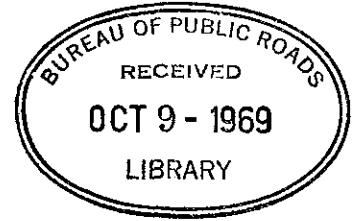


HE
1780
.A54
1967
May
c.1

✓
RAILROAD ACCIDENT REPORT.



NEW YORK CENTRAL RAILROAD COMPANY
TRAIN 1/NY-4 EXTRA 2020 EAST AND TRAIN ND-5 EXTRA 5305 WEST
HEAD-ON COLLISION
NEW YORK CITY, NEW YORK
May 22, 1967,

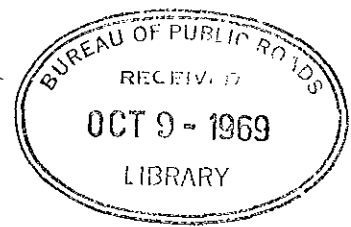
RELEASED:

U. S. NATIONAL TRANSPORTATION SAFETY BOARD ,

Department of Transportation

Washington, D. C.
20591

FOREWORD



The field investigation of this accident was conducted by representatives of the Federal Railroad Administration, Department of Transportation, under the authority of the Accident Reports Act (45 U.S.C. 40). This authority was transferred to the Department of Transportation by section 6(e) (1) (K) of the Department of Transportation Act (80 Stat. 931). Under section 5(b) (1) of the Department of Transportation Act, the National Transportation Safety Board, has the responsibility to determine cause or probable cause and report the facts, conditions and circumstances of such accident. Pursuant to the authority and to assist it in its determination of cause, a public hearing was held by the Board in New York City, New York, on July 12-13, 1967. The Board's determination as to the facts, conditions and circumstances relating to this accident and its determination of the probable cause thereof are set forth in this report. The Board's report shall not be admitted in evidence or used for any purpose in any suit or action for damages, as provided by section 4 of the Accident Reports Act (45 U.S.C. 41).

NATIONAL TRANSPORTATION SAFETY BOARD
DEPARTMENT OF TRANSPORTATION
WASHINGTON, D. C.

New York Central Railroad Company
New York, New York
May 22, 1967

TABLE OF CONTENTS

	<u>Page</u>
Synopsis	1
Location and Method of Operation	2
Signal System	4
Procedures for Train ND-5	5
72nd Street Station (DO)	6
Activity at DO, May 22, 1967	8
Train NY-4	9
Train Order	10
Train ND-5	12
The Accident	13
Tests After Accident	14
Radiotelephones	15
Analysis of Speed Tapes	15
Discussion of Rules	17
Control Tower Operations	21
Analysis of Causal Factors	24
Conclusions	32
Probable Cause	34
Recommendations	35

NATIONAL TRANSPORTATION SAFETY BOARD
Department of Transportation

RAILROAD ACCIDENT REPORT

Adopted: December 29, 1967

NEW YORK CENTRAL RAILROAD COMPANY
TRAIN 1/NY-4 EXTRA 2020 EAST and TRAIN ND-5 EXTRA 5305 WEST
HEAD-ON COLLISION
NEW YORK CITY, NEW YORK
May 22, 1967

SYNOPSIS

The accident occurred on the West 30th Street Branch of the New York Central Railroad at approximately 147th Street, New York, N. Y., at about 9:55 a.m. on May 22, 1967. The trains involved were 1/NY-4 extra 2020 east, consisting of three diesel-electric locomotives and 15 cars eastbound from Syracuse, New York to the 30th Street Branch of the New York Central Railroad, and train ND-5 extra 5305 west, consisting of four diesel-electric locomotives and 60 cars westbound from the vicinity of 105th Street, and proceeding north along the Hudson River on the 30th Street Branch.

The collision occurred on main Track No. 1, which was being used on the morning of the accident for train movements in both directions due to repairs which were being conducted on main Track No. 2.

As a result of the accident, six train service employees were killed, and three train service employees were injured. Six locomotives and 11 cars were destroyed, one locomotive was extensively damaged and five cars were also damaged.

The Board determines that the probable cause of this accident was the failure of the operator at the 72nd Street Station (DO) to restrict

train ND-5. Contributing causes were the failure of the dispatcher to assure positively that Track 1 had been blocked by D0 prior to issuance of the train order, the failure of the operator at the station at Spuyten Duyvil (DV) to secure a positive block on main Track No. 1 for train NY-4, and the failure of the New York Central Railroad Company to establish explicit boundaries of authority, explicit operating rules, and procedures to insure that its personnel are instructed in and comply with such rules.

LOCATION AND METHOD OF OPERATION

The 30th Street Branch of the New York Central Railroad extends from interlocking DV at Spuyten Duyvil, which is located near the junction of the Harlem River and Hudson River, south to East Bank Street, a distance of 11.4 miles. There are two main tracks which are designated as such in Timetable 21, extending from DV to West 105th Street. Proceeding south from DV, the right-hand track is designated as main Track No. 2 for trains moving south by geographical direction or east by timetable direction. The other main track, Track No. 1, is designated for train movements in a northerly geographical direction or westerly direction by timetable. Timetable directions are used hereafter in this report.

The area of the 30th Street Branch, to the east of West 153rd Street, is within yard limits. On the date of the accident, there were speed limit boards posted at 115th Street for 30 miles per hour, and at 138th Street for 45 miles per hour. Timetable No. 21 lists the speed limit between Signal 591 at West 107th Street and 137th Street at 30 miles per hour, and beyond West 137th Street to DV as 45 miles per hour. The yard limit area to the east of West 153rd Street contains yard tracks used for storing, switching, classification and make up of trains. A terminal

superintendent is in charge of the 30th Street Branch with, in order of authority, a train master, general yardmasters, assistant general yardmasters, and yardmasters under his control. The Rules of the Operating Department of the New York Central System, hereafter referred to as "Rules", state under the Duties of Yardmasters in Rule 812 that "They will have charge of their yards and direct the movement of trains and engines therein."

Timetable No 21 lists several first-class mail, express and passenger trains each day for the West 30th Street Branch. There are no listings for freight trains. The Rules provide that all train movements that are not provided for by timetable will be under train orders issued by the authority and over the signature of the superintendent unless other provisions are specified. On the 30th Street Branch, under normal conditions, trains moving on main Tracks 1 and 2, with the current of traffic, are operated by signal indications of an automatic block signal system. Movements against the current of traffic are governed by manual block signal system rules and by train order. See attached sketch

Under conditions making it necessary under the Rules to control movement of trains by train order on the 30th Street Branch, a dispatcher at 466 Lexington Avenue was required to transmit orders to the tower operators at Stations DV and DO on an open telephone line with a speaker so that instructions to one station would also be heard by the other. Under Special Rules for Train Dispatchers, Rule 807 states "They will control and issue orders governing the movement of trains in accordance with the Rules. They will record the movement of all trains and important incidents affecting the movement of traffic." It was customary on the

30th Street Branch for the dispatcher to control movements on the main tracks between DV and West 105th Street. However, there are no instructions in the Rules which specify whether the dispatcher or the yardmaster has control over the movement of trains on main tracks within yard limits. Moreover, the company did not furnish any other document or instruction to resolve this point when requested to do so by the Board at the hearing.

SIGNAL SYSTEM

The automatic block signal system for Track No. 1 begins at Signal 591, which is at 107th Street in a position 31,115 feet east of DV. The other signals, proceeding in a westerly direction, are given by number and distance to the east of DV. They are 641 at 25,350 feet, 751 at 19,750 feet, 811 at 16,350 feet, 871 at 13,500 feet and 1031 at 4900 feet. The accident location was 782 feet east of Signal 751. All of the signals on Track No. 1 are automatic two-unit search light type, with Signals 591 and 641 being continuously lighted, and all of the others are approach lighted. These signals, which show only to westbound trains, have combinations of lights so arranged that the engineer in a locomotive will be alerted to an obstruction in the next three signal blocks ahead. More restrictive aspects are shown when there is an obstruction in the next signal block than for obstructions in the second signal block ahead. In the vicinity of West 105th Street, there are, in addition to the main westbound and eastbound tracks, several side tracks, including Track No. 3 identified as the Wall Track or as Park 1 and 2. There is a tunnel from West 105th Street going east to West 72nd Street for a distance of approximately 2.6 miles. Control Tower DO is immediately adjacent to the eastern

end of the tunnel in the vicinity of West 72nd Street. The operator at the DO Tower controls a series of switches and signals in the vicinity of West 105th Street, which are not visible from the tower. A console located in front of the operator as he sits at his desk contains track layouts for certain of the tracks on the 30th Street Branch and signal lights indicating track occupancy, as well as toggle switches to control switches and signals within the yard.

PROCEDURES FOR TRAIN ND-5

Train ND-5 was a daily train which customarily left during the morning hours after being made up with a switching engine on Park 1 and 2 in the vicinity of and east of 105th Street during the previous night. After the cars for ND-5 had been made up on Park 1 and 2, the engines with all of the crew for the train would leave the enginehouse in the vicinity of 72nd Street and proceed to the west to be connected to the cars. The operator at DO would follow the progress of the engines during their trip of approximately 10 minutes from 72nd Street to 105th Street by noting track occupancy lights. It was necessary for the operator to align several switches to permit the engines to enter main Track No. 1 at 105th Street. The engines would then proceed west on Track No. 1 to clear a track circuit at 105th Street so the operator could align switches and set signals to permit the engines to back up on main Track No. 1 into Park 1 and 2. The operator at DO would receive a light and hear a bell when the engines first crossed the track circuit at 105th Street, and would again receive a light and bell as the engines backed over a track circuit after the switch and signal from Track No. 1 into Park 1 and 2 had been set. When the switches and signal are set to permit the engines

to back in to Park 1 and 2 from Track No. 1, Dwarf Signal 3-W shows a red light to an engine on track Park 1 and 2. There is no indication on the console showing occupancy of Park 1 and 2. After the engines were connected to the cars on Park 1 and 2, it was necessary that the operator at DO take positive action through a toggle switch to change Signal 3-W from its red or stop aspect to a yellow aspect which indicated permission to depart when ready.

As testified to during the hearing, it had been customary for the operator at DO under instructions from the yardmasters to put Signal 3-W in the clear aspect as soon as the engines had backed into Park 1 and 2 in order to prevent loss of time and inconvenience to the crew when the train was ready to leave. It had not been customary for the operator to call the dispatcher and ask for permission for train ND-5 to move on to Track No. 1; rather the operator would just notify the dispatcher when his track occupancy light on the console showed that train ND-5 had departed 105th Street. The only means of communication between the operator at DO and the crew of ND-5 was by several wall telephones with speakers in their vicinity located along Park 1 and 2. In effect, this telephone system was one-way, that being from the train to DO because of engine noise and the fact that the telephone locations were not necessarily close to the location of the crew on ND-5. There is no radio set at DO for contact with radios in train engines.

72nd STREET STATION (DO)

The operator's office at DO was in a room approximately 12 feet by 10 feet, about one and one-half stories above the ground. The operator's desk, the yardmaster's desk, which was adjacent thereto, a men's room and

a small table nearly filled the small space. The yardmaster occupies his desk for most of the time, and is very busily engaged in answering three telephones. The noise level within DO is very high due to inside activity, as well as the noise of trains in the close vicinity. In addition, it was customary for the crews of trains to use this office to have coffee, and on some occasions, as many as 12 men were in this small space. As testified to during the hearing by a number of witnesses, it was very difficult to hear the dispatcher's transmission on the loudspeaker and to concentrate on work in this office. Based on differing testimony, there could have been between 5 and 10 men in DO office in addition to the operator and yardmaster while the dispatcher was issuing the train order. The operator was also directed on occasion by the yardmasters to leave his station, go down to the ground and across several tracks to throw switches by hand. During this operation he was absent from his location from 5 to 10 minutes.

There was extensive testimony during the hearing that the yardmasters on occasion released work trains and yard switch engines onto main Tracks 1 and 2 within yard limits without obtaining permission from or notifying the dispatcher of these movements. The operator at DO, who was on duty during the morning of the accident, testified that except for receiving train orders on occasion from a dispatcher and reporting the arrivals and departures of trains such as ND-5 to the dispatcher, he considered that he was working under the yardmasters, and that he was taking his orders from them. The Rules Examiner testified that the dispatcher had authority over train movements on main Tracks 1 and 2 westward from 105th Street, including the area within yard limits up to 153rd Street. He further stated that there was no company directive on this point, but that it was operating practice, and that he did not know where to draw the line between jurisdiction of the dispatcher and the yardmaster within yard limits.

ACTIVITY AT DO, MAY 22, 1967

At about 8:45 a.m. on May 22, 1967, the foreman of a track repair crew requested permission from the operator at DO to conduct repairs to main Track No. 2 in the vicinity of 188th Street. The operator at DO notified the dispatcher at 9:00 a.m., and the dispatcher said that it was "okay." The track repair cars departed soon thereafter from the vicinity of DO Tower at West 72nd Street. At about 9:17 a.m. train B-7, the Manhattanville switcher, departed the vicinity of DO with four cars to engage in switching operations in the vicinity of 136th Street. The conductor of this train asked the yardmaster on duty at DO if the train was to go to 136th Street. The affirmative reply from the yardmaster was considered as authority to depart. Permission was not obtained from, nor was notice given to the dispatcher that train B-7 was proceeding to 136th Street via main Track No. 1 from 105th Street. When train B-7 reached 125th Street at about 9:30 a.m., it crossed over to main Track No. 2, and then the conductor called and advised the operator at DO that Track No. 1 was clear. The operator at DO did not advise the dispatcher of this fact.

The 60 cars for train ND-5 were made up during the evening hours of May 21, and the early morning hours of May 22, 1967 on Park 1 and 2, and extended from 91st Street to 79th Street. At about 8:30 a.m., the car inspectors began brake tests on the cars for train ND-5. Under orders from the general yardmaster, the four locomotives with the train crew departed the engine house at 72nd Street at about 9:20 a.m. en route to 105th Street to connect to the cars on Park 1 and 2. The operator at DO followed the movement across three switches in the vicinity of 79th Street, cleared a signal to permit movement north of 105th Street on Track No. 1,

and after the engines were over the track circuit at 105th Street, he cleared a switch and a signal so the locomotives could back into Park 1 and 2, and connect to the cars. When this operation was completed, Dwarf Signal 3-W displayed a red or stop aspect which would restrict ND-5 from departing Park 1 and 2 until the operator at DO changed the signal to yellow or proceed aspect under the Rules. When the operator received the track occupancy light and bell from 105th Street indicating that the engines were backing onto Park 1 and 2, he waited a few moments for the engines to leave Track No. 1 and then moved the toggle switch on his console and changed Signal 3-W to yellow or proceed. Under the circuitry arrangements for the switch from Park 1 and 2 and Signal 3-W, the change of Signal 3-W from red to yellow did not affect the switch which remained ready for ND-5 to proceed from Park 1 and 2 to Track No. 1. No witness was able to furnish the time that this action was taken, but it is estimated to be about 9:30 a.m. based on normal running time of the engines from the enginehouse to Park 1 and 2.

The general yardmaster returned to the station at DO and asked the operator if train ND-5 had the switch, meaning whether the signal was clear for the train's departure. The operator answered in the affirmative. During the hearing, the operator testified that on several occasions yardmasters had chastised him rather severely for his failure to immediately clear Signal 3-W, and thereby causing delay and inconvenience to the crew of train ND-5, and that those occurrences impelled him immediately to clear Signal 3-W on May 22, 1967.

TRAIN NY-4

Train NY-4 with a total of 75 cars received the prescribed brake test between 10:55 p.m. and 11:50 p.m. on May 21, 1967 in the yard at DeWitt in

the vicinity of Syracuse, New York, and departed DeWitt at 12:02 a.m. on May 22, 1967 bound for the West 30th Street Branch. There were no exceptions taken after the brake tests. NY-4 stopped briefly at several locations en route to drop off cars, and entered the area of responsibility of a dispatcher at 466 Lexington Avenue, New York City, when it departed Croton, New York at 8:46 a.m. The dispatcher, whose area included the West 30th Street Branch, followed NY-4 as it progressed toward Station DV. At about 9:05 a.m., the dispatcher called DV and told DV to advise him when train NY-4 was on the approach track to DV. At 9:16 a.m. NY-4 arrived at DV, and this information was transmitted by DV to the dispatcher. The dispatcher told the operator at DV to hold NY-4 at DV, and the operator at DV acknowledged this instruction.

TRAIN ORDER

The dispatcher called Station DO and asked about the status of train ND-5. He was advised that it was still not ready, but that it had been scheduled to depart at 10:00 a.m. This conversation which occurred at about 9:17 a.m. also advised the dispatcher that the locomotives for ND-5 had still not left the enginehouse at 72nd Street. The dispatcher then told the operator at DO "All right, block Track 1. Copy 31 Train Order " DO did not respond and the dispatcher called him again and asked if DO had blocked Track 1 and was ready to copy the train order. DO replied, "Just a minute." The dispatcher called again and asked DO if he was ready. DO replied "Yes." The dispatcher contacted DV and asked the operator to be ready to copy a train order. The dispatcher then, at 9:21 a.m. said, "DO 31 Order No. 301 to the operator, DV 19 Order No. 301 to C and E (meaning conductor and engineer).

"Extra 2020 East has right over opposing trains on
No. 1 Track interlocking DV to West 105th Street.
Signed LCL FC."

The initials LCL are those of the transportation superintendent as required by the Rules, and the letters FC are the initials of the dispatcher.

The operator at DO first read back the train order word for word as required by the Rules, and was then followed by the operator at DV who did the same thing. The dispatcher then at 9:22 a.m. said, "Complete," which in accordance with the Rules signifies that the operators have correctly read back the train order to the dispatcher, and that the train order is to be executed by them in accordance with the Rules. Under the Form 31 train order which was issued to the operator at DO, he had only one duty to perform which was to restrict the movement of train ND-5. In fact, the Rules require that before he copies the train order, it was his duty to take action to restrict train ND-5. All that he had to do was to leave the toggle switch lever for Signal 3-W alone so the signal would continue to show red and restrict ND-5. However, he changed the signal to yellow indicating "proceed" about 8 minutes after receipt of the train order. The Rules require that this signal "be kept in the position displaying the most restrictive indication, except when displayed for an immediate movement".

Under the Rules, after the receipt of Train Order 19 at Station DV, it was the duty of the operator to issue a clearance Form A to train NY-4, but only after he had established a positive block on Track No. 1 with the operator at DO. The clearance Form A would be delivered to the conductor and engineer of NY-4 at the same time that their copies of the train order were delivered to them. At about 9:23 a.m. the operator at DV called the dispatcher and stated, "One order, Order 301 complete at 0922." The dispatcher replied "Okay" at this time, and assumed that the

operator at DV was discussing clearance Form A and the procedures specified under the Rules with respect to that document, although the operator at DV did not mention the words "Clearance Form A." The operator at DV delivered copies of the train order and the clearance Form A to an unidentified member of the crew of NY-4 after having called Station DO and asking if he could have a block on Track 1. The operator at DV did not receive any reply from DO. The copies of the train order at DV for the conductor and engineer of NY-4 had not been signed by the operator at DV, and the engineer went to the station to obtain the signature of the operator. At about 9:40 a.m. DV called DO and asked for a route within the yard for NY-4 after arrival. The reply was that NY-4 was to go into side tracks in the vicinity of 72nd Street. The operator at DV testified that because he heard the dispatcher tell the operator at DO to block Track 1, the train order was made complete, and further that a route was given by DO for NY-4, he was convinced that he had received a block on Track 1 and could release NY-4 from DV. The operator at DV then called the dispatcher and advised that the engineer and the crew were on board NY-4 and that the train was ready to go. The dispatcher replied, "Okay." NY-4 was then released by DV and departed DV at 9:48 a.m. DV then reported the departure time to the dispatcher and also to Station DO.

TRAIN ND-5

After the prescribed brake test for ND-5 was completed with no exceptions taken, the train departed Park 1 and 2 onto main Track 1 at 105th Street at 9:50 a.m. as noted by the conductor in the caboose. No call was received at DO from ND-5 prior to departure. At this time the operator at DO received a "ding" or bell sound and saw the light on his

console indicating that ND-5 had crossed the circuit at 105th Street. The operator at DO then reported the departure time for ND-5 of 9:50 a.m. to the dispatcher, and almost immediately the dispatcher and the operator at DV were alerted to the fact that there were two trains opposing each other on main Track No. 1. DV immediately called DO and asked if ND-5 had been released to main Track No. 1, and when he received the affirmative answer, DV told DO that NY-4 was going down. The operator at DO's reply was, "Oh, my God I forgot," and then he hung up the phone. The operator at DV then grabbed the radio and started shouting in it for train NY-4, but was unable to contact anyone on that train. The dispatcher at 466 Lexington Avenue ran in the next room to the radio and tried to contact both trains, but was unsuccessful. The operator at DO tried to change Signal 3-W, but it was too late, and a few minutes later when the conductor of the Manhattanville switcher train B-7 called DO, he was asked if he could flag down ND-5. The reply was that it was too late because ND-5 had already passed B-7

THE ACCIDENT

At approximately 9:55 a.m. on May 22, 1967, in clear, sunny weather, the lead engines of train NY-4 and ND-5 were in a head-on collision at 147th Street on the 1°55' curve to the left, which began at a point 328 feet prior to the collision as seen from train ND-5. Train NY-4 was also on this curve which began at a position 600 feet west of the accident point as seen from train NY-4. The track grade in the accident area was 0.65% descending for 2,620 feet east of the accident, and continuing for 630 feet to the west of the accident location. The engineer, fireman and front brakeman on each train were killed. The conductor and brakeman of train NY-4, and the brakeman of

ND-5 were injured. Another brakeman on each train and the conductor on ND-5 suffered no injury.

A stone retaining wall, approximately 25 feet high, and an earthen embankment along the north side of the track concentrated the derailed locomotive equipment into a very restricted area and contributed to the extensive damage which was incurred. Six locomotives and 11 cars were destroyed; one locomotive was extensively damaged, and five cars were also damaged.

TESTS AFTER ACCIDENT

From tests conducted after the accident on May 30, 1967, it was determined that personnel in the lead locomotives of trains NY-4 and ND-5 would be first able to see each other at points 733 feet from the accident location, or a distance of 1,466 feet apart. They would be first able to ascertain that they were on the same track approximately 264 feet from the accident location, or 528 feet apart. The observations were made from positions in the test locomotives that were closest to the river, that is, the left side of the westbound locomotive and the right side of the east-bound locomotive. This was necessary because the accident location was on a 1°55' curve which went to the left as seen from the westbound locomotive. The district engineer for the New York Central Railroad testified that in his opinion, based upon the tests that were conducted after the accident, the engineer in his seat on the right side of the lead locomotive of train ND-5 could not see the other engine or any part of train NY-4 up to the moment of the collision because his view was restricted by the front of the engine and the curvature of the track.

After the accident, a Federal Railroad Administration signal inspector witnessed a test of the signals on Track 1, and found no

discrepancies that would indicate that they were not operating in a normal fashion on the day of the accident.

RADIOTELEPHONES

The lead engines of both trains were equipped with radiotelephones, which by company policy were placed aboard whenever they were available. When radiotelephones are aboard, their use to conduct operations is not required; rather, they are considered as only an informal adjunct to other communication systems. Radiotelephones need not be monitored. The operator at DV had talked to personnel in the lead locomotive of NY-4 while the train was at DV, and the radiotelephone was known to be operational at that time. The conductor of train ND-5 had attempted to contact the lead locomotive on his train while in the tunnel proceeding north from 105th Street, but was unable to do so. The radio telephone is normally not effective in the tunnel.

ANALYSIS OF SPEED TAPES

The speed recorder tape taken from the lead locomotive on train NY-4 shows that NY-4, upon departing from DV, accelerated rapidly to a speed of 42 miles per hour between Signals 1031 and 961. The speed then was reduced to 32 miles per hour between Signals 961 and 871, promptly increased to 42 miles per hour passing Signal 871 at 42 miles per hour, and maintained this speed to the vicinity of Signal 751, where the speed started to reduce from 40 miles per hour as a result of a brake application. After approximately 600 feet the speed started to reduce at emergency rate from 37 miles per hour. In the next 500 feet, speed had reduced to 32 miles per hour when the accident occurred.

The speed recorder tape from the third locomotive of ND-5 indicates

that this unit departed from West 105th Street, passed Signal 591 at 23 miles per hour, continued to accelerate to 30 miles per hour which speed was reached about 1000 feet east of Signal 641. Thirty miles per hour was maintained to the end of the 30 miles per hour speed restriction at 137th Street where the speed started to increase. Speed had increased to 36 miles per hour when the accident occurred. There is no indication of the brakes having been applied, or throttle reduced just prior to the accident.

The tapes also show that 107 seconds elapsed from the time ND-5 passed Signal 641 to the collision, and that NY-4 passed Signal 871, 109 seconds before the accident. The tapes also indicate that at the moment the lead engine of NY-4 was adjacent to Signal 871, the lead engine of ND-5 was in a position 2 seconds before passing Signal 641. The supervisor of locomotive performance in charge of examining locomotive tapes and determining locomotive performance testified, however, that there very possibly could be up to a 2-second error in the calculations, because a very short mileage scale was being used. He testified that had the lead locomotive of ND-5 been 2 seconds away from passing Signal 641, that signal would have indicated yellow over yellow under Rule 282-A, which means that a train must proceed prepared to stop at the second signal ahead, or Signal 811 in this case, and that a train exceeding a limited speed, must at once reduce to that speed, which is defined as a speed in the Rules not exceeding 45 miles per hour. The supervisor also testified that it was possible, considering a 2-second calculation error, that the engineer in the lead locomotive of ND-5 saw a green over green aspect on Signal 641, which would indicate a clear track ahead.

The lead locomotive of ND-5 traveled 4,818 feet from Signal 641 to the accident location at an average speed of 31.5 miles per hour, while the lead engine of NY-4 traveled 7,100 feet from Signal 871 to the accident location at an average speed of 41 miles per hour.

DISCUSSION OF RULES

During the hearing there was a discussion of Rule D-93a entitled "Movements Against the Current of Traffic" which states:

"A train or engine must not be moved against the current of traffic within yard limits unless provision has been made for the protection of such movement.

"Movements against the current of traffic within yard limits must be made prepared to stop short of train or obstruction."

The train order issued in this case, if it had been properly executed, met the requirements of the first part of Rule D-93a in that protection was provided for NY-4 to move against the current of traffic.

Train NY-4 crossed the yard limits at W. 153rd Street at a speed of 40 miles per hour which was reduced at routine, then emergency rate, in the last 1100 feet to 32 miles per hour at the moment of collision with ND-5 at about W. 147th Street. The question immediately arises as to whether NY-4 was in violation of the second portion of Rule D-93a in that this train was moving too fast to "stop short of train or obstruction" when moving against the current of traffic. The Board determines as fact that the train order, if correctly executed, was assurance to NY-4 that there was no train to obstruct NY-4 between DV and W. 105th Street. There was a violation by NY-4 of Rule D-93a, however, because the speed of 40 miles per hour would not permit stopping short of any other "obstruction" such as an incorrectly set switch or a foreign object on the tracks when seen ahead by the engineer. Inquiry by the Board failed to disclose any effort on the part of the operating company to limit the speed of trains against the current of traffic on the W. 30th Street Branch of the railroad during a period of several

weeks prior to the accident when track repairs required such movements. Company officials stated the speed of trains against the current of traffic was within the discretion of the engineers provided Rule D-93a was complied with. There was no evidence of any engineer being charged with a violation of Rule D-93a during the period of repairs.

The Board determines that the wording of the second part of Rule D-93a is indefinite as to necessary speed, and that in practice, as far as could be determined, was not complied with. In order to permit a train such as NY-4 to stop short of an "obstruction," a very slow speed not exceeding 10 miles per hour would be necessary beginning at and within yard limits. If the intent of this Rule was to require such a speed, it should be specified in the Rule so as to leave no doubt as to what the Rule required.

The Rules Examiner testified that in his opinion it was a violation of the Rules for train B-7 to have been on main Track 1, north of 105th Street without permission from the dispatcher on the morning of May 22, 1967.

An examination of the Rules discloses that they do not contain any information with respect to the operators accepting instructions from yardmasters. The boundaries of authority between the yardmasters and the dispatchers are not specified. There was a direct inconsistency within the Rules which applied to the circumstances of this accident.

Rule 204 states:

"Train orders must be addressed to those who are to execute them, naming the place at which each is to receive his copy. Those for a train must be addressed to the conductor and engineman, and also to anyone who acts as its pilot. A copy for each employee addressed must be supplied by the operator.

"Orders addressed to operators restricting the movement of trains must be respected by conductors and enginemen the same as if addressed to them."

The Train order issued before this accident was not addressed to the conductor and engineman of train ND-5, but only to the operator at DO. The Rules Examiner testified that in his professional opinion the train order should have been addressed to the conductor and engineer of ND-5.

Questions arise upon review of Rule 204 as to how conductors and enginemen can respect an order restricting their train when they know nothing of the order, and further as to whether all train orders are required by this Rule to be addressed to the operating personnel on the train, even though in the instant case, the operator could keep ND-5 restricted until he changed Signal 3-W.

Soon after this accident the New York Central Railroad Company required trains departing West 105th Street to receive clearance forms from the DO operator, and all train movements west of West 105th Street to be controlled by the dispatcher.

With respect to the Rules, Supplement No. 1, which became effective October 28, 1964, and which contains revisions and modifications of the Rules which were promulgated on October 28, 1956, does not indicate whether a particular rule is superseded, added to or subtracted from. The supplement is merely attached to the book of Rules with no indications having been made in the Rules themselves to show that changes were made.

The dispatcher did not comply with Rule 204 in that the train order was not addressed to train ND-5. He also failed to require the operators

at DO and DV to comply with Rule 221(b) which reads in part: "When an operator receives the signal '31' or '19' followed by the direction, he must immediately display the 'stop signal' for the direction indicated and then reply 'stop displayed' adding the direction, and unless otherwise provided, until the order has been delivered or annulled the signal must not be restored to 'proceed'." (emphasis added)

The operator at DO did not block Track 1 as he had been instructed to do by the dispatcher, did not reply "stop displayed" as required by Rule 221(b) and did not restrict train ND-5 under the terms of the train order.

Rule 505 states in part: "Unless otherwise provided, Manual Block Signal System Rules will govern movement against the current of traffic." The movement of train NY-4 against the current of traffic on Track 1 was therefore under Manual Block Signal System Rules. The operator at DV was required to obtain a block on Track 1 from the operator at DO prior to releasing train NY-4. The operator at DV did not obtain the block and thereby failed to comply with Manual Block Rule 317 which reads in part: "On single track, to admit a train to a block, operator must examine block record and if block in advance is clear of opposing trains and preceding passenger trains request operator at block station in advance to 'Block for No. ____.' If it is proper for the train to be admitted, the operator in advance will reply 'OK, blocking for No. ____.' Operator requesting block will then display the proper signal indication. Operators must promptly enter on block record the time block is given or received."

The conductor and engineer of NY-4 were assured of the exclusive use and right of way on Track 1 from DV to 105th Street when they received their copy of the train order, clearance form A and permission from the operator at DV to depart.

Upon receipt of the yellow or "proceed" aspect on signal 3W and without any knowledge of the train order or the movement of train NY-4, the engineer of ND-5 was authorized to proceed when ready with the expectation of operating normally under the automatic-block signal system on Track 1.

CONTROL TOWER OPERATIONS

The training of operators begins after the New York Central Personnel Department selects applicants according to general criteria of employability. A new applicant, before finally hired, is required to take an open-book written test on the book of operating rules followed by an oral examination on his ability to understand the written rules. If he is hired, the applicant is then assigned to a location for an unspecified period of on-the-job training. There is no written examination to determine when or whether the applicant is qualified to work as an operator. After being assigned to a job as an operator, he is required to attend an annual "rules examination." At the rules examination, a group of operators are orally questioned and simultaneously instructed on the book of operating rules. There is no specific written examination by which the operator's proficiency can be checked after he is assigned. The check by his supervisors and Rules Examiner is not good enough to accomplish this. To advance from Operator to Dispatcher, the Operator posts with the Dispatcher for an unspecified time and is then orally examined by the Rules Examiner. The Dispatcher's examination by

the system rules men requires no written examination or the accomplishment of any specified grade for qualification. The Rules Examiners visit towers and spot check copies of train orders within the towers, and point out mistakes to the operators when those operators are present, but there is no regular system for reviewing copies of train orders to insure compliance with the rules by the dispatcher and the operators.

It is useful to compare this form of training and maintenance of proficiency with methods used for air traffic control tower operators. In air traffic control work, the means of communication, modes of control, and complexity of control situations are different, but there is a common need for correlating instrument indications and messages, for proficient performance in handling a number of control actions simultaneously and a need to maintain disciplined attention to the task.

The requirements for certification as an Air-Traffic Control-Tower Operator are specifically spelled out in the Code of Federal Regulations, Title 14, Part 65, Subpart B. These regulations specify certificate and rating required, general eligibility requirements, the written tests on which a passing grade must be made, ratings, performance of duties, maximum hours and rest requirements, general operating rules, and current experience required to continue a certificate's validity. The training includes both formal school and on-the-job training. In both cases there are published standard procedures and guidelines. After certification regular monthly and semi-annual examinations and annual proficiency examinations are required. Controllers are required to exercise regularly in simulated problems. Whenever changes require it, there are tests on regulations.

Based on the testimony, there do not appear to be any requirements or standards regulating the physical arrangements at control stations pro-

vided for operators on the New York Central System. The rules regulating the number or class of employees allowed in an operator's control station are either nonexistent or not enforced. There is no evidence that any effort has been made by the New York Central management to provide the control station for the operators at "DO" with reasonable freedom from interference by unauthorized personnel and incompatible activities related to the yard operation.

Again, a comparison to the physical working surroundings and disciplinary control at an airport control tower indicates what measures can be taken in such control situations to reduce operator error. The physical arrangements of work spaces are the same at all airports except the very largest, even though the routes controlled and instruments of control are different. This allows desirable human factors features to be built in without the need of separate studies at each location. Considerable research has been done to provide maximum light with minimum glare at work areas. Acoustical treatment is used in ceilings and the work space is carpeted for acoustic reasons to improve speech communication within the control cab. Access to the control tower operating cab is controlled by the chief of the tower, using an electrically-operated lock. Toilet facilities are located elsewhere.

It may be noted that these differences between the control tower at DO and an air traffic control tower are not primarily a matter of high cost, but of informed attention to detail and discipline. An example of a change ~~made~~ at little cost after attention is drawn was a change ~~made~~ by the New York Central at DO after this accident. The operator's desk and control panel were turned about 30° so that the yardmaster as well as the operator could see the status of every indication on the panel. Systematic analysis of the entire control system, including the human operator, can be performed with equal validity before accidents occur.

ANALYSIS OF CAUSAL FACTORS

A causal factor in an accident is any event or action which, if it had not occurred or had occurred in different degree, would have prevented the accident or minimized human or property losses. One ~~or~~ several causal factors may be selected as probable causes.

Because this accident is unusually complex in the large number of probable or possible causal factors involved, it is desirable for analysis to set down the causal factors and their relationships in as short a form as possible. This allows direct factors visible at the day and time of the accident and contributing factors at other times and places to be seen in their logical relationship. In determining which preventive measures will be recommended, it is as necessary to chart contributing factors as direct and immediate factors, since changes to contributing factors can be equally effective in accident prevention and may be much less costly.

Causal factors are outlined below, in an outline form which indicates the contributory relationships. Factors in occurrence of the accident and the severity of collision are included:

- A. Causal Factors in Movement of Train ND-5
 - 1. Occurrence of collision
 - 2. Severity of collision
- B. Causal Factors in Movement of Train 1/NY-4
 - 1. Occurrence of collision
 - 2. Severity of collision
- C. Causal Factors After Opposing Movement was Discovered
- D. Causal Factors in Loss of Life at Collision

OUTLINE OF CAUSAL FACTORS

A. Causal Factors in Movement of Train ND-5

1. Causal Factors in Occurrence of Collision, Train ND-5

- a. Operator at DO failed to block the sidetrack at 105th Street by changing dwarf signal 3-W to Red immediately on receipt of request to copy a 31 order from the dispatcher.
 - i. Noise, confusion, and crowding in control tower at DO, 72nd Street.
 - (a) Failure of rules to provide for control tower working conditions.
 - ii. Inadequacy of operator training and maintenance of proficiency.
- b. Operator at DO allowed the switch on the main line Track 1 at 105th Street to remain open after Train ND-5 had entered the side track and displayed a yellow "proceed" signal even though he already had an order giving Train 1/NY-4 right to run on Track 1.
 - i. Although this action was a violation of the rules, the operator had been criticized by yardmasters for following the rule by closing the switch and displaying red signal, due to inconvenience and lost time to the train crew.
 - (a) Operator believed that the yardmaster, who recorded his arrivals at work and departures, was his superior.
 - (b) Rules do not clarify the boundaries of authority of Operators, Dispatchers, and Yardmasters in this situation.

ii. Inadequacy of operator training and maintenance of proficiency.

c. Dispatcher did not require an affirmative response from the operator at DO, indicating that Track No. 1 had been blocked before he began issuing the train order for 1/NY-4.

i. Supervision of dispatchers did not reveal that rules were being violated by the dispatcher and unsafe work habits were being developed.

d. Dispatcher did not address the train order to the conductor and engineer of ND-5, as required by rule but to the operator, nor did he require copies to be delivered to the crew.

i. Inconsistency within rule 204.

ii. Telephone near side track said to be inconvenient to trainmen and radio inoperative in tunnel.

iii. Supervision of dispatchers did not reveal that rules were being violated and unsafe work habits were being developed.

e. Clearance Form A, normally required by Rule 83d, was not in use for extra trains such as ND-5 originating in two-track territory by special instructions at the time of the accident. Signal indication above was sufficient according to the change which had the effect of dropping one safeguard against improper movement.

2. Causal Factors in Severity of Collision, Train ND-5

a. No brake application was made by Train ND-5 prior to impact.

i. Signal 751, undoubtedly showing red, which would have indicated a mandatory stop, was not visible to the engineer of ND-5 at a distance along the track.

(a) Signal 751 or an auxiliary signal, if placed 200 feet to the East of its actual location, would have been visible at least 3/4 mile before the point of impact, allowing very significant speed reduction before collision and possibly a complete stop.

(b) Engineer could not see Signal 751 from the right side of the cab even when it was visible from the front of the train, because his sight line is below the top of the hood which obscured his vision to the left.

(1) Angular vision from locomotives not subject to rule or regulation.

ii. Although Signal 751 and approaching train 1/NY-4 were visible from the left side of the cab several hundred feet before impact, there was either no observation from that side or no action resulted from the observation.

B. Causal Factors in Movement of Train 1/NY-4

1. Causal Factors in Occurrence of Collision, Train 1/NY-4

- a. Dispatcher elected to release 1/NY-4 to run against the current of traffic at a low speed (if rule were followed) while ND-5 waited, instead of allowing ND-5 to clear Track 1 at normal speed before releasing 1/NY-4.
 - i. Background of non-observance of the slow speed rule (D-93a) by engineer of 1/NY-4 and lack of specific effort to enforce the rule by the railroad and lack of a specific statement in the rule of the speed necessary to stop short of obstruction.
 - b. Operator at DV failed to receive an absolute block of Track No. 1 from the Operator at DO before clearing Train 1/NY-4 to operate against the current of traffic.
 - i. Inadequacy of operator training and maintenance of proficiency.
2. Causal Factors in Severity of Collision, Train 1/NY-4
- a. Engineer of 1/NY-4 did not obey Rule D-93a requiring speed at which he could stop for obstruction when operating against the current of traffic, which would have reduced his speed to ten miles per hour or below at time of collision.
 - i. Rule D-93a printed in the rule book in two forms, one of which did not require speed able to stop.
 - ii. Rule D-93a did not require a specific speed, thus placing discretion on the engineer.
 - iii. No particular effort to enforce Rule D-93a by the railroad.
 - iv. Rule D-93a, if followed to the letter, would have delayed arrival time of 1/NY-4 by at least 15 minutes. (A possible factor.)

C. Causal Factors After Opposing Movement was Discovered

1. Although both train ND-5 and train 1/NY-4 were equipped with radio-telephone and efforts were made to contact them after it was discovered that a collision was imminent, no answer was received from either train.
 - a. Radiotelephone on 1/NY-4 probably not in operation. Instrument was known to be operational a few minutes earlier and no other reason for non-response can be found. Radiotelephone on ND-5 not answered. No evidence of good or bad condition on ND-5.
 - i. Railroad rules do not require routine use of radio-telephone for operation, but only convenience use when radio-telephone is available.
 - (a) Insufficient radiotelephones in inventory to equip all locomotives.
 - (b) Radiotelephones do not operate satisfactorily under all circumstances.

D. Causal Factors in Loss of Life at Collision

1. At the moment of collision impact, the frames of the two head locomotives opposed each other without overriding. However, the frame of the second unit of ND-5 overrode the frame of the head locomotive of ND-5 from the rear, shearing off the cab of the head locomotive. The second unit was then thrust upward to the top of the nearby retaining wall, carrying the crushed cab and its occupants in front of it. It is inferred that severe crushing injuries were sustained by the occupants.
 - a. General absence of crash-injury prevention analysis and injury prevention technology in the present state of the art of locomotive design.

This accident involves a very large number of causal factors, any one of which, if different, could have prevented the collision or minimized its severity. In many accidents, this situation suggests that the accident resulted from a very unusual coincidence of human error or mechanical conditions. Such a "coincidence" theory would imply that accidents of this type would seldom recur and that the system for safe control is not in question. In this accident, however, no mechanical failures were involved. The causal factors are numerous, broad in scope, and touch many features of the operating system and its organization and supervision. The Board considers the accident more indicative of a weak operating system than an occurrence governed by coincidental and unpredictable error.

Some of the causal factors might be considered localized to this particular branch of the railroad and its supervision. The Board notes that since the accident, the railroad has discharged the two operators and the dispatcher most closely involved with the accident. Other causal factors, such as the inadequacies of training, may be localized or may be general in the railroad company. Such factors as inconsistencies or non-specificity in rules, the casual publication of a rule supplement without obliterating the superseded rule, and the use of radio telephone only as an optional convenience, definitely extend throughout this particular railroad company. Still other causal factors, such as the economic pressures to cut corners or disregard rules in the name of convenience or time saving are definitely pressures felt throughout the railroad industry.

The Board considers it significant that this wide variety of operating problems was found in one of the Nation's largest and longest-established railroads, which has had many years of development of its operations. Without extending its conclusions beyond this particular accident and railroad, the Board nevertheless believes that this accident raises a question about the extent to which these problems may generally be found in the railroad industry, and whether general corrective steps, such as legislation, may be necessary.

CONCLUSIONS

The Board concludes that:

- (1) The brake tests and hours of duty for personnel of trains NY-4 and ND-5 were in compliance with Federal Regulations.
- (2) There were violations of Federal regulations at DO station in that the prescribed Operators Daily Time Report and Station Record of Train Movements were not being used.
- (3) Tests conducted after the accident indicated that the automatic-block signal system on main Track No. 1 between West 105th Street and DV was functioning normally prior to the accident on May 22, 1967.
- (4) The dispatcher failed to **assure positively** that Track 1 had been blocked by DO before the train order was issued, and failed to require the operators at DV and DO to use procedures specified in the Rules of the operating company. Specifically, neither DV nor DO were required to state that "stop signals" were displayed for NY-4 and ND-5 after receipt of the train order.
- (5) The dispatcher failed to address the train order to train ND-5 in addition to the operator in violation of company Rules. Mitigating factors in this case were that the DO operator could restrict ND-5 by Signal 3-W alone, and further that ND-5 was on a side track between DO and DV stations in a relatively inaccessible location insofar as delivery of train orders was concerned. However, as stated by the Rules Examiner, the order should have been addressed to ND-5. It is most unlikely that ND-5 would have departed until NY-4 passed by, had the contents of the train order been known to the conductor and engineer of ND-5.

(6) The operator at DV failed to secure a positive block on main Track 1 from DO operator prior to releasing NY-4.

(7) The operator at DO failed to block Track 1 as he had been instructed to do by the dispatcher before receiving the train order, and also failed to restrict ND-5 as required by the train order.

(8) The failure of the operator at DO to block Track 1 was pre-conditioned by his routine action in leaving the switch at W. 105th Street open after the entry of ND-5's engine to the yard track and his action in giving train ND-5 a yellow signal to proceed prior to the time when ND-5 was ready to proceed. This action which did not protect the main track and was in violation of the Rules was caused by prior complaints of delay and inconvenience made to the operator by yardmasters.

(9) The working conditions at the DO Station were unsatisfactory. The lack of adequate space and excessive noise were not conducive to the level of concentration necessary for an operator to perform properly his duties.

(10) The assignment by yardmasters of operators at DO to throw switches in the area required the operators to leave their offices in violation of a company rule which specifies that they be continuously on duty in their offices.

(11) a. There was no evidence of fault on the part of personnel on train ND-5.

b. The engineer of train NY-4 was in violation of the second part of Rule D-93a in that the speed of NY-4 within yard limits from W.153rd Street to the accident location at about W.147th Street was greatly in excess of a speed which would permit stopping short of an obstruction. However, the wording of the second part of Rule D-93a does not state the

maximum speed permitted and there was no evidence of effort by the Company to enforce Rule D-93a by specifying a maximum speed. It is determined that a speed over ten miles per hour would not permit stopping short of an obstruction and Rule D-93a should have stated a maximum speed.

(12) There were numerous violations of company Rules in this case, and in the implementation of train orders by dispatchers and by operators at DV and DO prior to this accident.

(13) The New York Central Railroad Rules are conflicting in a number of instances, are not clear in others and thereby lead to misinterpretation and misunderstanding that are deleterious to operating safety.

(14) The New York Central Railroad has not established or maintained adequate supervisory procedures to insure that its operating personnel comply with its Rules.

PROBABLE CAUSE

The Board determines that the probable cause of this accident was the failure of the operator at the 72nd Street Station (DO) to restrict train ND-5. Contributing causes were the failure of the dispatcher to assure positively that Track 1 had been blocked by DO prior to issuance of the train order, the failure of the operator at the station at Spuyten Duyvil (DV) to obtain a positive block on main Track No. 1 for train NY-4, and the failure of the New York Central Railroad Company to establish explicit boundaries of authority, explicit operating rules, and procedures to insure that its personnel are instructed in and comply with such rules.

RECOMMENDATIONS

A wide variety of inadequacies in rules, operating practices and personnel training were revealed by the investigation of this accident on one of the largest railroads in the country. The investigation also identified ineffective organization, inadequate use of modern communications devices (such as radiotelephone), and a lack of application of modern techniques such as the use of human factors engineering in designing operators' control stations.

The observed situation would indicate the need for a re-appraisal, a self-assessment and corrective action by the industry. This we recommend.

Beyond that, conditions found to exist and recounted in detail in this report are specifically called to the attention of the Federal Railroad Administration of the Department of Transportation and of the Congress with the recommendation that both consider them in connection with their consideration of legislation (S. 526) now pending in the Congress, and which proposes that additional safety regulatory authority be conferred on the Department of Transportation in the railroad field.

The Board recommends that the New York Central Railroad revise and amend its operating Rules, and require compliance with them by its operating personnel.

The Board recommends that the New York Central Railroad reconcile its rules and procedures concerning operators being on duty in their offices until relieved.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD:

Joseph J. O'Connell, Jr. 12/29/67 4:45 P.M.
Joseph J. O'Connell, Jr. Date Time
Chairman

Oscar M. Laurel 12/26/67 9:05 A.M.
Oscar M. Laurel Date Time
Member

John H. Reed 12/22/67 3:35 P.M.
John H. Reed Date Time
Member

Louis M. Thayer 12/27/67 3:00 P.M.
Louis M. Thayer Date Time
Member

Francis H. McAdams 12/21/67 9:30 A.M.
Francis H. McAdams Date Time
Member

Notation 55, December 20, 1967
Railroad Accident Report
New York Central Railroad Company
Train 1/NY-4 Extra 2020 East and Train ND-5 Extra 5305 West
Head-on collision
New York City, New York
May 22, 1967

