident. The train proceeded on the schedule of train 142NL. The preceding train was stopped at the location train 132NL had been struck, and its left rear light was turned off. The signals were deenergized from the Saratoga Avenue Station to Nostrand Avenue. The motorman of the test train was instructed to proceed, to "key by" all automatic signals, and to stop when he first sighted the standing train ahead. After leaving the Sutter Avenue Station, the motorman operated the test train at a speed of approximately 5 mph and brought his train to a stop when he sighted the stopped train ahead. The last car of the stopped train first became identifiable to the motorman of the test train when he had closed to a distance of 185 feet and was able to see the lights of the car in the dark tunnel, at which time he brought the train to a stop in 20 feet. (See appendix C.) After the test train stopped, observers walked back to a point 230 feet to the rear of train 132NL, from where they could see partially the right corner of the last car.

A brake test was conducted on a 10-car train consisting of the same type car equipment as train 142NL. One second after the master controller handle was released to initiate an emergency application of the train brakes, the brakes of all cars applied in emergency.

Using the data obtained from measurements of the damage to the car equipment and the distance the trains moved in the course of the collision, a mathematical computation of impact speed was made. The calculated speed of train 142NL was 12.7 mph at impact.

Examination of the train sheet maintained by the train dispatcher at the New Lots Avenue Station indicated that trains 122NL, 132NL, and 142NL were logged as having left at the scheduled times. In addition to the trip arms used in connection with the signals, trip arms are also used between signals to control the speed of trains. If a train arrives at a speed trip arm before the allotted time has passed, the train will be stopped. The running time between the New Lots Avenue Station and the accident sight is 7 1/2 minutes. Train 132NL was scheduled to arrive at the signal where it stopped at 1:39:30 p.m. but actually stopped and reported at 1:36 p.m. Train 142NL was not scheduled to arrive in the area until 1:49:30 p.m. but struck train 132NL at 1:44 p.m. The NYCTA assistant general superintendent stated in testimony that a train dispatcher can dispatch trains before or after their scheduled times but that all points on the line and the command center must be notified.

After the accident, the cause of the grounding of the signal power cable was found to be a broken insulator that allowed the cable to drop against the steel beams of the elevated structure.

ANALYSIS

Signal Failure

At 11:12 a.m., the NYCTA power department system supervisor was notified of a momentary signal failure and intermittent signal outages but he did not notify the NYCTA command center of the problem. Likewise, the signal department foreman, who was notified by the power department system supervisor, did not notify the NYCTA command center. Without notifying the command center, a signal foreman and signal maintainer began an attempt to locate the signal fault by cutting switches and substations in and out, which resulted in intermittent signal outages. Signal personnel at the Saratoga Avenue Station, while trying to locate the signal problem, were flagging trains past the red signals. Although not required by NYCTA operating rules, reports of all of these activities should have been made to the command center, which was responsible for train movements. Only after a complete failure of a power substation and the loss of signals, and only after the motorman of train 122NL reported dark signals to the command center at 1:34 p.m., 2 hours 22 minutes after the trouble began, did the command center become aware of the situation.

Interdepartment communication is necessary for a system as large as the NYCTA to perform the many functions necessary to keep trains running. The command center must be made aware of any activity or event which affects the operation of trains, regardless of its duration. The failure to notify the command center of the intermittent deenergizing of the signal power, of the cutting of signal power switches in and out by the signal department, and that substations were off the line created a hazardous situation. The Safety Board believes that the NYCTA must require better interdepartment communications to give the command center the ability to properly and safely direct train movements.

Because of the failure of employees to transmit vital information to the command center, it was virtually impossible for command center personnel to have known the locations of the trains and the conditions that existed in the area before the accident

occurred. Command center personnel do not have an electronic model board display to indicate the locations of trains. If train 142NL had been held at the red signal at the Saratoga Avenue Station until the signal maintainer had contacted the command center instead of being flagged through, the command center would have known the location of train 142NL and could have held the train until trains 122NL and 132NL ahead were moved forward. The trip arm at the north end of the Saratoga Avenue Station was found tied down after the accident. The investigation could not determine when or by whom this was done. The practice of signal foremen and maintainers hooking trip arms down and flagging trains by red signals without notifying the command center creates a situation where a train can enter a portion of the system without the command center being aware that the train is in the area.

Train Dispatching

The scheduled running time for a train from the New Lots Avenue Station to the accident site is 7 1/2 minutes, but witness statements indicated that train 142NL was operating slower than normal before the accident. Even though the train sheet at the New Lots Avenue Station indicated that train 142NL departed at 1:42 p.m., it must have departed some time before 1:37 p.m. because the accident occurred about 1:44 p.m. Because the train dispatcher at the New Lots Avenue Station allowed train 142NL to depart from the station before its scheduled departure time, command center personnel were unaware that the train was en route because they can assume that a train is on schedule and properly separated from other trains if they have not been advised otherwise as required by NYCTA operating rules. When the command center train dispatcher broadcast on the radio at 1:37 p.m., "Hello motormen all trains, 122NL, 132NL, stop and stay in stations where you are please, we have signal trouble until further notice," train 142NL may have just been entering the system. Therefore, when train 142NL came on line ahead of schedule, the train dispatcher would not have known that train 142NL was closing on train 132NL. To allow a train to operate on the system without command center personnel being aware that it is not operating on its normal schedule is a violation of NYCTA rules and degrades the ability of the command center to control the movement of that train. If command center personnel had known that train 142NL was en route from the New Lots Avenue Station, they probably could have stopped the train or held it farther back, and this accident might not have occurred. During testimony, the assistant general superintendent in charge of the NYCTA rapid transit department stated that the terminal dispatcher may change the timetable to reflect actual conditions but this information must be immediately passed to all points up the line as well as the command center. The dispatching of trains ahead of schedule, as apparently was being done at the time of this accident, without the command center being notified is a dangerous operating practice. The Safety Board believes that the NYCTA should vigorously enforce its rule against such a practice.

After boarding at the New Lots Avenue Station and after departing, the motorman of train 142NL did not have any conversation with the command center. The command center only becomes involved in train handling when problems exist. Because the command center was not aware that train 142NL was operating on the system after the time the radio warning directed at trains 122NL and 132NL was given, no specific warning or instructions were given to the motorman of train 142NL. The motorman of train 142NL apparently heard the instructions that were given by the trainmaster to key by automatic signals and the general warning given at that time to operate with extreme caution; however, he was never advised that trains 122NL and 132NL were stopped ahead. If he had been advised, this accident most likely would not have occurred.

Operating Rules

Since the motormen of trains 122NL, 132NL, and 142NL were flagged through the red signals at Saratoga Avenue and then proceeded through dark signals without stopping, each motorman apparently had accepted the instructions from the command center at 1:41 p.m. to key by signals as permission to proceed by the dark signals without stopping to report as required by the rules. Train 122NL did so until arriving at the Utica Avenue Interlocking, and train 132NL did so until after entering the tunnel and observing train 122NL ahead. Allowing motormen to key by automatic signals permits the operation of more than one train in a signal block.

As a result of its investigations of four previous rail rapid transit accidents, 7/ the Safety Board warned against the operation of more than one train in a signal block and concluded that it should only be done in an emergency and only after positive safeguards are in place to keep trains separated. A November 13, 1970, report 8/ of an investigation contracted by the Metropolitan Transportation Authority (MTA), a New York State agency, stated (paragraph 6.22.2) that the automatic "keying-by" procedures had been suspended and that it should never be restored. However, even after this report and the warnings of the Safety Board, the NYCTA has resumed without adequate safeguards, and is still engaging in, this very dangerous practice. When questioned about the command center instruction to "key by" automatic signals and what it means, one motorman stated, "command center gives you permission to key by the signals, you key by them. You make sure the trip arm is down and you key by the signal." Another motorman stated that when the command center gave permission to key by the signals, he radioed a following train to alert the motorman of that train to his location. He said that it was a courtesy to do so and that some of the other motormen do the same.

In this accident, when the signals failed and the motormen were instructed to key by, the safe movement of the trains was no longer assured by the signaling equipment but was dependent upon the skill and alertness of the motormen. Accident investigations have demonstrated that people make mistakes in these circumstances. In each of the four previous accidents cited, the Safety Board found that the onboard crewmembers did not take adequate action to avoid a collision. Therefore, positive means to insure train separation, other than the motorman, must be used. The broad permission given by the command center trainmaster for motormen to key by all automatic signals was a violation of NYCTA rule No. 37 that requires motormen to obtain permission to pass a dark signal. By giving blanket permission to key by, the command center relinquished to the motormen its responsibility for directing the train movements through the dark signal area. If the command center had required the motormen to stop their trains at each dark signal as required by rule No. 37, the command center could have ascertained the location of each train and, by radio commands with direct instructions to each motorman, could have safely moved the trains through the dark area. If the command center had assumed its responsibility in this manner, this accident might not have occurred.

7/ Railroad Accident Reports: "Collision of Illinois Central Gulf Railroad Commuter Trains, Chicago, Illinois, October 30, 1972" (NTSB-RAR-73-5); "Collision of Two Penn Central Commuter Trains at Botanical Gardens Station, New York City, January 2, 1975" (NTSB RAR-75-8); "Rear-End Collision of Two Greater Cleveland Regional Transit Authority Trains, Cleveland, Ohio, August 8, 1976" (NTSB-RAR-77-5); "Rear-End Collision of Two Chicago Transit Authority Trains, Chicago, Illinois, February 4, 1977" (NTSB-RAR-77-10).

8/ "Report of the Panel Appointed to Study the Safety of Train Operations on the Subway System of the New York City Transit Authority," November 13, 1970.

The Accident

Train 142NL was flagged through the red signals at Saratoga Avenue by an employee of the signal department, and because the trip arm on the north end of the station was tied down and because of the dark signals from the Saratoga Avenue Station to the point of collision, it was not necessary for the motorman to stop the train at each dark signal to cause the trip arm to fall into the nontripping position. In fact, the motorman may have believed that the block ahead was clear because the trip arm was in the down position and the signal at the north end of the Sutter Avenue Station appeared to be green. He also may have thought that the trip arm had been put down by signal department employees to indicate that the track ahead was clear. Since none of the operating employees involved in this accident, including command center personnel, understood that the trip arms did not rise automatically to the up or stop position when signals failed in this area, it is doubtful that the motorman of train 142NL understood that fact. It is also unlikely that he heard the communications from trains 122NL and 132NL to the command center concerning their being stopped because of dark signals, since he would have been boarding his train at the New Lots Avenue Station about that time. He may have heard only the radio transmission from the command center trainmaster to key by automatic signals and to use extreme caution. All these circumstances may have led the motorman of train 142NL to believe that the track ahead was clear. After the train departed the Sutter Avenue Station and approached the tunnel entrance, the motorman must have assumed that the track was clear and failed to maintain a diligent lookout ahead.

As the train descended from the elevated section toward the tunnel, and came to the point where the train ahead would have become identifiable at 185 feet as indicated in the test at 5.0 mph, the motorman of train 142NL moving at 12.7 mph would have had 9.9 seconds to respond to the emergency. Because he did not react and apply the brakes, he must have been distracted. Because he had been observed by the signal foreman with his head out of the side window of the cab and it was a warm day, he simply may have been attempting to cool off. Also, he may have been looking out to observe the cars in his train if he suspected something was wrong with the equipment. But for whatever reason, it is apparent from the lack of any braking or slowing of train 142NL that the motorman was not looking ahead to observe conditions as required by NYCTA rules.

Training

This accident indicates that training for operating department personnel on the operation of the signals and trip arms is inadequate. Motormen were operating trains on the run from New Lots Avenue to 241st Street under two different train control systems but did not know what the differences in the systems were. They did not understand the protection or lack of protection provided by the trip arms of each system. Their lack of understanding that in some sections of track the trip arms do not come up automatically if a signal power failure occurs, and the practice of hooking trip arms down when a power failure occurs led to confusion about the conditions that existed in the affected area. Moreover, the train dispatchers and trainmasters at the command center and their supervisors also did not know that the two different systems existed on this line. For the NYCTA to have allowed this situation to arise demonstrates a fundamental lack of concern for adequate operating procedures on the part of management. The Safety Board believes that it is essential for all operators of NYCTA trains and those charged with the responsibility for handling the trains to be trained thoroughly in the use of the two train control systems.

The need for the NYCTA to review and revise its operating rules and procedures is evident. When the signal power failure occurred, confusion and improper procedures and instructions also resulted. The NYCTA should establish proper procedures for other-than-normal train operations and insure proper training through instructions, drills, and monitoring of employee compliance. The Safety Board believes that the NYCTA should immediately review the events of this accident and establish necessary training and operating procedures to avoid the confusion and conflicting instructions in future situations of this type.

Safety Oversight

Since its investigation of an NYCTA accident in 1978, 9/ the Safety Board has repeatedly called attention to the need for independent oversight of NYCTA safety. Existing safety problems must be resolved and new problems affecting passenger safety must be quickly identified and resolved before they lead to accidents. The safety oversight activities of the Urban Mass Transportation Administration (UMTA) of the U.S. Department of Transportation (DOT) are extremely limited and inadequate for safety oversight. UMTA's investigative authority under Section 107 of the National Mass Transportation Assistance Act of 1974 is unwieldy, primarily because it requires the existence of an unsafe condition as a prerequisite to investigation. It is extremely difficult to make a determination that an unsafe condition exists without first investigating it. However, UMTA's Section 107 authority is so narrowly defined that it does not permit UMTA to investigate a suspected safety problem to determine if a condition is, in fact, unsafe. UMTA's investigation in 1974 of the problems of NYCTA's R-46 subway cars was the only test of its Section 107 authority. In most respects it operated well, resulting in the identification of serious safety problems, the development of a corrective action plan, and implementation of the plan with UMTA's direct approval and oversight. However, the DOT has proposed that Section 107 be repealed "in an attempt to remove the Federal Government from an intrusive role in rail transit safety." 10/ UMTA had recognized the limitations of its Section 107 authority and had been seeking, before the department proposed its repeal, the authority to establish investigative procedures that would clarify this function. Therefore, because UMTA does not have the kind of capability for systematic safety oversight that is needed for systems like NYCTA, and because UMTA does not plan to establish such oversight capability, 11/ the need for safety oversight of the NYCTA can only be met at the State or local level. Because the membership of the Boards of Directors of the Metropolitan Transportation Authority (MTA) and the NYCTA are identical, the MTA lacks sufficient independence from the NYCTA to exercise effective safety oversight.

On September 22, 1981, as a result of its special investigation of eight subway fires on the NYCTA system, 12/ the Safety Board recommended that the State of New York:

Initiate legislative and/or executive action to authorize a new or existing independent agency to oversee and regulate the safety of the New York City Transit Authority. (R-81-116)

9/ Railroad Accident Report—"Derailment of New York City Transit Authority Subway Train, New York, New York, December 12, 1978" (NTSB RAR-79-8).

10/ Letter from Secretary, DOT to NTSB, April 22, 1981.

11/ Letter from UMTA to NTSB, March 4, 1982.

12/ Special Investigation Report—"Eight Subway Train Fires on New York City Transit Authority with Evacuation of Passengers" (NTSB-SIR-81-5).

The State of New York has not yet responded to the Safety Board on this recommendation.

Survival Aspects

Because of the extensive damage to the operating cab of train 142NL as a result of this 12- to 13-mph collision, the collision was unsurvivable for the motorman. Although the DOT has done extensive research on the crashworthiness of rapid transit car cabs, UMTA needs to take the initiative to establish guidelines for construction of rapid transit cars. Requirements should be imposed to improve the structural integrity of transit cars to provide more protection for the operators. Following an accident on October 30, 1972, 13/ the Safety Board made two recommendations (R-73-17 and -18) to UMTA in regard to establishing crashworthiness specifications for newly designed cars which may qualify for purchase with Federal grants. UMTA responded on July 25, 1973, that it agreed with the recommendations and was working to implement them. The Safety Board has investigated a number of accidents 14/ in which crashworthiness has been identified as inadequate to provide protection for passengers and crewmembers. However, to date no minimal criteria for the structural design of rapid transit vehicles have been published. Because of the lack of adequate crashworthiness and the damage sustained by the front end of the first car in train 142NL, the emergency forces had extreme difficulty rescuing the injured motorman. The Safety Board strongly urges that the DOT quickly resolve the problem of inadequate crash protection for the occupants of rapid transit vehicles.

The first fire department units to arrive at the accident site did not know what the situation was that they were responding to. This lack of information resulted in delay because of their having to assess what had happened, locate the train cars in the tunnel, and call for additional help. The motorman of train 132NL had assessed the situation at the collision site and reported his findings to the command center. However, because the command center apparently did not give sufficient information to the fire department, they arrived with insufficient men and equipment. Rescue personnel had difficulty in evacuating the passengers from the elevated portion of the track because there is no emergency stairway to the street level at this location. The NYCTA should evaluate the difficulties experienced because of the location of this accident and take action to provide adequate means for the emergency evacuation of passengers and crew in future accidents.

CONCLUSIONS

Findings

1. Although they were not required to do so by NYCTA operating rules, power and signal department employees should have reported the intermittent signal failure and activities related to the signal failure to the NYCTA command center.

13/ Railroad Accident Report--"Collision of Illinois Central Gulf Railroad Commuter Trains, Chicago, Illinois, October 30, 1972" (NTSB-RAR-72-5).

14/ Railroad Accident Reports--"Collision of the State-of-the-Art Transit Cars with a Standing Car, High Speed Ground Test Center, Pueblo, Colorado, August 11, 1973" (NTSB-RAR-74-2); "Chicago Transit Authority Collision of Trains No. 104 and No. 302 at Addison Street Station, Chicago, Illinois, January 9, 1976" (NTSB-RAR-76-9); Rear-End Collision of Two Greater Cleveland Regional Transit Authority Trains, Cleveland, Ohio, August 8, 1976" (NTSB-RAR-77-5); "Derailment of New York City Transit Authority Subway Train, New York, New York, December 12, 1978" (NTSB-RAR-79-8).

2. Trains 122NL and 132NL did not stop at dark signals between the Saratoga Avenue Station and the tunnel portal as required by the NYCTA operating rules, apparently on the basis of improper and confusing instructions given by the trainmaster in the NYCTA command center at 1:41 p.m.
3. The motorman of train 142NL apparently did not hear the initial message from the NYCTA command center at 1:37 p.m. about the signal failure, but must have heard the message at 1:41 p.m. to "key by" all signals.
4. Train 142NL was dispatched from the New Lots Avenue Station ahead of schedule in violation of NYCTA operating rules and without the knowledge of the NYCTA command center.
5. The results of the sight and stopping distances tests indicate that the motorman of train 142NL could have seen the rear of train 132NL and stopped before the impact point.
6. The motorman of train 142NL did not apply the train brakes before the train struck the rear of train 132NL.
7. NYCTA motormen and command center personnel have not been trained adequately concerning the differing operational characteristics of the two train control systems currently in use on the system.
8. The severe damage to the lead car of train 142NL and the slow impact speed of 12 to 13 mph indicates a need for improved crashworthiness in the design of these type of NYCTA transit cars.
9. Local, State, and Federal authorities do not have effective oversight of NYCTA safety, and this accident indicates a need for oversight by one of these authorities.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the motorman of train 142NL to maintain a diligent lookout ahead and stop short of a collision with the rear of train 132NL, and the failure of the New York City Transit Authority to provide effective operating and maintenance procedures which would protect trains when the signal system was malfunctioning. Contributing to the cause of the accident was the NYCTA's tolerance of unsafe operating and maintenance practices and inadequate training of operating employees regarding the functional differences of its two signal systems.

RECOMMENDATIONS

As a result of this investigation, the National Transportation Safety Board recommended that the New York City Transit Authority:

Train operating department personnel in the differences between the two train control systems used on the New York City Transit Authority system. (Class II, Priority Action) (R-82-35)

Provide additional safeguards for "keying by" automatic signals in an emergency by requiring trains to stop at each signal and receive permission from the command center to proceed. (Class II, Priority Action) (R-82-36)

Require that any event or activity affecting the operation of trains be reported to the command center immediately. (Class II, Priority Action) (R-82-37)

Eliminate the practice of allowing nonoperating personnel to flag trains through red signals. (Class II, Priority Action) (R-82-38)

Accelerate the modernization of the New York City Transit Authority train control signal system by installing the prevalent TA train control, with particular emphasis on eliminating the use of two different types of signal systems on the same route. (Class II, Priority Action) (R-82-39)

Improve procedures and coordination between operating departments for handling train operations during emergencies or maintenance work. (Class II, Priority Action) (R-82-40)

Review and revise operating rules, procedures, and practices for other-than-normal train operations, and insure proper training through instructions, drills, and monitoring of employee compliance. (Class II, Priority Action) (R-82-41).

Review and revise the procedures for notification of emergency and rescue personnel to eliminate delays and provide as much available information as possible to assist them in assessing the equipment and manpower requirements. (Class II, Priority Action) (R-82-42)

In addition, the National Transportation Safety Board reiterates the following recommendation issued on September 22, 1981, to the State of New York:

Initiate legislative and/or executive action to authorize a new or existing independent agency to oversee and regulate the safety of the New York City Transit Authority. (Class II, Priority Action) (R-81-116)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JAMES E. BURNETT, JR.
Chairman

/s/ PATRICIA A. GOLDMAN
Vice Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ G. H. PATRICK BURSLEY
Member

May 14, 1982

APPENDIX A
INVESTIGATION

The National Transportation Safety Board was notified officially of the accident about 3:30 p.m., on July 3, 1981. A New York Field Office investigator was alerted to the accident earlier through radio reports and immediately went to the accident site. The Safety Board dispatched an additional investigator from the New York Field Office and an investigator from Washington, D.C., headquarters to the accident scene. Two additional investigators were sent later from Washington, D.C., to assist in the investigation.

A 2-day public hearing was held on August 4 and 5, 1981, in Brooklyn, New York. Parties represented at the hearing were the New York City Transit Authority, Urban Mass Transportation Administration, Transport Workers Union of America, and the Subway Service Supervisors Association. Testimony was heard from 22 witnesses.

APPENDIX B

PERSONNEL INFORMATION

Motorman Jessie B. Cole, Train 142NL

Motorman Cole, 36, was employed as a conductor by the NYCTA on January 19, 1970, and was promoted to motorman on October 17, 1971. He passed a company physical examination on June 23, 1980. He took a motorman's refresher course on March 17, 1978, which covered rules and regulations, proper operating procedures, and train breakdowns. He had made 220 trips between the New Lots Avenue Station and the tunnel portal in the 6 months preceding the accident. His discipline record indicates that he received a 1-day suspension on June 30, 1972, for a run-through switch; a 2-day suspension on July 6, 1972, for a collision; and a caution on December 28, 1974, for excess speed (46 mph in a 35 mph zone). He had also received caution on 12 occasions for being absent without a reason from work or late reporting for his assignment.

Conductor Earl English, Train 142NL

Conductor English, 56, was employed as a conductor by the NYCTA on August 6, 1973. He passed a company physical examination on January 23, 1979. He attended a conductor's refresher class on August 28, 1978, which covered rules and regulations, proper train operation, and proper handling of train breakdowns. His discipline record indicates he received nine cautions for being absent without reason from work or late reporting for his assignment. One caution was given to him for remaining in the operating cab while en route, a violation of the rules.

Trainmaster Joseph R. O'Reilly

Trainmaster O'Reilly, 54, was employed as a conductor by the NYCTA on August 29, 1949. He was promoted to towerman on May 23, 1952, to motorman on June 9, 1956, to train dispatcher on June 29, 1960, and to trainmaster on October 16, 1971. He passed a company physical examination on November 25, 1980. He received training in the duties and responsibilities of desk trainmaster on March 20, 1981. His discipline record indicates he received two warnings for failing to report for his assignment; a warning for failing to maintain control of train, tripped on signal; and a caution for failure to make a brake test. He was suspended for 2 days for improper supervision of a terminal. His discipline record is clear since June 22, 1965.

New Lots Train Dispatcher Walter L. Wilson

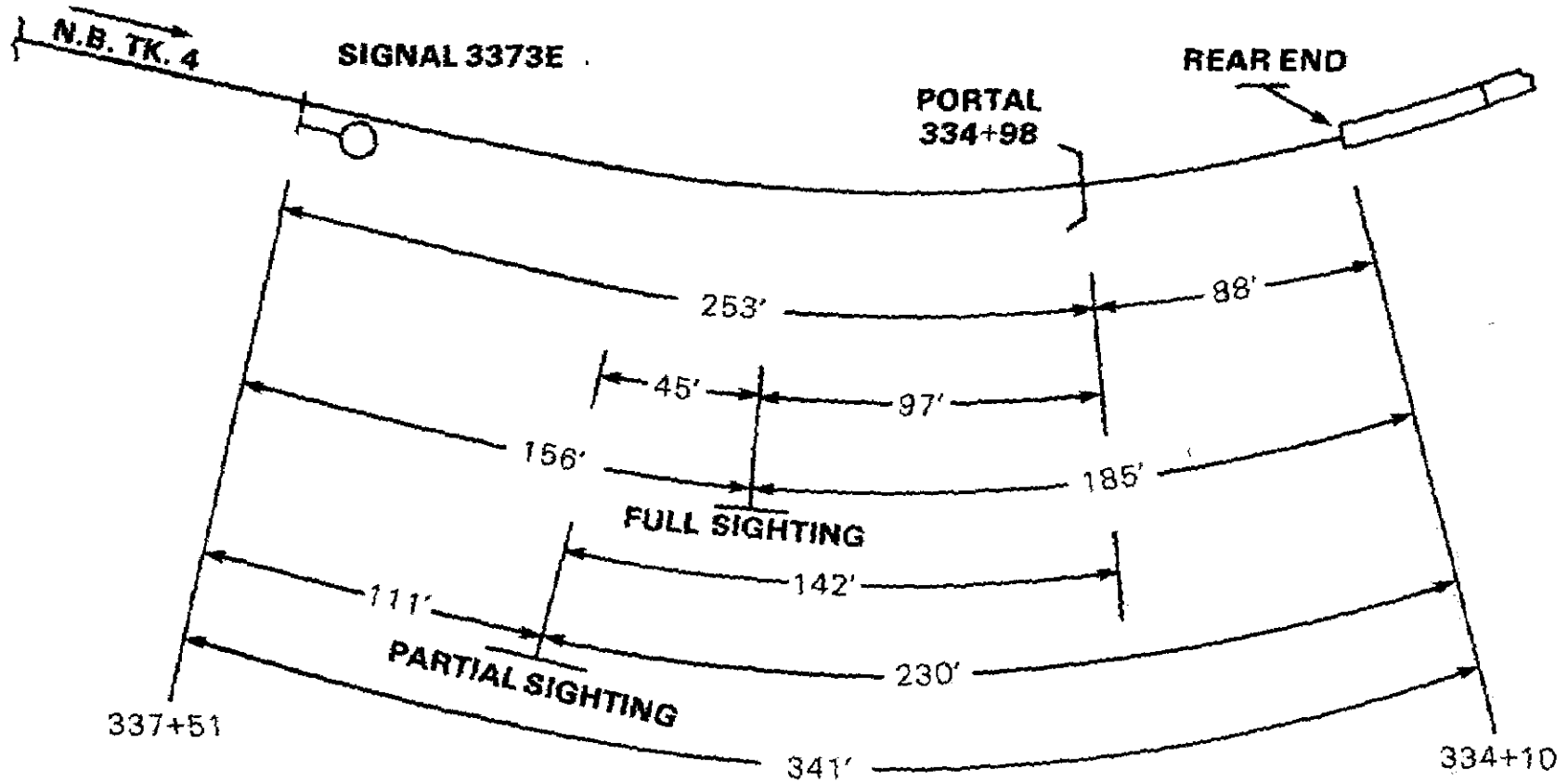
Train dispatcher Wilson, 49, was employed as a railroad clerk by the NYCTA on September 22, 1959. He was promoted to assistant train dispatcher on February 26, 1967, and to train dispatcher on July 26, 1970. He passed a company physical examination on January 2, 1973. On July 26, 1970, he attended a class on proper handling of train register sheets, the pay and allowance manual, proper handling of gap sheets, proper handling of inspection caps, and proper terminal operations. His discipline record indicates only one caution, given on August 26, 1974, for his failure to pass correct information to another location. His record is clear of any other discipline.

Command Center Train Dispatcher Felix Foster

Train dispatcher Foster, 56, was employed as a conductor by the NYCTA on July 30, 1962. He was promoted to towerman on July 14, 1965, and to train dispatcher on

August 13, 1972. He passed a company physical examination on August 13, 1972. On August 14, 1980, he received training in the duties and responsibilities of console operator. His discipline record indicates that he received three cautions for restoring a lever and tripping trains, three cautions for initiating wrong routes for trains, and several cautions for minor infractions of the rules. His discipline record has been clear of any violations since November 24, 1975.

APPENDIX C
SIGHT DISTANCE TEST RESULTS



NOTES:
PARTIAL SIGHTING - POINT AT WHICH RIGHT CORNER OF TRAIN IN TUNNEL WAS DISCERNIBLE FROM CAB OF FOLLOWING TRAIN.
FULL SIGHTING - POINT AT WHICH FULL REAR END OF TRAIN IN TUNNEL WAS DISCERNIBLE FROM CAB OF FOLLOWING TRAIN.