HE
1780
.A33
NO.
NTSB-
RAR-
75-3

FOR RELEASE: 6:30 PM JUN 15 1975

Dept. of Transportation
JUN 26
Library

RAILROAD ACCIDENT REPORT

COLLISION OF PENN CENTRAL FREIGHT TRAIN OV-8 WITH AN OPEN DRAWBRIDGE CLEVELAND, OHIO MAY 8, 1974

TRANSPORTATION SAFETY BOARD

NATIONAL TRANSPORTATION SAFETY BOARD,
Washington, D.C. 20594
REPORT NUMBER: NTSB RAR-75-3.

HE
1780
.A33
no.
NTSB-
RAR
75 3

Dept. Of Transportation
JUN 26
Library

SS-R-29

RAILROAD ACCIDENT REPORT

COLLISION OF PENN CENTRAL FREIGHT TRAIN OV-8 WITH AN OPEN DRAWBRIDGE, CLEVELAND, OHIO MAY 8, 1974

ADOPTED: MARCH 26, 1975

NATIONAL TRANSPORTATION SAFETY BOARD
Washington, D. C. 20594
REPORT NUMBER: NTSB-RAR-75-3

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No. NTSB-RAR-75-3	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Railroad Accident Report - Collision of Penn Central Freight Train OV-8 with an Open Drawbridge, Cleveland, Ohio, May 8, 1974		5. Report Date March 26, 1975 6. Performing Organization Code
7. Author(s)		8. Performing Organization Report No.
9. Performing Organization Name and Address National Transportation Safety Board Bureau of Surface Transportation Safety Washington, D. C. 20594		10. Work Unit No. 1493 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 MAY 8, 1974 14. Sponsoring Agency Code

15. Supplementary Notes

This report contains Safety Recommendations R-75-11 through R-75-15

16. Abstract

On May 8, 1974, Penn Central freight train OV-8 collided with the counterweight of a lift-span drawbridge on the Cuyahoga River at Cleveland, Ohio. Shortly before the collision, the eastbound train had been traveling at 33 mph on a main track equipped with automatic block signals when the DB operator contacted the traincrew and advised them that the route was clear ahead. Then, the operator remembered that a boat had been awaiting passage and, without informing the traincrew, he opened the bridge. The train passed the red home signal of the DB interlocking without braking and struck the counterweight of the open bridge about 600 feet beyond the signal. The two crewmembers in the lead locomotive unit died as a result of crash injuries.

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the locomotive crewmembers to obey a wayside signal indication to stop and the concurrent opening of the drawbridge by the DB operator after he had advised the oncoming traincrew by radio that the route was clear. Contributing to the accident was the absence of specific rules that either prohibited such a radio message or described the circumstances under which such a radio transmittal could be accepted as an operational control.

17. Key Words	18. Distribution Statement
Safety; Railroad Accident; Train Collision; Operating Rules and Procedures; Radio Rules and Procedures; Automatic Train Stop; Signal Systems; Drawbridge Regulations and Operation.	This document is available to the public through the National Technical Information Service, Springfield, Virginia 22151

19. Security Classification (of this report)	20. Security Classification (of this page)	21. No. of Pages	22. Price
UNCLASSIFIED	UNCLASSIFIED	31	

NTSB Form 1765.2 (11/70)

TABLE OF CONTENTS

	Page
SYNOPSIS	1
FACTS	1
The Accident	1
Accident Site	5
Method of Operation	5
Train Equipment	9
Damages	9
Crew Information	9
Medical and Pathological Information	10
Tests and Research	10
ANALYSIS	12
The Aspect of the Home Signal	12
Why OV-8 Failed to Stop	13
Safety Controls	15
The Use of the Radio	16
Operating Rules	16
Operation of the Drawbridge	17
CONCLUSIONS	18
PROBABLE CAUSE	19
RECOMMENDATIONS	20
APPENDICES	23
Appendix A: Excepts from Penn Central "Rules for Conducting Transportation"	23
Appendix B: Signal Aspects	29

FOREWORD

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

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D. C. 20594

RAILROAD ACCIDENT REPORT

Adopted: March 26, 1975

Collision of Penn Central Freight Train OV-8 with an Open Drawbridge, Cleveland, Ohio, May 8, 1974

SYNOPSIS

On May 8, 1974, Penn Central freight train OV-8 collided with the counterweight of a lift-span drawbridge on the Cuyahoga River at Cleveland, Ohio. Shortly before the collision, the eastbound train had been traveling at 33 mph on a main track equipped with automatic block signals when the DB operator contacted the traincrew and advised them that the route was clear ahead. Then, the operator remembered that a boat had been awaiting passage and, without notifying the traincrew, he opened the bridge. The train passed the red home signal of the DB interlocking without braking and struck the counterweight of the open bridge about 600 feet beyond the signal. The two crewmembers in the lead locomotive unit died as a result of crash injuries.

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the locomotive crewmembers to obey a wayside signal indication to stop and the concurrent opening of the drawbridge by the DB operator after he had advised the oncoming traincrew by radio that the route was clear. Contributing to the accident was the absence of specific rules that either prohibited such a radio message or described the circumstances under which such a radio transmittal could be accepted as an operational control.

FACTS

The Accident

Train OV-8 was a freight train en route from Columbus to Cleveland, a distance of 146 miles. The crew of the train consisted of an engineer and a fireman in the locomotive and a brakeman and conductor in the caboose. The train had been assigned an additional brakeman to ride in the locomotive but he had not reported for work at Columbus when the train departed at 9:10 p.m. on May 7, 1974.

The train last stopped at Berea, 11 miles from the accident site. The brakes functioned normally.

Train OV-8 consisted of 2 locomotive units, 89 loaded cars, 4 empty cars, and a caboose. The maximum authorized speed of the train as it approached DB on track No. 1 was 30 mph. The visibility was clear.

At 3:49 a.m. on May 8, 1974, the operator of DB interlocking, whose responsibility included the operation of a lift-span drawbridge, contacted the dispatcher to report a departing eastbound train. The eastbound home signal functioned properly as that train departed after it picked up its caboose which had been standing on No. 1 track. The interlocking plant, including the drawbridge, had functioned properly during the operator's 5-hour tour of duty. The dispatcher informed the operator that OV-8 would be the next train on track No. 1. The dispatcher instructed the operator to route OV-8 to track No. 2 by way of the crossover east of the bridge. At 3:52 a.m. the operator radioed the engineer of OV-8 and established the route for the movement of OV-8 from track No. 1 to track No. 2; however, he did not clear the home signal. That radio conversation follows.

DB: "Drawbridge to OV-8."

OV-8: "OV-8."

DB: "All clear ahead of you now, OV-8."

OV-8: "Oh--read that again."

DB: "All clear ahead of you now, OV-8. You can highball right along."

OV-8: "Roger."

Following that conversation, the DB operator remembered that a U.S. Corps of Engineers' boat had been awaiting passage through the bridge channel since 3:20 a.m., and he immediately opened the bridge. When the bridge was raised, the bridge counterweight was within 5 feet of the track. At 3:56 a.m., train OV-8 collided with the bridge counterweight. (See Figure 1.)

Two witnesses saw the governing eastward home signal at DB interlocking just before the locomotive of OV-8 passed. A railroad employee near No. 6 switch said he saw the signal indicate "proceed" with the bridge open. A yardmaster in a tower 1,500 feet west of the signal said he saw the signal indicate "stop" as OV-8 passed the tower. (See Figure 2.) In addition, the rear brakeman of OV-8 said he saw the home signal indicate "stop" about 15 or 20 car lengths before the caboose stopped in the accident.

Various witnesses estimated that the train was traveling between 30 and 50 mph. Witnesses did not agree as to whether braking began

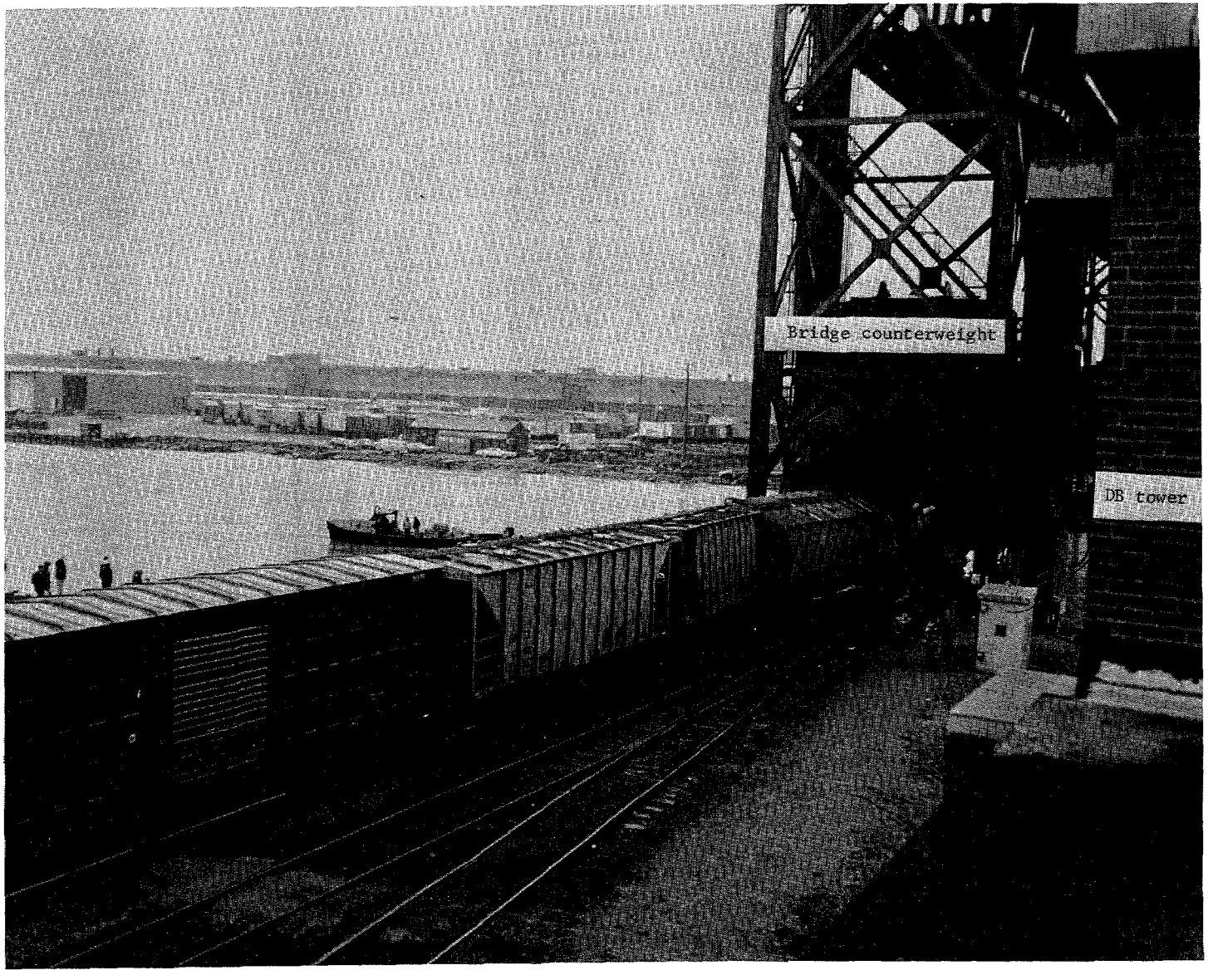

Figure 1. View of wreckage looking east toward Cleveland and the Cuyahoga River.

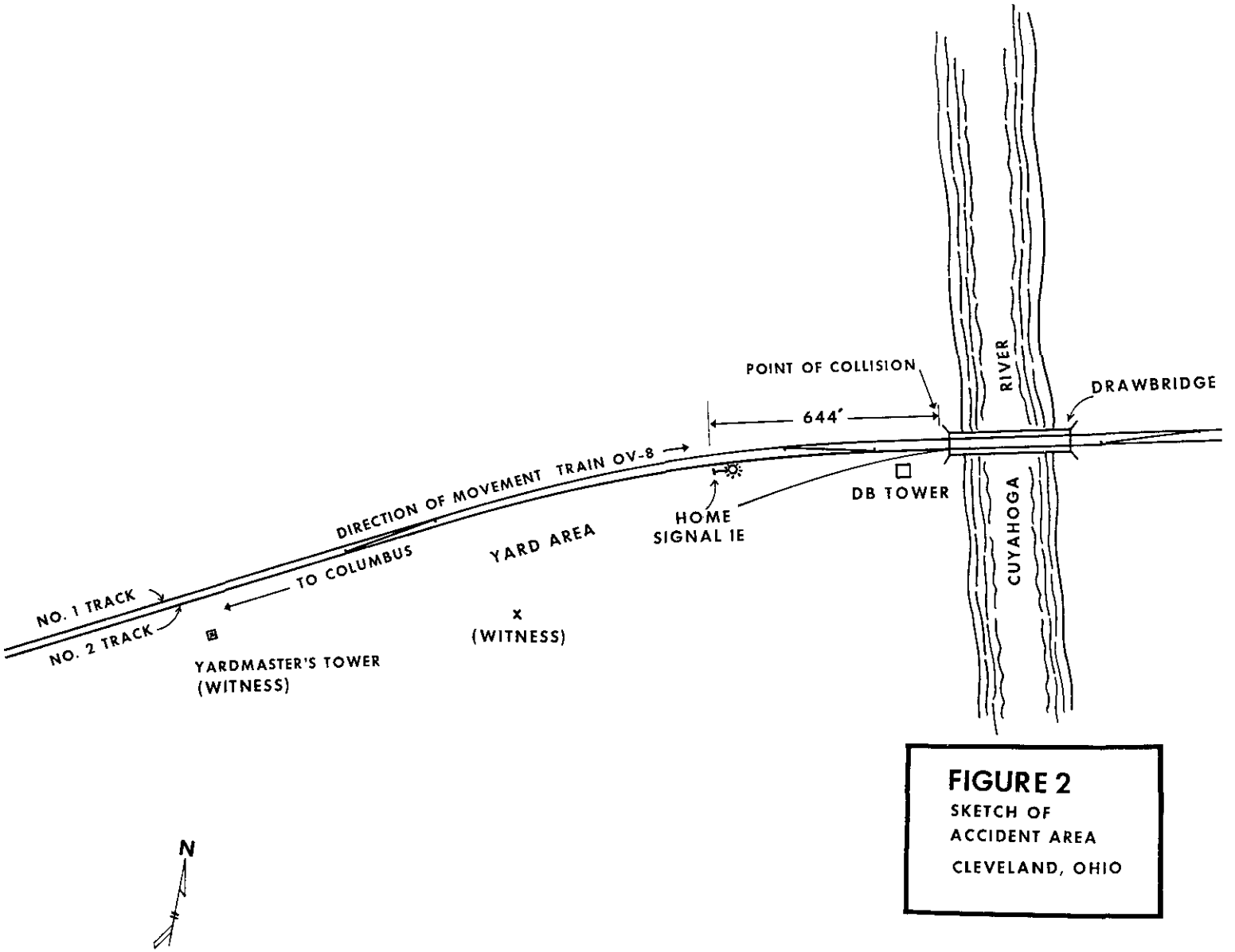

FIGURE 2
SKETCH OF
ACCIDENT AREA
CLEVELAND, OHIO

immediately before, or just after, the collision. The witness who saw the "proceed" signal also said that he saw fire fly from the locomotive wheels about a car length before the locomotive passed the home signal and that he heard an emergency brake application. The crew on the caboose of OV-8 had noticed normal braking several miles before the train reached the bridge. They were not aware of an emergency brake application until after the train stopped; they did not flag the adjacent track as required by rule 102.

Accident Site

The bridge -- The lift-span drawbridge was constructed in 1958. The bridge crosses the 250-foot-wide navigation channel of the Cuyahoga River with a high-water clearance of 3½ feet and a normal clearance of 8½ feet when the bridge is down. The lift-span can be raised 89 feet to accommodate the passage of boats. The superstructure of the bridge was painted black.

The track -- The two main tracks slope to the Cuyahoga River span from about 8 miles to the west of the accident site. The steepest portion of this grade begins about 5 miles from the bridge, varies from 0.26 to 0.94 percent, and averages 0.7 percent.

The track curves west of the bridge. About 2,577 feet west of the bridge, there is a 0°16' curve to the left for eastbound trains. The curve is 338 feet long and is followed by 1,004 feet of straight track. A 1°03' curve turns to the right, continues for 819 feet and ends 416 feet from the bridge. Straight track extends from that point across the bridge. Figure 2 shows the general layout of the facilities pertinent to the accident and the locations of the witnesses to the collision.

DB tower -- The DB tower is a 3-story structure which is located about 150 feet west of the west end of the drawbridge and about 50 feet south of the main tracks. The operator controls DB interlocking and the drawbridge from an office on the top floor of the tower. The bridge and river are visible from the office. The track to the west and the home signal are not visible unless the operator moves from his location in front of the interlocking control panel.

Method of Operation

Train operation -- The movement of trains in the area is controlled by the dispatcher through use of the block signals of a traffic control system. DB interlocking is within this system with its westerly limits at the home signal, 640 feet west of the bridge. Train movements within the interlocking are governed by signal indications which are activated by the route aligned by the DB operator. The operator's route selections are based on instructions from the dispatcher.

Train operations also are governed by timetable, special instructions, and the Rules for Conducting Transportation. (See Appendix A.)

The traffic density through the DB interlocking averaged 100 trains per day over the past 5 years. The authorized freight train speed through the area was 50 mph; however, the speed on No. 1 track had been restricted to 30 mph because of track conditions in January 1974.

River traffic -- The drawbridge spans the Cuyahoga River about 1,600 feet from where it discharges into Lake Erie. The river valley within the Cleveland urban area is an industrial complex. Vessels that use the channel vary in size from 650 feet long and 70 feet wide to small pleasure boats. Except in periods of low, calm water, the bridge has to be raised to accommodate almost all vessel traffic on the river, which could be 30 to 60 times per 8-hour workshift.

Drawbridge operation -- It was the understanding of the drawbridge operators that, according to Federal statute, 1/ boats have priority; however, the bridge usually was operated to accommodate the movement of trains. If a train and a boat approached at the same time, the operators would allow the train to pass if the train was within the approach circuit and if the signals had been displayed for the train's movement.

The lift-span drawbridge is opened by the DB operator through a control panel in DB tower. The bridge control panel and the movement of the bridge are interlocked with the signal protection in the area; that is, before the bridge is opened, the signals governing train movement over the bridge must display "stop" and the controlling track circuits must be unoccupied by trains. If a signal indicated "proceed" and then is changed to "stop," electrical time-locking circuits prevent the bridge from opening for 6 minutes 41 seconds. The design was intended to prevent the opening of the bridge if an approaching train has received a "proceed" signal.

However, if the normal "stop" signal is displayed on the home signals for the approaching train, the bridge can be opened by the DB operator without delay. This allows the operator to open the bridge for vessels as soon as a train clears the bridge circuit. The feature was intended to minimize delays. However, it relies on the engineers of approaching trains to comply with the signal indications. The bridge can be raised to its maximum height in 2 minutes 17 seconds. When this position is attained, a signal on the lift-span changes from red to green, which authorizes boats to proceed. The lowering of the bridge requires slightly more time than raising it. The DB operator normally did not inform the dispatcher when he raised or lowered the bridge.

Signal system -- The traffic control system was installed from DB west to Berea in 1968. In 1970, the system was installed east of DB.

1/ 33 USCA 499.

The system supplemented automatic block signals and automatic train stop. With approval of the Federal Railroad Administration (FRA), the automatic train stop was removed in 1971. The automatic signals of the traffic control system are the color-light type which are lighted only when a train is within the approach circuit for the signal. (See Appendix B.) The locations of the involved signals are shown in Figure 3.

The signal system had been installed, inspected, and maintained according to Federal regulations. The DB interlocking had been last inspected by an FRA representative on March 13, 1974. No defects were noted at that time.

Communication procedures -- The operator at the tower could communicate with trains and marine vessels by means of two-way radios. (The communication channels were not on the same frequencies.) The radio frequency used by the DB operator to converse with traincrews also was available to the dispatchers. However, the dispatcher and operator normally conversed with each other by telephone. Recordings were made of telephone conversations and of two-way radio communications with trains.

The DB operator understood that the radio was to be used to facilitate train movements. He stated that his message to the engineer of OV-8 indicating "All clear ahead of you...." was done "to alert him that there is nobody ahead of him now, and he doesn't have to come prepared to stop...."

Railroad rule 717 requires certain radio identification procedures that were not followed during the radio conversations on the day of the accident. The use of radio for communicating between trains and stations is governed by Federal Communications Commission Rules and Regulations, 47 CFR 93. These regulations do not specify the exact procedures for use of radio but generally provide that communications must be restricted to matters pertaining to safety or the efficient operation of the transportation system. These regulations also state that stations may be identified by call letters or by the name of the railroad and train number, caboose number, engine number, or name of a fixed wayside station, or by such other name or number as specified by the railroad. Permission to omit station identification may be granted upon application.

The radio communication between the DB operator and marine vessels was ordered installed under the provisions of 33 CFR 117, by the Commandant of the U. S. Coast Guard in 1971 as a result of complaints of delays registered by marine interests. The use of this radio was governed by FCC regulations provided in 47 CFR 81. The railroad issued no specific operating instructions to the DB operators when the radio was installed; however, operators were required to obtain a FCC operator's license and to abide by FCC rules.

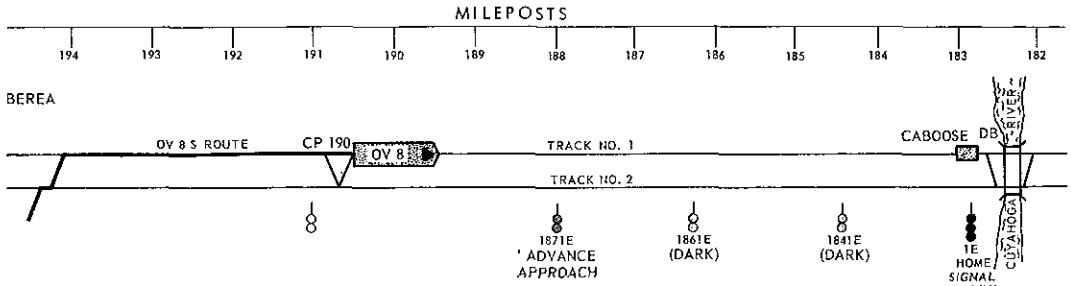

FIG 3-A (TIME=3:43 A M) (LIGHT ENGINE RETURNING TO CABOOSE)

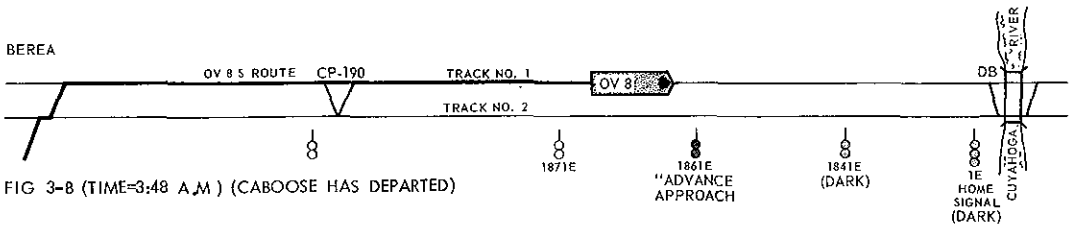

FIG 3-B (TIME=3:48 A.M) (CABOOSE HAS DEPARTED)

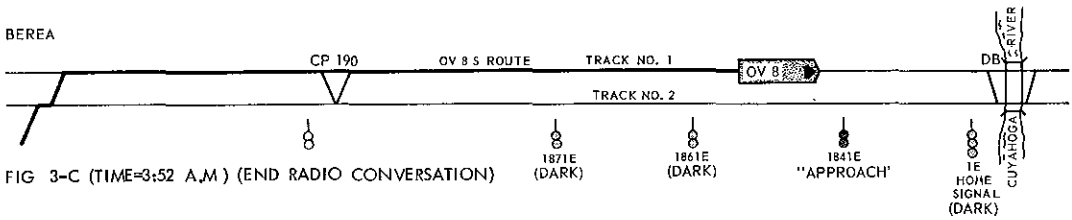

FIG 3-C (TIME=3:52 A.M) (END RADIO CONVERSATION)

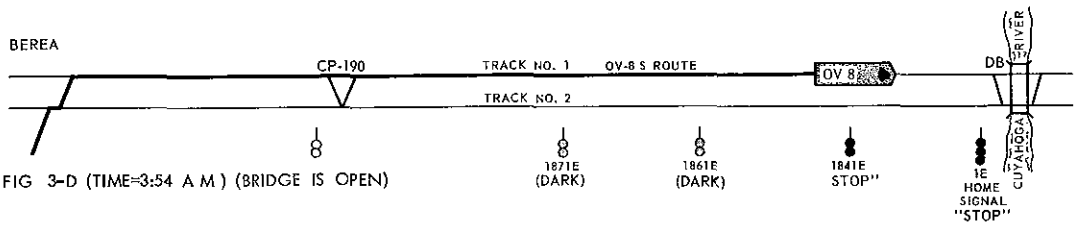

FIG 3-D (TIME=3:54 A M) (BRIDGE IS OPEN)

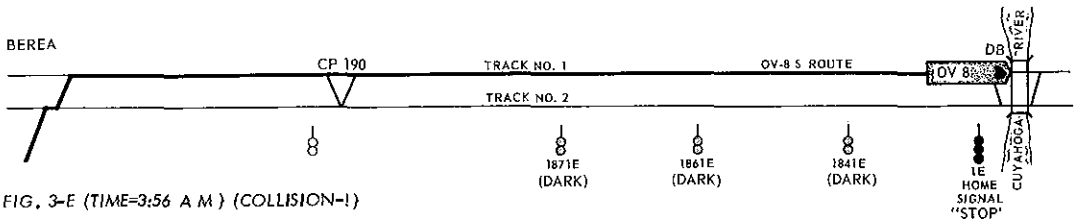

FIG. 3-E (TIME=3:56 A M) (COLLISION-!)

FIGURE 3

Train Equipment

The two locomotive units of OV-8 were manufactured by the Electro-Motive Division of the General Motors Corporation. The lead unit was a Model GP-35 and the second unit was a Model GP-40. The locomotive units were being operated with the short end forward. Both locomotive units were equipped with cast iron brakeshoes and sanders. The lead locomotive unit had a pedal-type safety control (deadman) and a speed recorder. The recorder was not equipped with a tape to record the speed, and there is no requirement for either.

Damages

When OV-8 collided with the bridge, the train's momentum propelled the underframe of the first locomotive through the opening and into the river below. The plunging locomotive underframe just missed the passing vessel which was almost through the open span at that time. The underframe of the trailing locomotive unit went partially through the opening, but the rear portion of the underframe caught on the track structure and was suspended above the river. The superstructures of both locomotive units were stripped from their beds, crushed between the bridge counterweight and the following cars, and twisted into a mass about 12 feet long. The engineer and fireman were found crushed in their seats in the demolished cab.

The three cars that followed the locomotive derailed as the rails spread under them. The next 10 cars remained on the rail. Cars 14 through 28 derailed and some jackknifed during the impact. The latter derailment destroyed the eastbound signal and the adjacent signal appurtenances.

The railroad estimated the cost of the accident as follows:

Equipment damage	$513,900
Track damage	1,300
Signal damage	1,500
Bridge damage	98,000
Lading damage	111,200
Cleanup costs	122,607
TOTAL	$848,507

Crew Information

The engineer of OV-8 was 52 years of age. He was employed as a fireman in 1941 and was promoted to engineer in 1951. He had been examined last on operating rules in April 1974. His last physical examination was in November 1973. He was extremely familiar with the territory and had made 23 trips through DB interlocking during the month before the accident.

The fireman was 20 years of age, and was hired as a fireman in 1971. He also received his last physical examination in 1971. He was last examined on the operating rules in April 1974.

The DB operator, aged 48, began work in that capacity in 1943. He had worked at the Cuyahoga drawbridge for most of his career, and had been an operator at DB interlocking since his qualification as such in 1958. He was last examined on the operating rules in November 1973. Several years had elapsed since his last physical examination and none was required.

Medical and Pathological Information

Post-mortem examinations were performed on the engineer and fireman by the Cuyahoga County Coroner, who established the cause of death as crash injuries. The examinations did not reveal any physiological failures which would have impaired either man's ability to function.

There was no evidence of drugs found in either body. Blood alcohol percentage was noted as follows:

	Engineer	Fireman
	Percent	Percent
Blood	0.05	0.00
Urine	0.06	0.04

The fireman lived for several hours following the crash which would have permitted the blood alcohol to metabolize. The engineer and fireman had last been seen by the brakeman at Galion, which is 59 miles from Columbus. There was no indication that either was under the influence of alcohol at that time.

Tests and Research

Inspection of the site -- At the time of the collision, the bridge was fully raised. The crossover east of the bridge was aligned for a movement from No. 1 track to No. 2 track.

The two signals (1841E and 1861E) west of the home signal were checked immediately following the accident. The simulation of the destroyed circuitry resulted in the display of aspects on these signals consistent with that which should have been displayed with the eastward home signal at "stop," i.e., signal 1841E displayed "approach" and signal 1861E "advance approach."

After this check, the railroad checked the entire signal system for defects, electrical characteristics, malfunctions, and to see whether the installation was in accordance with design. These tests were performed under the oversight of representatives of the FRA and included a simulation of the train movements. No exceptions were noted.

An inspection of the home signal and the four relay cases that were damaged in the derailment indicated that all wires were installed according to plan. Because of the derailment damage, it was not possible to test all individual components of these subsystems.

The Safety Board examined the light bulbs that were recovered from the damaged eastbound home signal. Only three of the eight bulbs had broken filaments. The filaments indicated that the bottom light of the three-position signal was red and that the top light was not yellow at the time of impact. However, it could not be determined if the top light was red or green.

A consultant for the Safety Board reviewed the design of the signal system and found no latent circuit which may have caused unwanted functions. Therefore, the home signal should not have been "clear" with the bridge open unless several components failed simultaneously.

Inspection of the locomotive cab -- Although the control compartment of the first locomotive unit was completely destroyed, the position of most of the controls could be determined. However, it could not be determined whether these positions were established before, during, or after the collision.

Personal effects of the crew were recovered from the destroyed cab. There was no trace of alcohol or any alcohol container among those effects.

Examination of the train's braking system -- The train's equipment was inspected and no indication of a failure of the train's braking system was detected; however, the 15 derailed cars in the center of the train were damaged extensively and provided little information. The angle cocks on the locomotive and cars No. 1 through No. 3 were fully opened except for the one at the head of the first locomotive unit. That angle cock was closed. All available evidence indicated that the brake-pipe was cut in and was functioning throughout the train.

The wheels and brakeshoes on the front portion of the train did not show signs of heavy braking. However, such indications would not necessarily result from short, heavy braking. There was no sand on the track on the approach to the bridge, such as that which should result during an emergency brake application. Sand was deposited at the collision point, which indicated that the sanders contained sand.

Seventy-nine cars of the train were tested at a local yard for proper brake operation. Of these, 9 cars, or 11 percent, had either ineffective brakes because of excessive piston travel or were defective because the brakes were cut out. Federal law permits a maximum of 15 percent of the brakes in an en route train to be inoperative.

After the accident, the Westinghouse Air Brake Company used a computer to determine the stopping distance for a train such as OV-8. For an assumed speed of 30 mph, the approximate stopping distance, after an emergency brake application was simulated at the eastbound home signal, was 967 feet. The stopping distance from 30 mph with a full service brake simulation made at the home signal was computed to be 2,100 feet. In addition, a test train with a consist similar to that of OV-8's was used to compare braking distance. This train stopped in 1,565 feet when a full service brake application was initiated at 30 mph at a location 5,025 feet in approach to the home signal.

Visibility tests -- Railroad personnel conducted tests with a locomotive similar to the lead locomotive of OV-8 to determine various sight distances on the approach to the drawbridge. On the night of the test, visibility conditions were judged to be similar to those of May 8, 1974, and a replica of the demolished home signal was erected at its former position. Signal 1861E could be seen at a distance of 1,585 feet; signal 1841E was visible at 10,149 feet; the home signal could be identified from 5,366 feet; and the lowered bridge counterweight was visible within the beam of the locomotive headlight at 639 feet.

ANALYSIS

The Aspect of the Home Signal

The testimony of one of the two witnesses concerning the "clear" aspect displayed by the eastbound home signal suggests that there may have been a false "clear" signal. The lack of apparent escape action by the head-end crewmembers supports the false "clear" theory. A false "clear" signal also could explain the lack of emergency braking described by some witnesses; however, the same witness who stated that the train was braking before the locomotive passed the home signal also stated that the signal indicated "proceed" as the train approached the home signal. The two conditions described by this witness are not consistent.

If the home signal indicated "proceed," there was no reason for the engineer to initiate an emergency brake application in advance of the signal unless he saw the open bridge. Yet the counterweight was not visible in the headlight of the locomotive until after the locomotive passed the home signal. Further, based on the computation for the braking distances of OV-8, if braking had been effective before passing the signal, the speed of the train would have been reduced substantially before the collision. Evidence does not support that the train's speed was reduced. Finally, if the crewmembers had recognized that the bridge was open before the locomotive passed the home signal, there would have been sufficient time for them to take some type of protective action. If braking had been initiated, the reaction-time would have been in excess of 14 seconds. Thus, the evidence suggests that braking of the train did not occur until just before or upon collision.

The evidence also indicates that the home signal was indicating "stop" as OV-8 approached it. The design of the signal system was not entirely fail-safe; however, the system includes redundancies throughout. Therefore, a series of improbable failures must occur simultaneously to produce a "proceed" indication with the bridge open. There was nothing in the examinable apparatus to suggest that any failures did occur. The analysis of the signal system for the possibility of latent circuits substantiated that there were no oversights in the design. Finally, the field inspection revealed that the system had been installed as designed.

The testimony of the one witness that the home signal indicated "stop" before OV-8 passed it was supported by the testimony of the brakeman of OV-8 who saw the home signal indicate "stop" just before the collision. Since the length of the train was about the same as the visibility distance to the home signal, the brakeman would have been able to see the signal from the caboose only for about 30 feet before the locomotive passed the signal. Thus, the brakeman may have seen the signal after the locomotive passed it. But even if the signal was not observed to display "stop" until that time, this would be further confirmation that the signal system was functioning. If a false "clear" had been displayed with the bridge open, the passing of the locomotive would not necessarily have corrected this malfunction.

The Board therefore concludes that the signal system was functioning properly before the accident.

Why OV-8 Failed to Stop

There was no indication that the train's braking system failed; yet, the train passed a signal which displayed "stop" without appreciable slowing. Such action by the crew would have been contrary to all training and experience that an engine crew acquires. After successfully controlling the speed of the train on the long descending grade, the engineer would have known immediately if the brakes had failed. Further, if the brakes had failed, an engineer of his experience would have taken some action to protect himself, such as evacuation. Since both the engineer and fireman remained in their seats, it does not appear likely that the brakes had failed.

The Board believes that the engineer and fireman were awake. The train had stopped and started successfully about 20 minutes before the collision. Four minutes before the collision, the engineer had talked by radio with the operator and subsequently maintained the approximate proper speed on the downgrade approaching the drawbridge.

Alcohol was not a contributing factor. Alcohol at the 0.05-percent level would not affect an experienced engineer's judgment to the extent that he would run by a home signal indicating "stop."

A review of the preaccident events may offer the best explanation of why OV-8 failed to stop. (See Figure 3.)

OV-8 cleared CP-190 at 3:43 a.m. At that time the caboose of the previous eastbound train was still located west of the home signal. The respective signal indications at that time would have been as shown in Figure 3-A. (Signals 1861E and 1841E were not lighted since no trains were in the approach circuits.)

From CP-190 to the collision, OV-8 averaged 33.3 mph. At this speed, the light engine and caboose had cleared the DB tower when the engineer of OV-8 was first able to see signal 1861E. The time was about 3:48 a.m. The position of OV-8 and the signal indications are shown in Figure 3-B. Thus, the engineer could have concluded that the traffic conditions ahead of him were improving since he had observed two "advance approach" signals in succession.

About 3:52 a.m., the radio conversation between the engineer and the DB operator took place, which indicated the route was clear ahead. Figure 3-C shows the position of OV-8 and the signal indication at that time. The "approach" indication of signal 1841E would suggest to the engineer that the home signal was not yet displayed for the route; however, in view of a message that says "all clear ahead of you..." and "you can highball right along," an engineer could reasonably conclude that the route ahead would improve, unless a broken rail or some other obstruction unknown to the DB operator existed.

The Safety Board could not reconcile the irrational action of the DB operator in not advising the engineer of OV-8 that he had opened the drawbridge after telling the engineer that the way was clear. Although the home signal was indicating stop and the operator's message did not give the engineer authority to pass it, once having told the engineer the way was clear, the operator should have advised the engineer that the route was being obstructed.

The operator's communication clearly violated Rule 628 which prohibits advancing a train by verbal permission when the proper indication can be displayed by the interlocking signal.

Figure 3-D shows the location of OV-8 when the home signal would have been visible to the engineer. At this time, the bridge was opening and the home signal indicated "stop." Figure 3-E shows the collision of OV-8 with the bridge counterweight. At 33.3 mph the home signal should have been visible to the locomotive crewmembers for 1 minute 51 seconds before passing it and the open bridge should have been visible for an additional 13 seconds. Thus, there would have been more than 2 minutes available to the crew before the collision.

Although improving signal indications and the radio conversations with the DB operator would have assured the crew that there were no trains ahead, this assurance should have ended when the home signal continued to display "stop." The crew may have expected the home signal indication to change to "proceed" at the last moment. Distraction, preparation for the forthcoming arrival at the crew's destination, or panic may have been factors in the crew's failure to react to the wayside signal. In any event, the radio conversation caused the engineer to disregard the visual wayside indications.

Safety Controls

The signal system was similar to many other modern railroad signal installations--it was installed to accommodate high density railroad traffic, and it apparently was functioning properly.

Many accidents involving the disregard of signal indications have occurred and have been charged to human error, rather than signal-system failure. Since man is part of the system, his shortcomings should be considered in the design of the system. Fail-safe systems should back up the compliance with operating rules to minimize human failures. The automatic train stop which was removed in 1971 was one type of backup intended to minimize human error.

In this accident, however, the removal of the train stop was not a contributing factor, because of the short distance between the bridge and the home signal.

One of the justifications for removal of the automatic train stop was that locomotives would be equipped with radios. The circumstances of this accident suggest the engineers may now be relying upon radio conversations instead of wayside signals. Thus, the intended safety control of radio-equipped locomotives may have introduced a hazard.

The fireman, himself, was a safety check since he should have provided redundancy when the engineer failed to react to the emergency; he did not. Perhaps his failure to react relates to the junior-senior relationship between an engineer and brakeman/fireman. These relationships should be investigated to determine how cab duties can best be organized and managed.

The brakeman, when on the locomotive, is also required by rule to maintain a lookout and take preventive action if the engineer fails to operate the train in accordance with the rules. It could not be determined whether the brakeman's absence could have been causative as far as failing to react to the emergency. The brakeman's exact duties in cab management are not specified.

The Use of the Radio

The radio conversation between the engineer of OV-8 and the DB operator contributed significantly to the cause of the collision. After the accident, railroad management stated that the message was unnecessary and improper. Yet, similar radio messages had been transmitted by the operator before the accident. These transmittals could have been monitored by the dispatcher or supervisory personnel either at the time of transmittal or later. Yet, the necessary enforcement action for the discontinuance of the improper practice had not been taken.

The Safety Board believes that corrective action was not taken because the rules do not specify that this practice is improper. The rules only state that, "Radio and telephone systems will be used for conducting transportation...."

By contrast, trains move under the authority of timetables, train orders, and signal systems. In each of these instances, there are extensive rules on how the authority is to be conveyed and applied. In this accident, it appears that OV-8 was moving under the authority of a radio message. The rules should state specifically under what circumstances this can occur, if any.

The Safety Board's investigation included the monitoring of other radio conversations. Generally, the radio identification procedures prescribed by rule 717 were not followed. Since it was the railroad's practice to record these conversations, the rules were apparently disregarded by both employees and management.

The lack of user identification in the radio transmissions was in violation of FCC regulations. The repeated violations imply that these regulations were not enforced.

This accident further illustrates that radio usage for operations in the railroad industry has not been adequately treated. On April 19, 1972, the Safety Board recommended 2/ that the FRA develop Federal regulations that provide for the use of the radio in railroad operations. We also recommended that these rules be patterned after safeguards found in railroad operating rules. To date, no regulations have been promulgated.

Operating Rules

There were more than a dozen operating rules which were not followed by the employees involved in the movement of train OV-8. Some of the specific violations included: the engineer and fireman consumed alcohol during duty; the speed of OV-8 exceeded that which was prescribed for

2/ National Transportation Safety Board Recommendations R-72-9 and R-72-10.

certain areas; the rear brakeman of OV-8 did not protect the adjacent tracks when the emergency brake application occurred; and, most important, the train was not operated in accordance with signal indications.

A difference in rule interpretation also was involved, which presents a separate problem. Specifically, the established procedures at DB do not include the notification of the dispatcher when the bridge is to be opened. Yet, a management authority on rules stated that the dispatcher should be notified before a bridge is to be opened. Thus, as has been demonstrated in other accidents, management's interpretation of the rules was not disseminated to employees, who must apply the rules.

Part of this problem may have resulted from the obscurity of the applicable rule. The management's representative stated that Rule 458 was applicable, which is listed under "Traffic Control System Rules." Yet, the same witness stated that DB interlocking was "an island within traffic control" and not part of it. To complicate the interpretation further, only certain rules listed under "Traffic Control System Rules" were said to apply to DB interlocking, as many "Interlocking Rules" superseded them; yet, nowhere did it state which rules applied. The timetable showed Traffic Control System Rules applicable to the territory which included DB interlocking. The DB operator was uncertain whether these rules applied.

Rule 458 does not state specifically that a dispatcher must be notified of the opening of a movable bridge. Instead this interpretation is expressed indirectly by "...must be advised in advance of any known condition that will delay the train or prevent it from making usual speed." The opening of the bridge was considered by the operators as normal operation and, thus, they did not advise the dispatcher. That was not the intent of management.

Operation of the Drawbridge

After the DB operator advised the crew of OV-8 that the route was clear, he opened the bridge. This action was apparently prompted by the sudden realization that a Corps of Engineers' vessel had been waiting for the bridge to open for about 32 minutes. The drawbridge operator stated that he was not aware of the proximity of OV-8 and, in any event, relied upon the signal system to protect his actions.

For many years, there has been a conflict regarding the accommodation of the two modes of transportation. The 1894 Federal law, which gives river traffic the priority if a train can be stopped safely, is still in force. The law was interpreted in this case by the DB operator. In arriving at his decisions on which traffic to accommodate, he balanced his obligations to his employer and his statutory responsibility not to delay vessels. The responsibilities were complicated by the high density of both train and vessel traffic. It was in this environment that his decision was made to open the bridge even though OV-8 was approaching.

It was in the interest of expediting river traffic that the Coast Guard required the installation of a marine radio at DB tower. The radio did not resolve the conflict that the operator was faced with; it only aggravated it.

A thorough examination of the risks in accommodating the two modes of transportation at the Cuyahoga River crossing might produce markedly different rules for handling the traffic. With proper operational controls, rail transportation would be exposed only to minimal risks in crossing the bridge, but delays would occur. Large ships are difficult to manage since they lose steerage at low speeds. They are also exposed to the risks of grounding, ramming the bridge, or colliding with other vessels. Therefore the requirement to give such large vessels priority is understandable as a safety measure.

Such conflicts of priorities may also exist at other drawbridges in the U.S. So far as the Safety Board knows, there has been no recent review of the economic or safety effects of the 1894 Federal law on a National basis; however, specific operational procedures have been established at various locations by regulations. Such regulations at the Cuyahoga River crossing could lessen the conflicts that face DB operators. However, the same risks are not present for small pleasure craft, which share the priority. This priority may cause a real economic loss by delaying trains.

CONCLUSIONS

1. The crew register procedure at Columbus did not assure a full crew.

2. Although all brakes in the train may not have been effective, the braking capability of the train was not a causal factor in the collision.

3. The design and installation of the signal system at DB interlocking were in accordance with the state-of-the-art and Federal regulations.

4. The signal system was operating properly and the eastbound home signal at the drawbridge indicated "stop" as train OV-8 approached. The signal was visible at a distance which would have permitted a normal stop.

5. Train OV-8 exceeded the maximum authorized speed of 30 mph as it approached the drawbridge.

6. The radio message from the drawbridge operator to train OV-8 that the route was clear undermined the engineer's reliance upon the wayside signals.

7. Neither the railroad nor Federal authorities had prescribed the exact role intended for the use of radio in facilitating train movements.

8. In the radio conversation, the DB operator and the engineer did not identify themselves in the manner required by the Federal Communication Commission's regulations and Penn Central operating rules.

9. It had not been the practice for the DB operator to notify the dispatcher when he opened the drawbridge. Management's interpretation had not been effectively transmitted to employees.

10. The removal of the automatic train stop in 1971 was not a causal factor in the accident because of the short distance between the bridge and home signal.

11. The fireman failed to stop the train short of the home signal or the bridge counterweight when the engineer failed to do so.

12. The failure of the crewmembers in the caboose to flag the adjacent track after OV-8 stopped in the accident was a violation of Penn Central operating rule 102.

13. The operation of the drawbridge was not based on a formal analysis of risks to traffic. Instead, it depended on the discretion of the individual operators.

14. The Penn Central's interpretation and the DB operator's application of the Federal law governing the operation of drawbridges resulted at times in unusual stress and workload for the operator.

PROBABLE CAUSE

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the locomotive crewmembers to obey a wayside signal indication to stop and the concurrent opening of the drawbridge by the DB operator after he had advised the oncoming traincrew by radio that the route was clear. Contributing to the accident was the absence of specific rules that either prohibited such a radio message or described the circumstances under which such a radio transmittal could be accepted as an operational control.

RECOMMENDATIONS

The National Transportation Safety Board recommends that:

1. The Penn Central Transportation Company:

   (a) Review its rule enforcement program and take the necessary action to insure that its employees understand and comply with the operating rules. (Recommendation R-75-11)

   (b) Promulgate operating rules that provide specific guidance for the use of radio in railroad operations. (Recommendation R-75-12)

   (c) Provide specific, current operational criteria to drawbridge operators to guide them in the reasonable accommodation of both trains and ships. A copy of these and all subsequent instructions should be furnished to the U. S. Coast Guard to insure their awareness of current railroad operating procedures. (Recommendation R-75-13)

2. The U. S. Coast Guard review the waterway and railway operating conditions at the Penn Central crossing of the Cuyahoga River and promulgate appropriate regulations to accommodate both river and rail traffic safely. (Recommendation R-75-14)

3. The Federal Railroad Administration (FRA) issue regulations to require that railroads institute formal locomotive cab management procedures which will specify the duties of each crewmember and to insure appropriate crew action when the engineer does not function in a manner consistent with the safety of the train. These procedures should be integrated with the results of the ongoing FRA/industry locomotive-cab design project. (Recommendation R-75-15)

The Safety Board reiterates the following recommendations:

1. That the FRA issue as soon as possible regulations to provide for the use of radio in railroad operations. These regulations should include the traditional safeguards found in existing railroad operating rules where they apply to train movements. It is further recommended that, in drafting such regulations, consideration be given to the principles and procedures for radio used by military and civilian aviation authorities. (Recommendation R-72-9 adopted April 19, 1972.)

2. That the FRA include in their proposed Standards for Rules Governing the Operation of Trains, regulations that will in

effect prohibit the use of narcotics and intoxicants by employees for a specified period prior to their reporting for duty and while they are on duty. (Recommendation R-74-9 adopted March 20, 1974.)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JOHN H. REED
Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ LOUIS M. THAYER
Member

/s/ ISABEL A. BURGESS
Member

William R. Haley, Member, did not participate in the adoption of this report

March 26, 1975

APPENDIX A

C.T. 400

EXCERPTS FROM

PENN CENTRAL

RULES FOR CONDUCTING TRANSPORTATION

EFFECTIVE APRIL 28, 1968

APPENDIX A

GENERAL RULES

F. Accidents, failure in the supply of water, fuel or electric power, defects in track, bridges, signals, catenary, third rail and transmission lines, or any unusual conditions which may affect the movement of trains must be reported by quickest available means of communication to the proper authority and protection provided when necessary

G The use of alcoholic beverages, intoxicants or narcotics by employes subject to duty is prohibited Being under the influence of alcoholic beverages, intoxicants or narcotics while on duty, or their use or possession while on duty is prohibited

DEFINITIONS

Block Signal Systems

Automatic Block Signal System (ABS)—A block signal system wherein the use of each block is governed by an automatic block signal, cab signal, or both

Manual Block Signal System (MBS)—A block signal system wherein the use of each block is governed by block signals controlled manually or by block-limit signals or both upon information by telephone or other means of communication

Traffic Control System (TCS)—A block signal system under which train movements are authorized by block signals, cab signals, or both whose indications supersede the superiority of trains for both opposing and following movements on the same track

Bridge, Movable

Movable Bridge—That section of a structure so designed that it may be displaced to permit passage of traffic

Interlocking

Interlocking—An arrangement of signals and signal appliances so interconnected that their movements must succeed each other in proper sequence and for which interlocking rules are in effect It may be operated manually or automatically

Interlocking Limits—The tracks between the extreme opposing home signals of an interlocking

98. Trains and engines must approach the end of two or more tracks, junctions, railroad crossings at grade and movable bridges, prepared to stop, unless switches are properly lined, signals indicate proceed and track is clear

If a signal at a movable bridge cannot be changed from stop, verbal permission and/or hand signal must not be given to pass signal in stop position until a competent employe has personally examined and ascertained that the movable bridge is in place, with rails lined up properly, locked and safe for train movement Train must not exceed 4 miles per hour over movable bridge

When movable bridges are not a part of an interlocking, they will be listed on the station page of the timetable and, when necessary, instructions governing movement over such movable bridge will be indicated by timetable special instructions

102. When a train is disabled or stopped suddenly by an emergency application of the air brakes or other causes, adjacent tracks as well as tracks of other railroads that are liable to be obstructed must, while stopping and when stopped, be protected in both directions until it is ascertained they are safe and clear for the movement of trains

106. The conductor, enginemen, and pilot are responsible for the safety of the train and the observance of the rules, and under conditions not provided for by the rules, must take every precaution for protection

This does not relieve other employes of their responsibility under the rules

OPERATING RULES

Rule 281



FIG. A



FIG. A-1

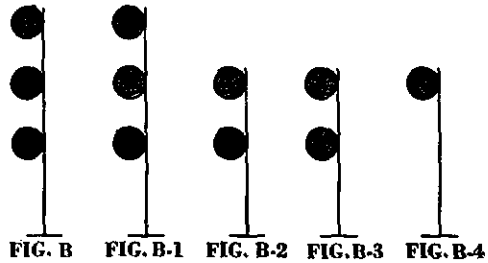

FIG. B FIG. B-1 FIG. B-2 FIG. B-3 FIG. B-4

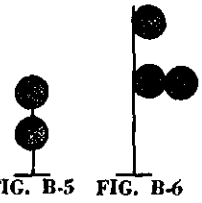

FIG. B-5 FIG. B-6

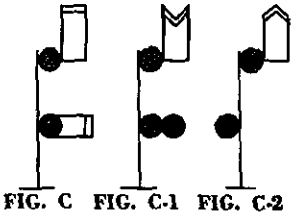

FIG. C FIG. C-1 FIG. C-2



INDICATION—Proceed

NAME: Clear

Rule 281(C)

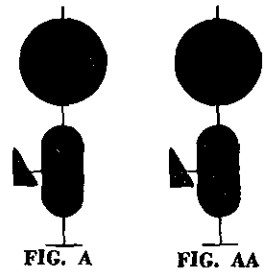

FIG. A FIG. AA

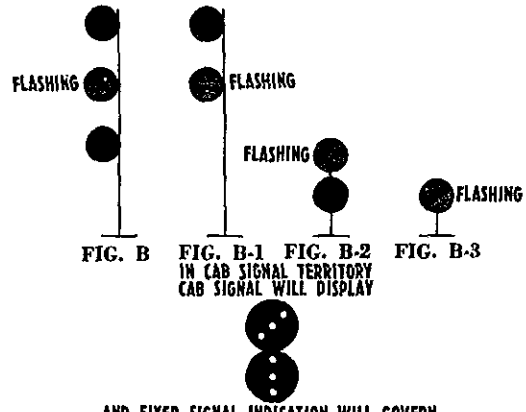

FIG. B FIG. B-1 FIG. B-2 FIG. B-3

AND FIXED SIGNAL INDICATION WILL GOVERN

INDICATION—Proceed: Limited speed within interlocking limits.

NAME: Limited Clear

NOTE—In cab signal territory with fixed automatic block signals, trains with cab signals not in operative condition, or not equipped with cab signals, must not exceed Medium Speed to next signal.

Rule 281(D)

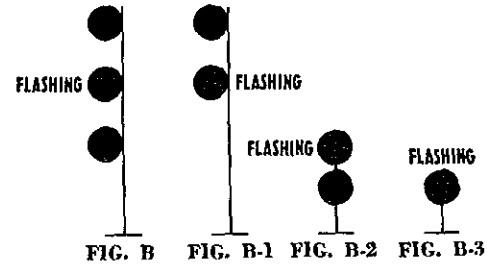

FIG. B FIG. B-1 FIG. B-2 FIG. B-3

INDICATION—Proceed at Limited speed preparing to stop at next signal.

NAME: Limited-approach.

APPENDIX A

Rule 282(A)

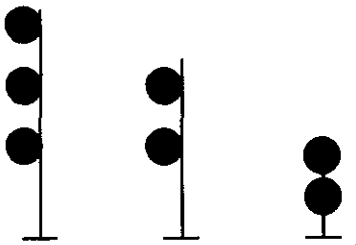

FIG. B FIG. B-1 FIG. B-2

INDICATION—Proceed preparing to stop at second signal.
Train exceeding Limited speed must at once reduce to that speed.

NAME: Advance Approach.

Rule 285

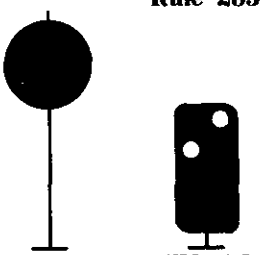

FIG. A FIG. A-1

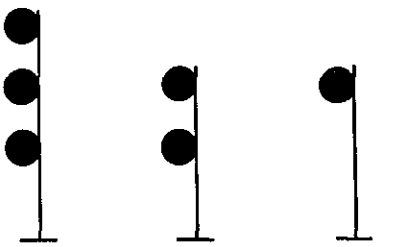

FIG. B FIG. B-1 FIG. B-2

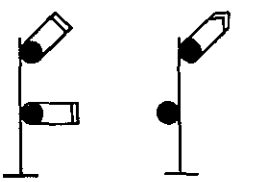

FIG. C FIG. C-1

IN CAB SIGNAL TERRITORY
CAB SIGNAL WILL DISPLAY



INDICATION—Proceed prepared to stop at next signal. Train exceeding Medium speed must at once reduce to that speed.

NAME: Approach.

Rule 292

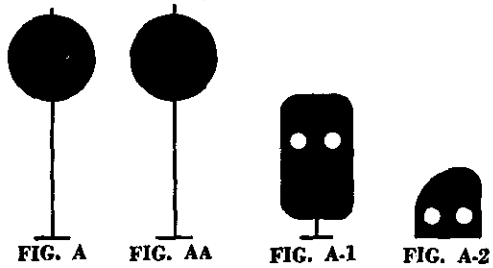

FIG. A FIG. AA FIG. A-1 FIG. A-2

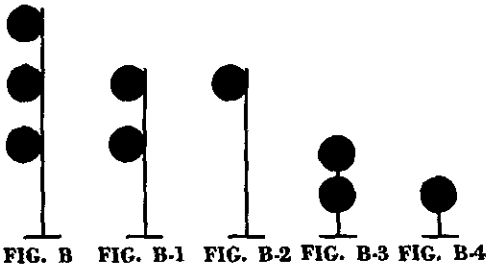

FIG. B FIG. B-1 FIG. B-2 FIG. B-3 FIG. B-4

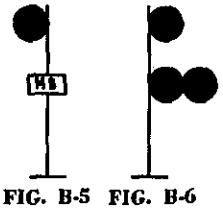

FIG. B-5 FIG. B-6

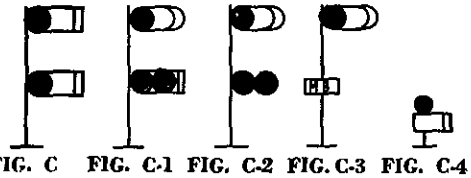

FIG. C FIG. C-1 FIG. C-2 FIG. C-3 FIG. C-4

IN CAB SIGNAL TERRITORY
CAB SIGNAL WILL DISPLAY



AND FIXED SIGNAL INDICATION WILL GOVERN

INDICATION—Stop

NAME: Stop Signal

TRAFFIC CONTROL SYSTEM RULES

NOTE—Rules 450 to 462 inclusive will not be effective except by special instructions.

450. Trains will be governed by block signals whose indications will supersede the superiority of trains and will take the place of train orders for both opposing and following movements on the same track Automatic Block Signal System Rules, Interlocking Rules and Operating Rules, except as modified by Rules 450 to 462 remain in effect

451. The movement of trains will be controlled by the Train Dispatcher who will issue instructions to operator or others when required

452. Instructions governing emergency or manual operation of remotely controlled power operated switches are posted at each location

458. The Train Dispatcher or operator at control station must be advised in advance of any known condition that will delay the train or prevent it from making usual speed.

INTERLOCKING RULES

605. Interlocking signals govern the use of the routes of an interlocking, and as to movements within interlocking limits, their indications supersede the superiority of trains, but do not dispense with the use or the observance of other signals whenever and wherever they may be required

Rules 99 and 152 do not apply within interlocking limits

611 Signals must be kept in the position displaying the most restrictive indication, except when displayed for an immediate movement, unless otherwise specified in the timetable

When the route is set the signals must be operated sufficiently in advance of approaching trains to avoid delay

627. An operator or Train Dispatcher informed of any obstruction in a block must immediately attempt to contact any trains involved, notify the next station in advance and each must display Stop-signal to all trains that may be affected and must not permit any train to proceed until it is known that its track is not obstructed

APPENDIX A

628 Verbal permission must not be given nor hand signals used to advance a train when the proper indication can be displayed by the interlocking signal

629. Trains or engines must not pass an interlocking signal indicating "Stop" (Rule 292) When it is necessary to authorize a train or engine to pass a stop signal verbal permission or hand signal may be given by the Train Dispatcher, or operator when authorized by the Train Dispatcher, for the movement to be made at Restricted Speed

105

Permission or hand signals must not be given until the train or engine has stopped at the signal and a member of the crew is fully informed of the situation

When hand signals are necessary, they must be given from such a place and in such a manner that there can be no misunderstanding on the part of the employe receiving them as to the signals given or as to the train or engine for which they are intended

Permission or hand signals must not be given until the route to be used has been examined and is known to be safe for the passage of trains or engines At remote interlockings and at interlockings where it is impracticable for Train Dispatcher or operator to examine the route a member of the crew, when governed by instructions from the Train Dispatcher or operator, must examine the route to be used, and when required will in addition operate switches by hand before proceeding

Where Rule 261 is in effect, and the interlocking signal is also a block signal, authority to pass such signal indicating stop must be given by train order, except verbal permission will be given when a signal cannot be displayed for an engine returning to its train

RADIO AND TELEPHONE SYSTEMS

701. Definition: A Railroad Radio Communicating System is one employing radio for the transmission of intelligence between moving equipment, between moving equipment and a fixed point, between fixed points and/or between employes provided with portable radio equipment

702. Radios are under the jurisdiction of the Federal Communication Commission (FCC) The Company and its employes are governed by the rules of the FCC and any violation is a Federal offense

717. Employes transmitting or receiving communications by radio or telephone must identify themselves to the operator, Train Dispatcher or other employe concerned by giving identification, occupation, name and location of train, engine, track car or other equipment involved

Conductor, engineman or driver of track car must personally receive all communications and take all necessary action pertaining to the movement of their train

Train Dispatchers and operators must identify themselves by name, occupation, and station The instructions transmitted must include identity of the receiver

Employes must insure being in communication with the proper persons and must not take action until certain that all conversation concerning them has been heard, understood, acknowledged and finished.

An operator may accept information regarding the movement of other trains from the conductor or engineman of a train or Track Car Driver to be

110

admitted to a block, and must then apply the rules to the portion of the block to be used

When using radio the words "PENN CENTRAL" must preface all originating calls

Three key words enable the radio user to exchange information clearly and concisely They are defined and explained below:

OVER — This word at the end of a transmission tells the listener that the radio channel is being released and "turned over" to the receiving end for a reply

ROGER — This word means message received and understood

OUT — This word means end of transmission — no reply expected

The following is an example of radio operating procedure:

ORIGINATING CALL

"Penn Central train SV-1, engine 6115, Engineman Brown calling rear end. Over"

REPLY

"Train SV-1, Engine 6115, Conductor Smith answering Brown Over"

MESSAGE

"Brown to Smith Home Signal indicates Stop Over"

REPLY

"Smith to Brown Roger Out'

APPENDIX B

Signal Aspects

The signal system was installed so that the most favorable indications, displayed when the drawbridge was open, were as follows: 1871E - Clear (green over red); 1861E - Advance Approach (yellow over yellow); 1841E - Approach (yellow over red); and 1E - Stop (red over red over red).

When the circuit between signal 1841E and 1E was occupied by train equipment and the drawbridge was closed, the most favorable signal indications displayed were: 1871E - Advance Approach; 1861E - Approach; 1841E - Stop (red over red); and 1E - Clear (green over red over red).

When the drawbridge was closed and the crossover east of the bridge was aligned for a movement from No. 1 track to No. 2 track, the most favorable signal indications displayed were: 1871E - Clear; 1861E - Clear; 1841E - Limited Approach (red over flashing yellow); and 1E - Limited Clear (red over flashing red).

NATIONAL TRANSPORTATION SAFETY BOARD
Washington, D. C. 20594

SS-R-29

RAILROAD ACCIDENT REPORT

COLLISION OF PENN CENTRAL FREIGHT TRAIN OV-8 WITH AN OPEN DRAWBRIDGE, CLEVELAND, OHIO MAY 8, 1974

ADOPTED: MARCH 26, 1975

E R R A T A

Make the following changes in the subject report:

Page 18, paragraph 3 should read:

> However, the same risks are not present for small pleasure craft, which share the priority. This priority may cause a real economic loss by delaying trains. Such conflicts of priorities may also exist at other drawbridges in the U. S. So far as the Safety Board knows, there has been no recent review of the economic or safety effects of the 1894 Federal law on a National basis; however, specific operational procedures have been established at various locations by regulations. Such regulations at the Cuyahoga River crossing could lessen the conflicts that face DB operators.

Page 29, last paragraph, last line: Change (red over flashing red) to (red over flashing green over red).

June 10, 1975

REPORT NUMBER: NTSB-RAR-75-3