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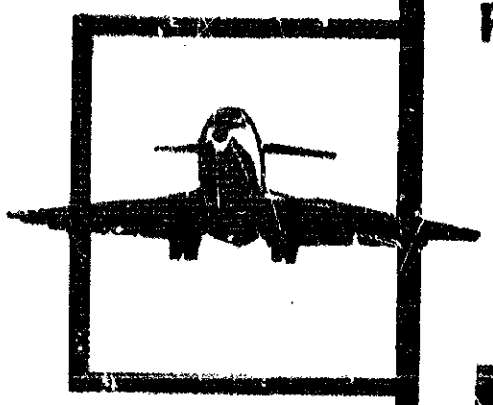

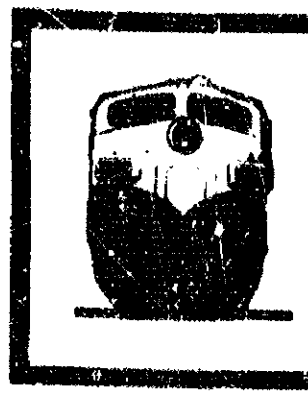

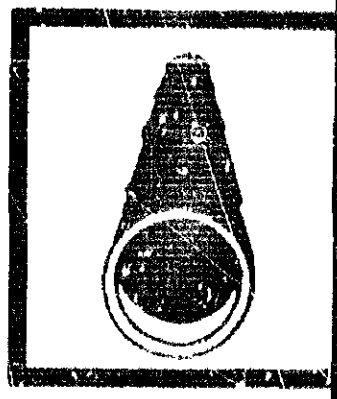

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT

REAR END COLLISION OF
LOUISVILLE & NASHVILLE RAILROAD COMPANY
TRAINS NO. 586 AND EXTRA 8072 NORTH
NEW JOHNSONVILLE, TENNESSEE
DECEMBER 28, 1981

NTSB-RAR-82-4

UNITED STATES GOVERNMENT

TECHNICAL REPORT DOCUMENTATION PAGE

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15. Supplementary Notes		

16. Abstract

About 9:30 a.m. on December 28, 1981, Louisville and Nashville Railroad Company (L&N) northbound train No. 586 struck the rear of standing L&N train Extra 8072 North at New Johnsonville, Tennessee. Train No. 586 passed two consecutive wayside automatic block signals displaying an approach aspect (yellow) and a restricted proceed aspect (red), respectively, before it struck the rear of Extra 8072 North. The caboose and six cars of Extra 8072 North and five locomotive units and one car of No. 586 were derailed. The conductor of Extra 8072 North was killed, and the engineer and head brakeman of No. 586 were slightly injured. Damage was estimated at $998,313.

The National Transportation Safety Board determines that the probable cause of this accident was the lack of alertness of the engineer and head brakeman of train No. 586 in approaching the area of the accident and the failure of the engineer of train No. 586 to properly use the automatic train brakes to control the speed of the train in compliance with the speed requirements of the wayside automatic block signal aspects, so that the train could be stopped before it struck standing train Extra 8072 North. Contributing to the cause of the accident was the failure of the head brakeman to cause the speed of the train to be brought into conformance with the automatic block signal aspects, and the failure of the conductor to request clarification of a radio message from the dispatcher notifying the crewmembers of train No. 586 that Extra 8072 North was stopped ahead when he did not understand the message.

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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT

Adopted: August 23, 1982

REAR-END COLLISION OF LOUISVILLE AND NASHVILLE RAILROAD COMPANY TRAINS NO. 586 AND EXTRA 8072 NORTH NEW JOHNSONVILLE, TENNESSEE DECEMBER 28, 1981

SYNOPSIS

About 9:30 a.m. on December 28, 1981, Louisville and Nashville Railroad Company (L&N) northbound train No. 586 struck the rear of standing L&N train Extra 8072 North at New Johnsonville, Tennessee. Extra 8072 North had stopped on the main track just south of New Johnsonville on instructions from the train dispatcher at Bruceton, Tennessee. The locomotive had been detached, and the train's head-end crew had moved the locomotive into New Johnsonville to pick up three freight cars. Train No. 586 passed two consecutive wayside automatic block signals displaying an approach aspect (yellow) and a restricted proceed aspect (red), respectively, before it struck the rear of Extra 8072 North. The caboose and six cars of Extra 8072 North and five locomotive units and one car of No. 586 were derailed. The conductor of Extra 8072 North was killed, and the engineer and head brakeman of No. 586 were slightly injured. Damage was estimated at $998,313.

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INVESTIGATION

The Accident

Extra 8072 North.--Louisville and Nashville Railroad Company (L&N) train Extra 8072 North 1/ originated at Radnor Yard, Nashville, Tennessee, on December 28, 1981. The train consisted of 3 diesel-electric locomotive units with 39 loaded cars and 82 empty cars, for a trailing tonnage of 6,032 tons. Following a satisfactory airbrake test, Extra

1/ Timetable direction between Nashville and Bruceton is north and south whereas the geographical direction is southwest-northeast. Timetable direction will be used in this report.

8072 North departed Nashville at 5:30 a.m. with the engineer and head brakeman on the locomotive and the conductor and rear brakeman on the caboose. The train made an uneventful trip to near Pursley, Tennessee, where at 8:49 a.m. the train dispatcher at Bruceton, Tennessee, radioed the engineer instructions to stop the train on the main track just south of New Johnsonville, Tennessee, at the Fish Camp Crossing, a railroad/highway grade crossing. The dispatcher also told the engineer to detach the locomotive from the train at that location and to go into New Johnsonville and pick up three freight cars. The dispatcher said that when the move was completed, he would instruct the engineer when to move the train from the Fish Camp Crossing into the siding at New Johnsonville to allow southbound L&N train No. 587 to pass on the single main track. If Extra 8072 North had proceeded into the siding immediately and had had to remain there for more than 10 minutes, the train would have had to have been separated to allow highway traffic to move over one or two highway grade crossings that would have been blocked. Therefore, the dispatcher, based on his knowledge of No. 587's movement, elected to hold Extra 8072 North on the main track and move it onto the siding for only a short time so that the train would not have to be separated.

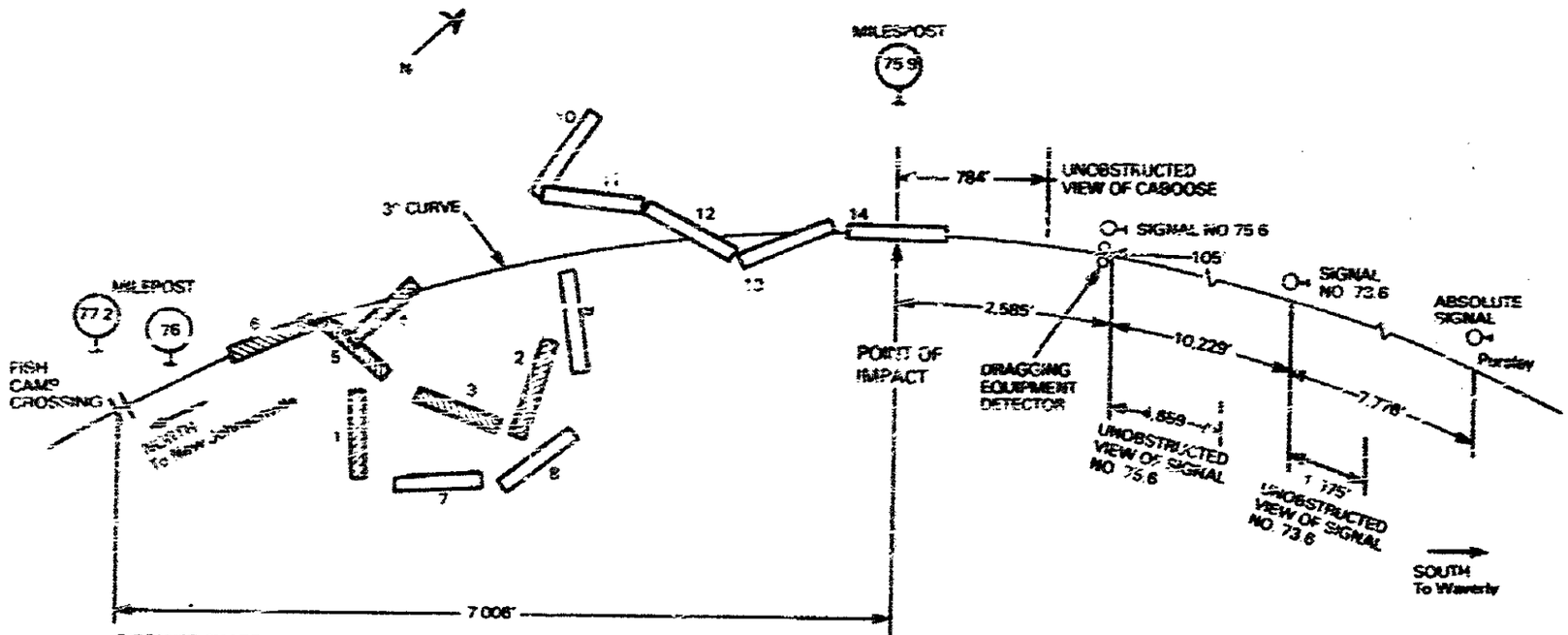
The engineer acknowledged and complied with the dispatcher's instructions. When the locomotive of Extra 8072 North was stopped at the Fish Camp Crossing, the caboose was standing 2,585 feet north of automatic block signal No. 75.6 (see figure 1), which should have displayed a restricted proceed (red) aspect because Extra 8072 North was stopped in the block. L&N operating rules, which are in conformance with Federal regulations, did not require the crew of Extra 8072 North to use flags, fusees, or rail torpedoes to mark and protect the rear of the standing train in automatic signal territory. The engineer reduced the brakepipe pressure to 20 psi to set the train's airbrakes so that the cars would not roll back down the hill on which they were stopped, and the locomotive was detached from the train. The locomotive proceeded into New Johnsonville to pick up the three freight cars. The head-end crew said that they did not hear any radio broadcasts from northbound L&N train No. 586 which they knew would be following them on the single main track.

When Extra 8072 North stopped at the crossing, the rear brakeman left the caboose carrying a portable radio and began inspecting the train as he walked toward the front; the conductor remained on the caboose. The rear brakeman said that he did not hear any radio conversations during his walk to the front of the train nor did he hear a locomotive whistle to the rear of the train. The rear brakeman said that the caboose radio had begun to fail in the receive mode earlier in the trip near McEwen, Tennessee, about 22 miles south of New Johnsonville, where he noticed that the reception became intermittent. He said that from McEwen northward he and the conductor used the portable radio which he carried with him on his walking inspection of the train at the Fish Camp Crossing.

About 9:35 a.m., while the cars of Extra 8072 North were standing in the block of automatic signal No. 75.6, they were struck from the rear by No. 586. (See figure 1.)

Train No. 586.--When L&N train No. 586 originated in Louisville, Kentucky, as train No. 277, it had 5 diesel-electric locomotive units, 62 loaded cars, and 52 empty cars. No. 277 departed Louisville at 2:30 a.m. on December 28, 1981, after an initial terminal airbrake test, 2/ which was acceptable to those concerned and to which no exceptions

2/ Federal regulations require that an initial terminal brake test be made by a fully charged train first having its brakepipe pressure reduced 20 psi and then being inspected to see that the brakes are fully applied and that brake cylinder piston travel does not exceed 10 inches. Following the 20 psi reduction, a leakage test is performed which must not exceed 5 psi in 1 minute. After inspection, the brakes are released and the train is inspected again to ascertain that all brakes have released.



DISTANCE CHART

NASHVILLE	
	2 54 MILES
SHOPS	
	30 53 MILES
CROW	
	23 00 MILES
MCEWEN	
	4 6 MILES
GORMAN	
	10 00 MILES
PURSLEY	
	7 74 MILES
NEW JOHNSONVILLE	
	15 89 MILES
DERAILMENT	

EXTRA 1072 NORTH	1	LN 110312	BOX
	2	LN 114025	BOX
	3	GACX 45119	COV HOP
	4	LN 102235	BOX
	5	GONX 310803	GONO
	6	RBOX 37598	BOX
	7	6293	CABOOSE
TRAIN NO. 586	8	5123	LOCO UNIT
	9	5125	LOCO UNIT
	10	2735	LOCO UNIT
	11	2740	LOCO UNIT
	12	2723	LOCO UNIT
	13	TTBX 800758	TOTE
	14	TTBX 964636	TOTE

Figure 1.--Plan view of accident site.

were noted. The train arrived in Nashville, a crew change point, about 7:05 a.m. where the crewmembers from Louisville terminated their trip and a new four-member crew assumed control of the train which was now designated No. 586.

The Nashville crewmembers for No. 586 reported for duty at 6:50 a.m. at the L&N's Kayne Avenue facility. The head brakeman of Extra 8072 North had talked with the conductor of No. 586 at Kayne Avenue and was told the time for which the new crew for No. 586 had been called. The crewmembers of No. 586 were transported by taxi to the Church Street Tower where the operator gave the conductor a train order which restricted the train's speed to 40 mph between Nashville and Bruceton, Tennessee. After receiving the train order, the crewmembers continued by taxi to the 8th Avenue Wye where they assumed control of the train, now identified as No. 586. The conductor said that he determined that all of his crewmembers were capable of performing their respective duties. During the trip from Kayne Avenue to the 8th Avenue Wye, the crewmembers discussed the fact that a train was ahead of them and that it had to perform work at New Johnsonville.

When the crewmembers arrived at the 8th Avenue Wye, the engineer and head brakeman made a visual check of the locomotive and then boarded it for departure. An airbrake test for No. 586 was not required at Nashville because the train had traveled less than 500 miles since the initial terminal test in Louisville. The train moved slowly from the crew change point while the conductor and rear brakeman inspected the train as it passed. When the caboose reached them, the two men boarded it and advised the engineer by the caboose radio that they were onboard and that he could leave Nashville. After that radio message was given, No. 586 began to accelerate as it departed the 8th Avenue Wye at 7:15 a.m. for Bruceton. The train consisted of the same 5 diesel-electric locomotive units with which No. 277 left Louisville, but it only had 59 loaded and 52 empty cars, for a trailing tonnage of 6,176 tons. Extra 8072 North and No. 586 departed Nashville from different yard locations, and No. 586 was only about 35 minutes behind Extra 8072 North on its northward trip.

The engineer said that as the train reached the summit of Shops Hill, just a few miles north of Nashville, it was necessary for him to apply some retardation to the train in order to maintain speed control so that the 40-mph maximum authorized speed would not be exceeded. He said that when he attempted to control the speed of the train by use of the dynamic brake, a control panel light illuminated indicating a wheel slip-slide condition, and the ammeter, indicating traction motor load current, was about 200 amperes. 3/ Because he understood from his training and instruction that when this happened the dynamic brake should not be used, the engineer said he released the dynamic brake and made a minimum service brakepipe reduction, which is about 6 psi, with the automatic brake valve to apply the train's airbrakes. He said this application of the airbrakes did not slow the train's speed to his satisfaction, so he increased the brakepipe reduction to about 10 psi, which slowed the train to suit him. Thereafter, and during the remainder of the trip, he used 10 psi as a minimum service brakepipe reduction. He did not use any sand during his attempted use of the dynamic brake nor did he attempt to use the dynamic brake again during the remainder of the trip.

As the train continued northward, the engineer said he commented occasionally to the head brakeman that he had to use more air to control the train's speed than he

3/ The ammeter indicates only electrical current on the lead locomotive unit and the wheel slip-slide light indicator only indicates a wheel slip-slide on the locomotive consist. It does not identify on which unit or units the wheel slip-slide is occurring.

felt was desirable. He said later that he did not think the train responded to braking demands as he thought a train of that weight and length should, but that the brakes did allow him to control the speed of the train.

The engineer said that as No. 586 approached the hot box detector near McEwen, he asked the head brakeman to "watch out" for him while he went to use the toilet facilities. There were no facilities on the lead locomotive unit, so the engineer had to leave the operating compartment and move back to the second unit. Specifically, the engineer said that he asked the head brakeman to sound the whistle for highway grade crossings and to announce the hot box detector to the crew on the caboose when the train passed it. The train was in a "static," steady pull situation and moving about 22 mph at that time, so the head brakeman should not have had to operate any of the operating controls. The L&N operating procedures require that an engineer stop his train if he has to leave the operating compartment and another qualified engineer is not present to take over the operating controls. The head brakeman was not a qualified engineer.

The engineer said that when he returned to the operating compartment, he resumed his position at the operating controls of the locomotive. The head brakeman had not been required to make any changes in the operating control settings during the engineer's absence from the operating compartment, but he had blown the whistle for several highway grade crossings and radioed the conductor when the locomotive passed the hot box detector. The head brakeman said that when he blew the whistle it was a little weak and he told the engineer that the whistle was not sounding a loud clear note each time it was blown.

Near Crow, Tennessee, the head brakeman of No. 586 informed the train dispatcher by radio that No. 586 contained cars destined to New Johnsonville and said that some shifting would be necessary before the cars could be set off because they were intermixed with cars destined for Bruceton. The dispatcher told the head brakeman to take the cars to Bruceton where they could be switched out and later returned to New Johnsonville. During the radio contact, the head brakeman told the dispatcher that No. 586 had a length equivalent to 130 cars. 4/

At 9:23:35 a.m., when the dispatcher estimated that No. 586 was somewhere between Waverly, Tennessee, and Pursley, in disregard of L&N operating rule No. 708 and Federal regulations (49 CFR 220.31(c)), he radioed a message to No. 586 without first establishing a contact with the train and having it acknowledge his call. The radio message was, "L&N dispatcher at Bruceton calling 586. Got an Extra North ahead of you stopped at the Fish Camp, 587 leave here in about 20 minutes, over." The engineer and head brakeman of No. 586 said that they did not hear this transmission. The conductor and rear brakeman of No. 586 said that they heard it, although the transmission was garbled, 5/ and that their understanding of the message was, "holdup at the Fish Camp." They did not acknowledge or question the radio message, and the dispatcher did not call the train a second time or repeat the message.

The engineer said that as No. 586 approached Waverly, he slowed the train to about 25 mph by use of the automatic brake valve to comply with the reduced speed requirement of a town ordinance. The engineer said that as the train left Waverly, he released the airbrakes to allow the brakepipe to recharge for downgrade braking requirements north of Pursley. From near Pursley, the grade is descending northward to

4/ The average length of a railroad car currently is calculated to be 55 feet. Thus, train No. 586 would have been about 7,150 feet long.
5/ Defect in transmission, reception, or encryption which renders the message or a portion thereof incorrect or undecryptable.

near milepost 74.5 where it changes to an ascending grade. The engineer said that at the south end of Pursley he made a 10 psi minimum service brakepipe reduction with the automatic airbrake valve to maintain the maximum authorized train speed of 40 mph, but that there was no air exhaust from the brakepipe. Therefore, he said that he increased the brakepipe reduction from 12 to 14 psi, and the speed of the train was controlled so that it did not exceed 40 mph.

The engineer and head brakeman said that when the train approached automatic signal No. 73.6 (see figure 1), the signal was displaying an approach (yellow) aspect, and that the train's speed was about 38 to 40 mph. L&N operating rule No. 285 requires that, upon approaching or passing an approach signal aspect, trains exceeding a speed of 30 mph must at once reduce to that speed, and the engineer should operate the train prepared to stop at the next signal. Rule No. 34 requires the crewmembers in the locomotive operating compartment to call automatic wayside signal aspects to each other, but they do not have to radio signal aspects to the crew on the caboose. Both crewmembers on the locomotive said that they called the signal aspects to each other. (See appendix C.)

The engineer said that in order to comply with the speed requirement of the approach signal aspect, he tried to reduce the speed of the train by further increasing the brakepipe reduction to 18 or 20 psi, but that again there was no brakepipe air exhaust, and that the train was not slowing to his satisfaction. The crew in the caboose could not confirm or deny if this or any other brakepipe reductions were made because neither man monitored the brakepipe air pressure gauge mounted in the caboose and the conductor did not check the speed of his train at any point. The engineer and head brakeman said that when the train approached automatic signal No. 75.6, the signal was displaying a restricted proceed (red) aspect, and the engineer estimated the train's speed to be about 20 to 25 mph. L&N rule No. 291 requires that, upon approaching or passing a restricted proceed signal aspect, trains exceeding a speed of 15 mph must at once reduce to that speed and the engineer should operate the train prepared to stop short of another train, obstruction, or switch not properly lined, looking out for broken rail. (See appendix C.) The engineer said that at that time, in an effort to slow the train, he made a full 26-psi service brakepipe reduction but that there still was no brakepipe air exhaust. He said that the speed of the train still was not reducing as he thought it should and, because he knew that he would be unable to comply with the speed requirement of the signal, he put the automatic brake control handle into the emergency position, shut the throttle off, and opened the sanders. He said that when he made the emergency brake application, he did not notice what he considered to be a proper air exhaust from the brakepipe, and that the speed of the train still was not reducing as he thought it should. The engineer said that even though he did not hear the expected brakepipe air exhausts when he made the brakepipe reductions, the air pressure indicating gauges indicated the proper value for each reduction he made. Also, the head brakeman said that he heard weak brakepipe air exhausts when the brake reductions were made.

As the train passed automatic signal No. 75.6, the engineer said that he asked the head brakeman to radio a message to the conductor that the train was passing the dragging equipment detector located just north of automatic signal No. 75.6, because he was too busy trying to reduce the train's speed to make the call. The head brakeman said that he did as the engineer asked, using the radio located by the engineer on the right side of the cab, and that someone, whom he believed to be the conductor, acknowledged the call. The conductor said that about that time he heard a garbled radio message which, because of the train's location, he assumed to be a notification from the engineer of the dragging equipment detector. The engineer said that during this time he was

"fanning" 6/ the independent locomotive brake in an effort to stop the train but that the train continued to move at a speed he estimated to be 20 to 25 mph. He said that as an operating practice he always released the independent locomotive brake when the automatic airbrakes were in an emergency application. He said that he was "fanning" the independent locomotive brake so the wheels would not slide and thus reduce the locomotive's stopping ability and also to prevent causing flat spots on the wheels. Further, he said that he did not leave the independent brake on steadily because he did not see any reason for an immediate stop at that time.

As the train continued into the block governed by automatic signal No. 75.6, the two men said that they each saw the caboose of Extra 8072 North about the same time from about 15 car lengths (825 feet). The engineer said that he estimated the speed of the train to be about 15 mph at that time. When the caboose was sighted, the engineer said that he told the head brakeman to jump and then he immediately left the operating position beside the control stand and exited the operating compartment through the door behind the control stand. He said that he ran rearward along the long nose of the locomotive, climbed down on the steps at the trailing end, and jumped. He said that he lost his balance when he hit the ground and he rolled for a short distance. He said that he lay on the ground for a short time and then got up and looked for the head brakeman. He said that he did not know where the head brakeman was at any time following his own exit from the operating compartment. A pair of sunglasses that were identified as belonging to the engineer were found after the accident about 85 feet from the point of impact.

The head brakeman said that when the engineer shouted the alarm for him to jump, he moved from a location midpoint in the operating compartment to the engineer's side of the operating compartment and blew a short blast on the whistle. He said that he did not operate the emergency airbrake valve located on the firemen's side of the operating compartment. He said he then followed the engineer out the door behind the control stand, down the walkway to the trailing end of the unit, crossed over to the west side, and jumped. He said that when he hit the ground he lost his balance and rolled for a short distance before he stopped. He said that when he regained his footing, he began calling the engineer and found him on the east side of the train.

When the locomotive of No. 586 struck the caboose of Extra 8072 North about 9:30 a.m., the caboose and the first, second, third, and fifth rear cars of Extra 8072 North went down a 45-foot embankment on the west side of the track. The fourth and sixth rear cars derailed but remained upright on the track structure. The caboose caught fire after the impact and burned. The conductor of Extra 8072 North, who was either on or near the caboose at the time of the collision, was killed.

The first locomotive unit of No. 586 overturned to the west side of the track and came to rest on its side at the foot of the embankment. The anglecock and an electrical jumper cable box on the front of the unit were broken when the collision occurred. The second unit derailed to the west side and stopped almost perpendicular to the main track with the trailing end near the track structure. The third unit came to rest on its right side on the east side of the track structure near the foot of the embankment. The fourth unit derailed to the east of the track but remained on the track structure at an angle of about 30 degrees to the track. The fifth unit derailed to the east and came to rest upright and across the track. The first car in the train derailed to the west of the track and remained upright on the track structure. (See figure 2.)

6/ Fanning is the use of the brake control lever by first applying and then releasing it in a forward and backward motion. It is a term normally used in conjunction with the automatic trainbrake.

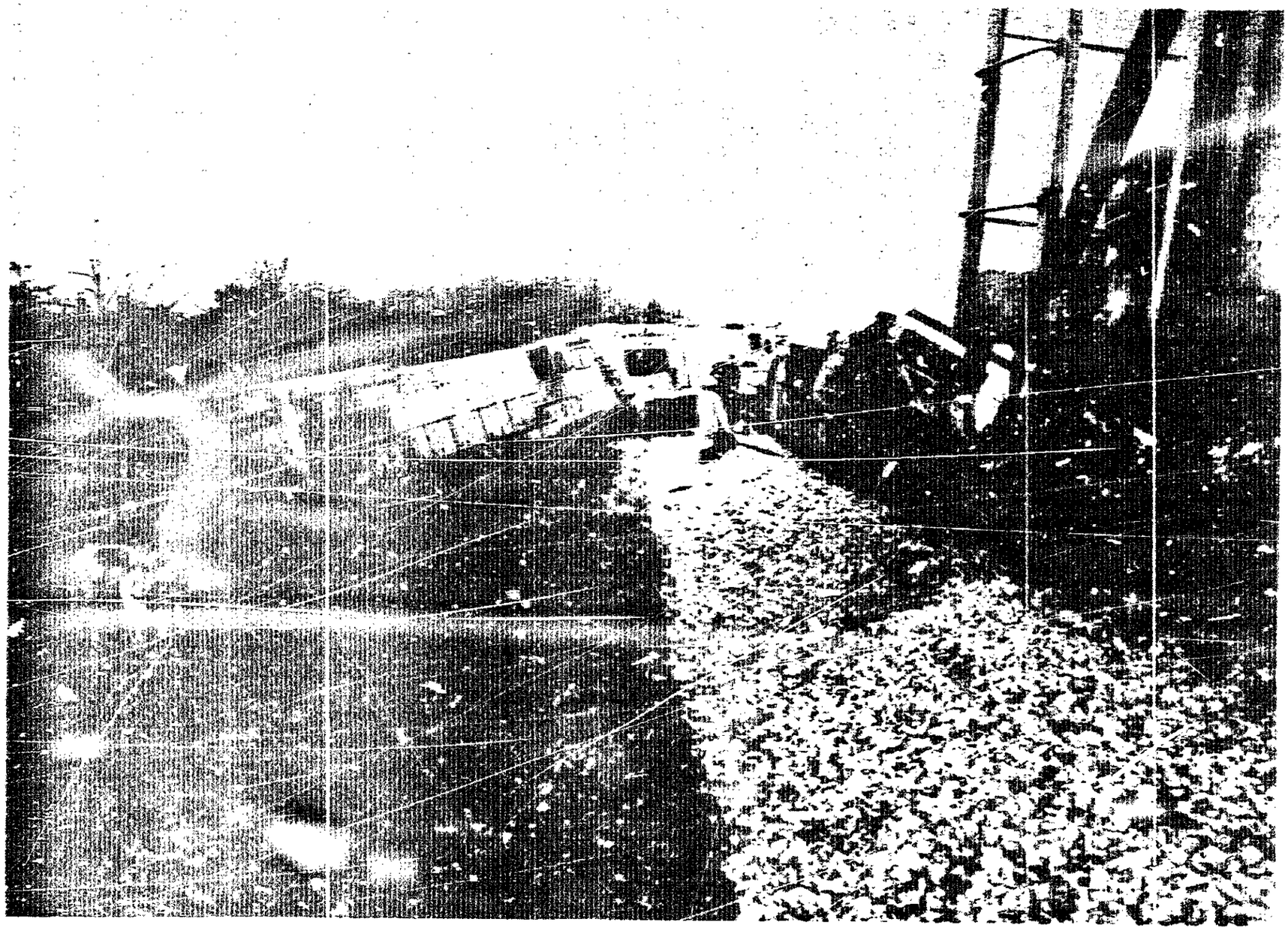


Figure 2.--Derailed locomotive units and cars in train No. 586.

After the accident the head brakeman of No. 586 entered the operating compartment of the overturned lead locomotive unit of No. 586 at the foot of the embankment. He said that the only thing that he did was to recover his personal belongings and those of the engineer, and to get the portable radio issued to him so he could contact his conductor. He said that he did not move any of the operating controls or change any relays or circuit breakers.

During a postaccident company hearing, the head brakeman confirmed the engineer's testimony that the emergency brake application was made when the locomotive was approaching automatic signal No. 75.6, but he told Safety Board investigators in a sworn deposition that the emergency brake application was made by the engineer only after the standing caboose of Extra 8072 North was sighted.

Injuries to Persons

Injuries	L&N employees	Total
Fatal	1	1
Serious	0	0
Minor	2	2
None	5	5
Total	8	8

Damage

One car of Extra 8072 North was destroyed, the caboose and two cars were moderately damaged, and three cars were slightly damaged. The caboose was destroyed by fire after the collision.

The lead locomotive unit of No. 586 was destroyed, the second and third units were substantially damaged, and the fourth and fifth units were moderately damaged. The first car was slightly damaged. About 200 feet of track was destroyed.

Damage was estimated to be:

Freight Cars	$126,200
Locomotive Units	842,000
Wrecking Expenses	23,049
Track	7,064
Total	$998,313

Crewmember Information

The crewmembers of Extra 8072 North and No. 586 were qualified according to L&N requirements.

The engineer of No. 586 had attended the L&N's engineer training school for 8 weeks in 1978. He said that the training was composed of classroom instruction in locomotive components, the electrical and mechanical aspects of the locomotive, train handling procedures, operating rules and practices, and the airbrake systems and their use. The engineer said that the training course was more heavily oriented toward on-the-job training than formal instruction. The L&N has two mobile train simulators installed in vans which are currently used in training student engineers and to provide periodic refresher training for all engineers. An outline of the L&N's current engineer training

program which was provided to the Safety Board during the accident investigation is given in appendix D.

Part of the training is on-the-job training during which the student is assigned to an engineer selected by management to instruct the trainee in train handling techniques and operation. The engineer of No. 586 said that road foremen of engines had ridden with him while he was a student and just before he was cleared to operate on his own as a locomotive engineer, but none had ridden with him since he began operating on his own. A road foreman of engines, under whose supervision the engineer came when he operated a train between Nashville and Bruceton, told Safety Board investigators that although he tried to ride often with each employee under his supervision, most of his time necessarily was devoted to riding with engineers who were having problems. The engineer of No. 586 was not reported to be having problems and was assumed by L&N officers to be a good employee and a proficient engineer.

The head brakeman of No. 586 was not qualified as an engineer and had not received any formal instruction in the operation of the train airbrake system in the locomotive operating compartment. He qualified for his position of switchman and trainman through on-the-job training. He told Safety Board investigators that he had operated a locomotive before and that he had a fair knowledge of how to operate the train brakes. Investigators were also told that he often insisted on being allowed to operate the locomotive. The head brakeman said that he had an ambition to become a locomotive engineer and had applied twice for engineer training, but had not been accepted. He said he was not given a reason for his not being accepted for the training.

Since the time the train crewmembers of No. 586 had been hired, the L&N has implemented a formal instructional and training course for newly hired trainmen. However, the only instruction given on the operation of train airbrake systems is the proper techniques for applying the airbrakes from the caboose.

For additional information on the traincrew personnel, see appendix B.

Track Information

The L&N has only a single track between Nashville and Bruceton. The track on which the accident occurred was maintained to meet or exceed class 4 standards in accordance with the Federal Railroad Administration (FRA) track standards. It was built of 132-pound continuous welded rail (CWR) set on standard double-shoulder, 7 3/4-inch by 14-inch tie plates laid on wooden crossties and ballasted with crushed stone ballast. The ballast depth was about 25 inches through the curve at the accident site. The track structure at the point of the derailment was built on a fill which runs in depth from about 15 feet at the south end to about 50 feet at the north end. The grade through the area of the accident is 0.6 percent ascending northward from 1.4 miles south of the point of impact. The accident occurred in a 3° curve to the left which begins about 1,900 feet south of the point of collision and extends on through and north of the area of the accident. (See figure 1.) Some vegetation, mostly trees, restricted vision at some points. The Safety Board investigators took no exception to the track condition through the area where the accident occurred.

Train Information

The locomotive of Extra 8072 North consisted of diesel-electric units 8072, 8073, and 8019, models EMD SD-40-2. They were built by the Electro-Motive Division of General Motors Corporation. Unit 8072 was equipped with a type 26-L airbrake system, a

two-channel radio by which a selection could be made between the road channel (dispatcher) and the end-to-end (locomotive to caboose) channel. Communications from the dispatcher or rear-end crewmembers could be received by locomotive crewmembers regardless of the position of the locomotive radio channel selector switch. Unit 8072 was not equipped with a speed recorder, an alertor, or a deadman control safety device.

The caboose of Extra 8072 North was equipped with the regulation FRA marker light. According to L&N operating rules, the marker light is to be turned on 2 hours before sunset and left on until 2 hours after sunrise. The marker light was operating when Extra 8072 North left Nashville, but it is not known if it was illuminated at 9:30 a.m., the time of the collision. The caboose was equipped with a permanently mounted radio, by which either the locomotive or the train dispatcher could be contacted, depending on the radio channel selected. However, it was destroyed in the ensuing fire and its operational status could not be determined. Each crewmember on the caboose had a portable radio assigned to him.

The locomotive of No. 586 consisted of diesel-electric units 5123, 5125, 2723, 2740, and 2735. The first two units were General Electric Company (GE) model B-23-7, and the following three units were GE model U-23-B. The lead unit was equipped with a type 26-L airbrake system, a two-channel radio, and a speedometer which was reported on the locomotive defect form by the Louisville to Nashville engineer as being 10 mph slow at times. The unit was not equipped with a speed recorder, an alertor, or a deadman control safety device. The total locomotive consist weighed 1,298,000 pounds. The caboose was equipped with an approved FRA marker light and a permanently mounted radio. The individual crewmembers on the locomotive and the caboose of No. 586 were issued portable radios; the radio channel arrangements were the same as those on Extra 8072 North.

The engineer who had operated No. 586 earlier as No. 277 from Louisville to Nashville said that en route he had not experienced any trouble with the train's automatic airbrakes or the locomotive's dynamic brake, and that he had operated both systems several times during the trip. He said that he had stopped the train at Bowling Green, Kentucky, to set off three freight cars and the brakes had operated satisfactorily at that point.

L&N operating rule 705 requires that the locomotive and caboose radios be given voice tests when a crew assumes control of a train. Both radios were tested satisfactorily as No. 586 left Nashville when the crewmembers communicated with each other and with yard-based personnel.

The locomotive of No. 586 was equipped with an automatic sander which should have automatically applied sand during a wheel slip or slide. This feature can be cut on or off manually; it is not known if the automatic feature was on or off at the time the slip/slide indication occurred.

The locomotive, in common with most diesel-electric locomotives used in the United States, had two dual-purpose air pressure indication gauges on the control stand. The gauges indicate the brakepipe pressure (psi), the locomotive brake cylinder pressure (psi), and the equalizing and the main reservoir pressures (psi). The L&N operates its freight locomotives with about 90 psi brakepipe and equalizing reservoir pressure, and a main reservoir pressure of from about 130 to 140 psi.

Application of the train airbrakes is initiated by use of the equalizing reservoir. When the engineer makes a 10-psi brakepipe reduction, 10 psi of air is released from the equalizing reservoir. After the 10-psi pressure reduction is made in the equalizing reservoir, which is almost instantaneous, the control valves act so as to release air from the brakepipe until the pressure in the brakepipe is equal to the pressure in the equalizing reservoir. This released brakepipe air is vented to the atmosphere through the brakepipe air exhaust pipe, and it is an indication to the engineer that the airbrakes have applied. When these two pressures equalize, the brakes are set with a pressure in the brake cylinder equal to 2.5 times the brakepipe pressure reduction. The product of these two values multiplied by the surface area of the brake cylinder piston head is equal to the pressure applied to the wheels via the brakeshoes.

Method of Operation

Trains are operated on the single track line in either direction in the area of the accident by the signal aspects of a Centralized Traffic Control System (CTC). The train dispatcher at Bruceton operates and controls the CTC system between Nashville and Bruceton. Train orders and a two-way radio system are used to facilitate train operations. It is not unusual for a northbound train to pick up or set off cars at New Johnsonville. There is a 165 car siding adjacent to and on the east side of the main track at New Johnsonville. Northbound trains are frequently held at the Fish Camp Crossing, a railroad/highway grade crossing located about milepost 77.2, while work is being done at New Johnsonville so that other crossings in the area will not be blocked and to eliminate the need for the traincrew to separate the train to allow highway traffic to pass. The locomotive engineer of a northbound train who plans to stop at the Fish Camp Crossing often will allow his train to roll freely downgrade from near Pursley, and then as the upgrade to New Johnsonville is begun, the engineer will place the locomotive in light dynamic braking and the train will roll to a stop near the Fish Camp Crossing.

L&N operating rules require a trainman to walk his train to inspect it, if time permits, when a stop is made such as the one at the Fish Camp Crossing. The engineer is required to announce to the conductor in the caboose the approach of the train to a hot box or dragging equipment detector location. The head-end crew is not required to call the wayside signal aspects to the rear, but they must call them to each other. Excerpts from the L&N operating rules are shown in appendix C.

A Tennessee State statute, Title 65, Section 1208, requires:

> (4) Every railroad company shall keep the engineer, fireman or some other person upon the locomotive, always upon the lookout ahead; and when any person, animal, or other obstruction appears upon the road, the alarm whistle shall be sounded, the brakes put down, and every possible means employed to stop the train and prevent an accident.

L&N supervisory personnel said that they are aware that head brakemen fill in for the engineer when the latter leaves the operating compartment to check on equipment or to use toilet facilities, but the expectation is that this will occur only when the brakeman will not be required to alter the controls.

Meteorological Information

Weather conditions were reported by the State of Tennessee Department of Conservation at New Johnsonville. For 9 a.m and 10 a.m., c.s.t., on December 28, 1981, the temperature was 50° F, and it was clear and sunny. The visibility was good. On December 28, 1981, sunrise and sunset were 6:57 a.m. and 4:40 p.m., respectively.

Medical and Pathological Information

The conductor of Extra 8072 North received fatal injuries as a result of the collision. The engineer and head brakeman of No. 586 each received a neck injury and multiple contusions and abrasions of the upper body and head. A toxicological test for alcohol only was performed on the engineer and head brakeman at the hospital in Waverly, and the test results for alcohol were negative.

Survival Aspects

The locomotive operating compartment of the lead unit of No. 586 was not crushed or deformed and could have provided a survivable environment during the impact sequence. The caboose of Extra 8072 North was not crushed, but the fire following the impact destroyed it; it could have provided a survivable environment as to deformation of the caboose for a person who may have been inside. It is not known whether the conductor of Extra 8072 North was inside the caboose or attempting to get out. He was not seen by the head-end crew of No. 586 as their train approached the caboose. His body was found outside the caboose at the bottom of the embankment.

The Humphrey County (Tennessee) Ambulance Service was notified of the accident about 10:14 a.m. by an unidentified man who called by telephone and said that he was an L&N employee. The ambulance service immediately notified the Humphrey County Sheriff's Office and then dispatched an ambulance to the scene where it arrived at 10:23 a.m. In the meantime, Extra 8072 North moved north with that part of its train that was intact, to allow an L&N hi-rail vehicle at New Johnsonville to proceed to the accident site. The injured were taken by the hi-rail vehicle to where they could be transferred to the ambulance. The ambulance left the scene at 10:51 a.m. and transported the engineer and head brakeman to the Nautilus Memorial Hospital at nearby Waverly where the ambulance arrived at 11:01 a.m. A second ambulance was dispatched to the scene at 11:10 a.m. to bring the fatally injured conductor of Extra 8072 North to the hospital where it arrived at 11:50 a.m.

Tests and Research

The engineer estimated the train speed to be about 12 to 15 mph when he jumped. Because of the derailment pattern of the locomotive units and the rear cars of Extra 8072 North and the numbers of pieces of equipment derailed, Safety Board investigators believe the speed of No. 586 at the time of the collision was, conservatively, at least 25 mph.

The conductor and flagman on No. 586 estimated that their caboose was about 15 to 20 car lengths south of the Denver Road crossing, located at milepost 74.7, when the train's airbrakes were applied in an emergency application. When the train stopped, the caboose was standing about five car lengths south of the crossing. A train with 130 cars, would be about 7,150 feet long; thus with the front of the locomotive at the point of impact, the train would extend from the point of impact to a point 837 feet south of the Denver Road crossing. Similarly, if the end of the train was 20 car lengths, i.e., 1,100 feet, south of the Denver Road crossing, the locomotive would be 263 feet south of the point of impact. Further, if the end of the train was 15 car lengths, i.e., 825 feet, south of the same road crossing, the locomotive would be 12 feet north of the point of impact, i.e., beyond the point of impact.

The point of impact was determined by superimposing locomotive and car length measurements on the track structure and measuring from standing cars in the train of Extra 8072 North to the end of the train. Also, using the same technique, L&N officers determined that train No. 586 traveled 434 feet after the impact.

The positions of the operating controls of locomotive unit No. 5123 or train No. 586 were examined by an L&N official, before Safety Board investigators arrived, who documented the positions as:

Throttle:	Idle
Reverser:	Forward
Automatic Brake Handle:	Handle off position 7/ (also see figure 3)
Fireman's Emergency Brake Valve:	Closed position
Locomotive Independent Brake Hand.	Release position
MU 2-A Valve: 8/	Cut-in
Dynamic Brake Control:	Fully applied. The cut-out switches for dynamic brakes on all units were in the "on" position except for unit 2740 which had its cut-out switch in the off position.
Radio Channel Selector Switch	Channel 2

The excitation breaker on the lead locomotive unit was in a tripped position after the accident. The function of the 15-ampere breaker is to protect the exciter field windings and the armature of the main alternator from high current. The exciter supplies current to the main alternator field windings which indirectly determines the amount of current supplied by the main alternator to the traction motors for propulsion power, depending upon the load requirement. The main alternator also supplies excitation voltage to the traction motors when they are used in dynamic braking.

After the accident, a locomotive was attached to the rear of No. 586's cars to move the cars from the accident site. The train was intact except for the head car and the original locomotive consist. An initial terminal brake test was made on the train before it was moved by L&N mechanical personnel accompanied by FRA representatives. During the inspection of the train at that time, eight cars were found to have excessive piston travel. The brakes on one car were cut out, and one car had a stuck bleeder rod which caused its brakes to be inoperative. However, despite the exceptions noted during the test results, the train was moved without incident about 15 miles south to Gorman, Tennessee.

7/ Handle Off Position - This position is located by . .irst quadrant notch to the right of suppression position. The brake handle may be removed in this position. This is the position in which the handle is to be placed (and removed) on trailing units of a multiple-unit locomotive or on locomotives being towed dead-in train. As in the case of the service position, a continuous service brake pipe reduction is obtained in this position. (Definition from "Track Train Dynamics," Association of American Railroads, Second Edition, page 1-8).

8/ A valve which, by its open or closed position, conditions the airbrakes of a locomotive unit for operating as a single unit or in multiple operations as a lead, trailing, or an inoperative unit.

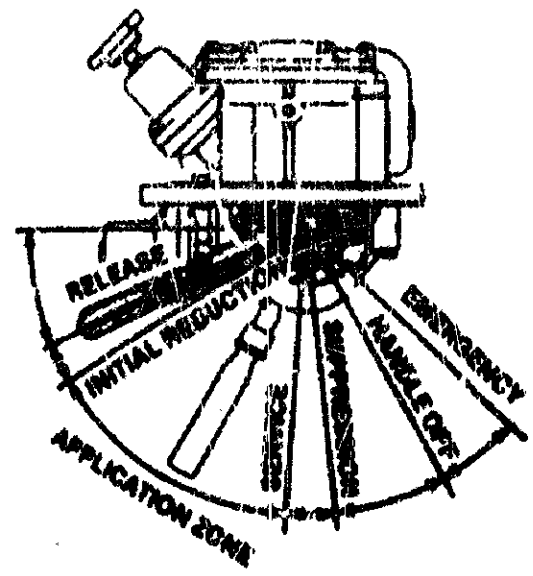


Figure 3.--Automatic brake valve handle positions on No. 26-L brake equipment.

Another airbrake test and inspection was made on the cars of train No. 586 on December 29 at Gorman. That test disclosed that nine cars had piston travel ranging from 10 to 12 inches, one car had its airbrakes cut out, and one car had inoperative brakes because of an open bleeder valve (manual release valve), and confirmed the results of the on-site inspection. Title 49 CFR 232.12, Initial Terminal Road Train Airbrake Tests, prohibits freight cars from being allowed to leave an initial terminal with more than 10-inch piston travel or car brakes cut out.

Forty-six cars were equipped with type AB brake valves, 49 cars were equipped with type ABD brake valves, and 15 cars were equipped with type ABDW brake valves. Forty-two of the cars had cast-iron brakeshoes, and 68 cars had composition brake shoes.

On December 29, No. 586's train of December 28, less the head car, was moved from Gorman to New Johnsonville with a similar consist of locomotive units to those used on December 28. The Lead road foremen of engines who operated the train for most of that distance had talked with the engineer of No. 586 while he was in the hospital and determined the engineer's recollection of the manner in which the brakes and throttle had been used in approaching New Johnsonville on the day of the accident. The road foreman operated the train from Gorman to near the point of the collision seeking to match the control settings and the sequence that was described to him by the engineer of No. 586. In some instances the road foreman said that he made slightly more of a brakepipe reduction than had been described to him by the engineer of No. 586, but he said that in no instance did he lose control of the train and that the brakes responded as he would have expected. As the train approached automatic signals Nos. 73.6 and 75.6, the road foreman responded as if the signals displayed the same signal aspects that had confronted the engineer of No. 586 on December 28. The road foreman said that even with his being

extravagant with the train's airbrake reserve air, he was able to stop the train well short of the point of impact. In fact, he said that he had to maintain power on the locomotive to prevent the train from stalling. He said that he took no exception to the manner in which the train responded to his operating techniques or in the manner in which the airbrakes responded.

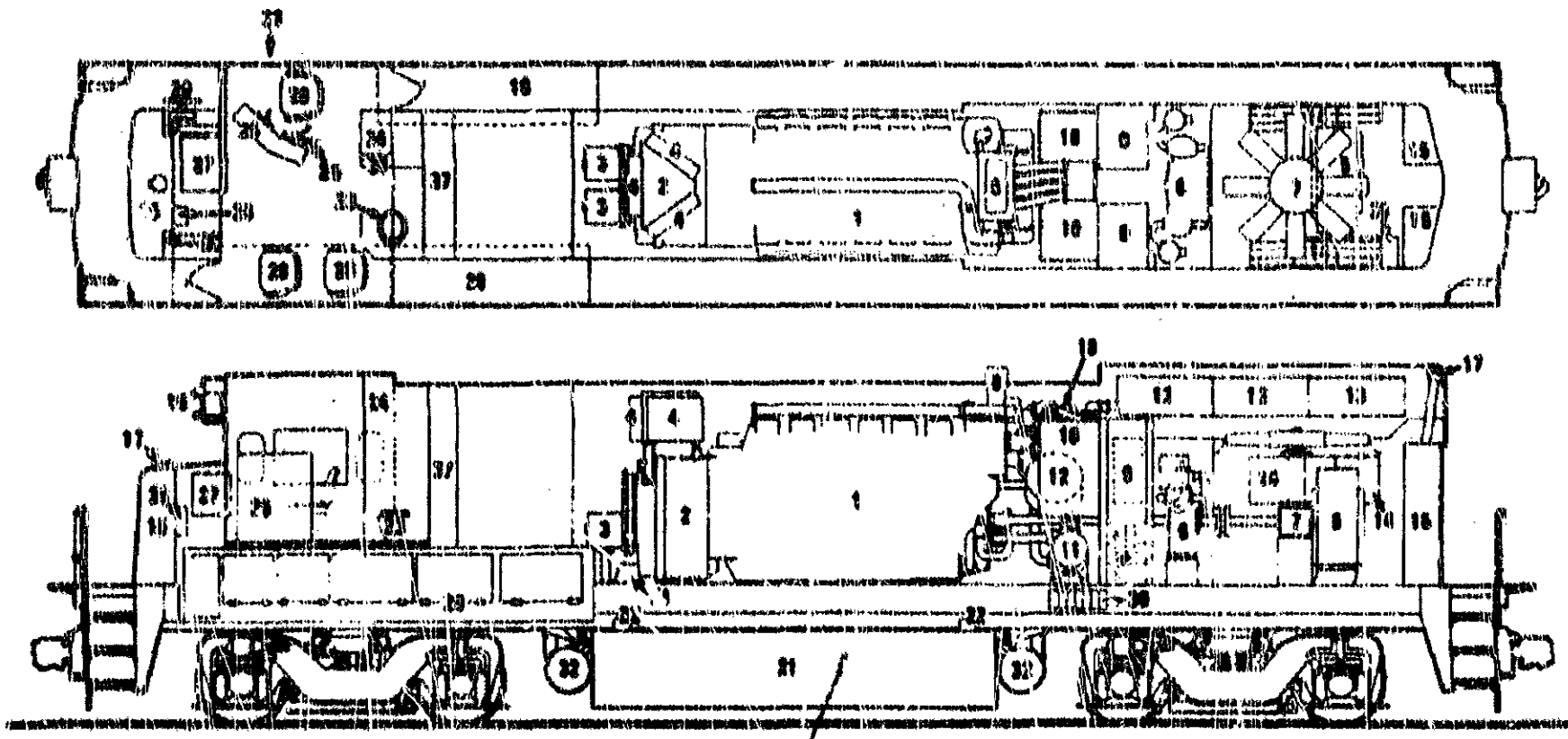
The locomotive units that were attached to No. 586 on December 28 were tested partially at the site on January 6, 1982, and again in New Johnsonville on January 7. Some minor accident-related damage to the airbrake system on some of the locomotive units had to be repaired before they could be tested. When the airbrakes were tested, using air supplied from another locomotive, no exceptions were taken to the test results. It was found that when an emergency brake application was made on the locomotive consist of No. 586, an 11-pound leakage developed in 2 minutes and a 17.5-pound leakage developed in 3 minutes. However, the L&N personnel making the tests and the FRA representatives present during the tests on both days agreed that, because some of the pipes and hoses in the brake system were damaged or broken during the accident, the equipment was not in the best of mechanical condition. Therefore, considering the conditions under which the tests were made, the leaks were not considered unusual, and the tests were evaluated as indicating that, apart from the accident damage, the brakes were adequate at the time of the accident to stop the train in a normal fashion. No defects were noted in the locomotive's running gear, truck side frame clearances, or wheels.

A postaccident inspection disclosed no damage to the relay that controlled the automatic sander on the locomotive of No. 586. All sand hoppers on the locomotive units of No. 586 had some sand remaining in them. The first sand found on the rails was at the point of impact.

Safety Board investigators inspected a locomotive operating compartment similar in design to that of the lead unit of No. 586. The engineer's seat is a floor-mounted swivel chair with no arm rests, which is adjustable fore and aft. The seat that the Safety Board investigators inspected was hard to turn, and they were told that the resistance to turning was typical of most seats at the control stand. The chair is close to the control stand with little side clearance between the chair and the control stand. The door behind the control stand is narrow and low. The walkway along the long hood of the locomotive unit is narrow and passage is severely restricted in the vicinity of the engine air intake because the hood is wide at that point to accommodate the air intake shutters and filters. The forward windows of the locomotive operating compartment are low, relative to the ceiling, and a man 5 feet tall or taller standing upright would have his line of sight restricted beyond about 100 feet ahead of the locomotive. (See figure 4.)

Postaccident sight distance measurement in the approach to the point of impact indicated an unobstructed view of the standing caboose from 784 feet. Other pertinent distances measured were: 2,585 feet from automatic signal No. 75.6 (restricted proceed signal aspect) to the point where the caboose was struck; 10,176 feet between automatic signals Nos. 75.6 and 73.6 (approach aspect); and 7,776 feet from the last controlled signal at Pursley to automatic signal No. 73.6.

Wayside automatic signal tests made following the accident indicated that the signal system functioned according to its design and no exceptions were taken.



LOCATION OF APPARATUS

1. Engine
2. Alternator
3. Auxiliary Generator
4. Rectifiers
5. Equipment Blower
6. Air Compressor
7. Gear Unit & Radiator Fan
8. Engine Exhaust Stack
9. Engine Air Filters
10. Engine Water Tank
11. Lube Oil Cooler
12. Lube Oil Filter
13. Radiator
14. Braking Resistors
15. Hand Box
16. Number & Light Box
17. Sand Filler
18. Fluid Amplifier
19. Batteries
20. Control Compartment (Lower)
21. Fuel Tank
22. Fuel Filler
23. Toilet (Optional)
24. Engine Control Panel
25. Control Console
26. Air Brake Valve
27. Cab Heater
28. Sliding Seats
29. Hand Brake
30. Equipment Air Filters
31. Air Duct
32. Air Reservoir
33. Air Brake Equipment
34. Battery Switch
35. Ext. Range Brk. Equip. (Optional)
36. Head Lite Resistors
37. Control Compartment (Upper)

MODEL B23-7 - GENERAL CHARACTERISTICS

DIESEL ENGINE
- Type ..... One GE FDL-12
- Horsepower ..... 2250 hp
- Number of Cylinders 12
- Bore and Stroke ..... 9 in x 10½ in
- R.P.M. 1050
- Compression Ratio 12.7:1
- Cycle 4
- Turbocharged ..... Yes
- Engine Cooling Fans 1
- Engine Cooling Fan Drive ..... Engine

OPERATING CAB & CONTROLS ..... Yes

WHEEL ARRANGEMENT ..... B-B

TRACTION EQUIPMENT
- Main Generator GTA-11
- Traction Motor ..... 4 - GE752
- Traction Motor Blowers 1
- Blower Drive ..... Engine
- Wheelslip Correction ..... Automatic Loading and Automatic Unloading of Main Alternator

AIR BRAKE SCHEDULE 26L

MAJOR DIMENSIONS
- Length inside knuckles ..... 62 ft 2 in
- Height ..... 14 ft 9¼ in
- Width ..... 10 ft 3¼ in
- Radius Curves ..... 87 ft 2 in
- Truck Wheel Base ..... 9 ft 0 in
- Minimum Track Curvature Fwd. & Dep.
  - For Single Unit ..... 150 ft or 39°
  - For MU or Coupled to Train ..... 250 ft or 23°

DRIVING WHEEL DIAMETER ..... 40 in

WEIGHT
- On Drivers - Minimum & Maximum ..... 253,000 lbs/280,000 lbs
- Total Minimum and Maximum ..... 253,000 lbs/280,000 lbs

TRACTIVE EFFORT
- Starting at 25% adhesion for Minimum & Maximum Weight ..... 63,250 lbs/70,670 lbs
- Continuous Tractive Effort & Speed
  - For Smallest Pinion ..... 61,000 lbs/10.7 mph
  - For Largest Pinion ..... 43,400 lbs/15.2 mph

GEAR RATIO AND MAXIMUM SPEED
- Smallest Pinion ..... 83/20 - 70 mph
- Intermediate Pinion ..... 80/23 - 79 mph
- Largest Pinion ..... 77/26 - 93 mph

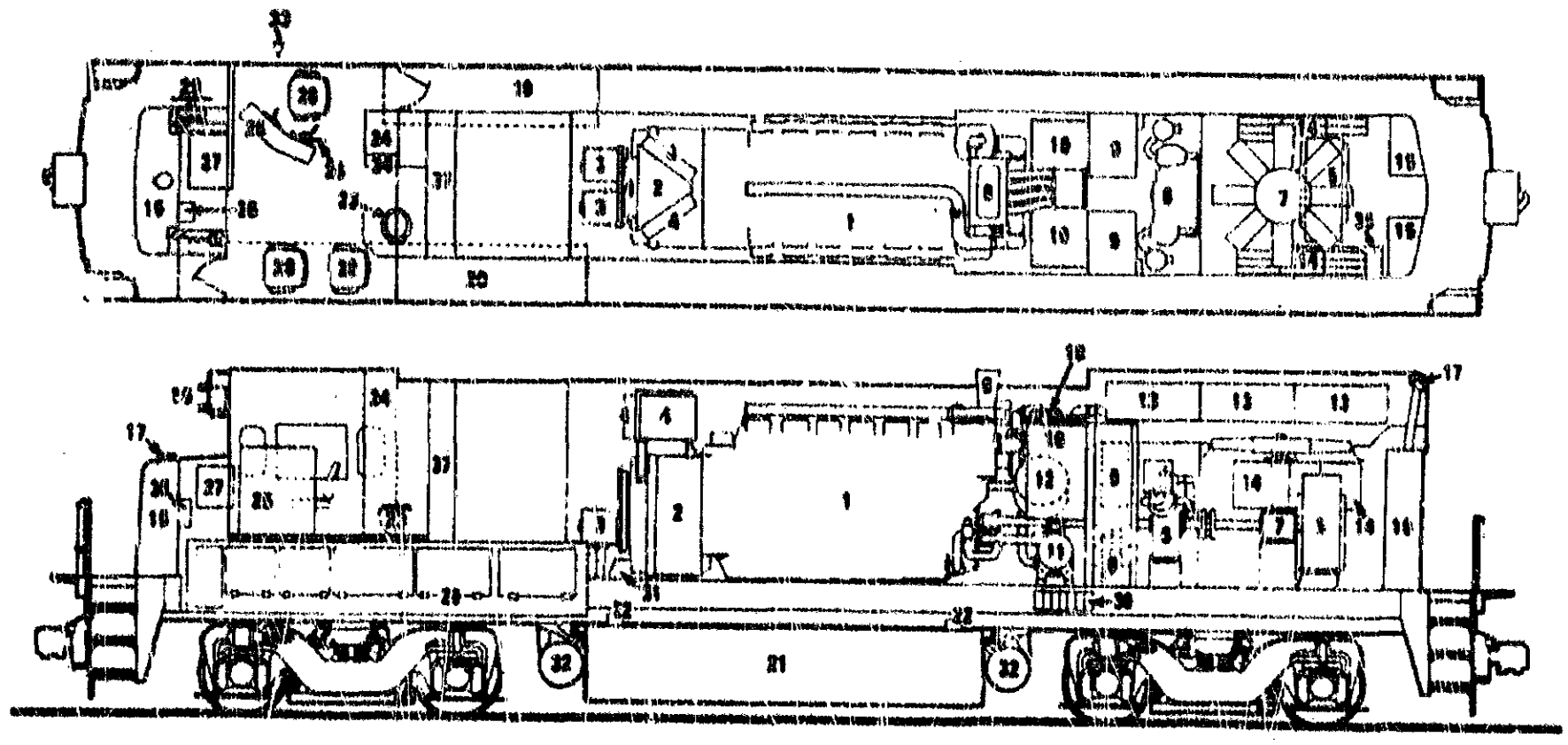
SUPPLIES
- Fuel - For Minimum & Maximum Tank ..... 2150 gal/3250 gal
- Coolant ..... 350 gal
- Lube Oil ..... 900 gal
- Sand ..... 60 cu ft

COMPRESSOR, AIR CFM
- Maximum Delivery 196
- Delivery Loding 127
- Type of Cooling ..... Water

DRAFT GEAR ..... NC-391 with Align. Control

AIR FILTERING DEVICES
- Primary ..... Vortex Self Clean
- Secondary Engine Air Intake ..... GE Paper
- Engine Room Pressurized ..... Yes
- Main Generator Pressurized ..... Yes

Figure 4.--Floor plan and characteristics of B23-7 locomotive unit.



LOCATION OF APPARATUS

1. Engine
2. Alternator
3. Auxiliary Generator
4. Rectifiers
5. Equipment Blower
6. Air Compressor
7. Gear Unit & Radiator Fan
8. Engine Exhaust Stack
9. Engine Air Filters
10. Engine Water Tank
11. Lube Oil Cooler
12. Lube Oil Filter
13. Radiator
14. Braking Resistors
15. Sand Box
16. Number & Light Box
17. Sand Filler
18. Fluid Amplifier
19. Batteries
20. Control Compartment (Lower)
21. Fuel Tank
22. Fuel Filler
23. Toilet (Optional)
24. Engine Control Panel
25. Control Console
26. Air Brake Valve
27. Cab Heater
28. Sliding Seats
29. Hand Brake
30. Equipment Air Filters
31. Air Duct
32. Air Reservoir
33. Air Brake Equipment
34. Battery Switch
35. Ext. Range Brk. Equip. (Optional)
36. Head Lite Resistors
37. Control Compartment (Upper)

MODEL B23-7 - GENERAL CHARACTERISTICS

DIESEL ENGINE
- Type ..... One GE FDL-12
- Horsepower ..... 2250 hp
- Number of Cylinders 12
- Bore and Stroke ..... 9 in x 10½ in
- R.P.M. 1050
- Compression Ratio 12.1:1
- Cycle 4
- Turbocharged ..... Yes
- Engine Cooling Fans 1
- Engine Cooling Fan Drive ..... Engine

OPERATING CAB & CONTROLS ..... Yes

WHEEL ARRANGEMENT ..... B-B

TRACTION EQUIPMENT
- Main Generator GTA-11
- Traction Motor ..... 4 - GE752
- Traction Motor Blowers 1
- Blower Drive ..... Engine
- Wheelslip Correction ..... Automatic Sanding and Automatic Unloading of Main Alternator

AIR BRAKE SCHEDULE 26L

MAJOR DIMENSIONS
- Length inside knuckles ..... 62 ft 2 in
- Height ..... 14 ft 9¼ in
- Width ..... 10 ft 3¼ in
- Bolster Centers ..... 37 ft 2 in
- Truck Wheel Base ..... 9 ft 0 in
- Minimum Track Curvature Rad. & Deg.
  - For Single Unit ..... 150 ft or 38°
  - For MU or Coupled to Twin ..... 250 ft or 23°

DRIVING WHEEL DIAMETER ..... 40 in

WEIGHT
- On Drivers - Minimum & Maximum ..... 253,000 lbs/280,000 lbs
- Total Minimum and Maximum ..... 253,000 lbs/280,000 lbs

TRACTIVE EFFORT
- Starting at 25% adhesion for Minimum & Maximum Weight ..... 63,250 lbs/70,000 lbs
- Continuous Tractive Effort & Speed
  - For Smallest Pinion ..... 61,000 lbs/10.7 mph
  - For Largest Pinion ..... 43,480 lbs/15.0 mph

GEAR RATIO AND MAXIMUM SPEED
- Smallest Pinion ..... 63/20 - 70 mph
- Intermediate Pinion ..... 80/23 - 79 mph
- Largest Pinion ..... 77/26 - 93 mph

SUPPLIES
- Fuel - For Minimum & Maximum Tank ..... 2150 gal/3250 gal
- Coolant ..... 350 gal
- Lube Oil ..... 300 gal
- Sand ..... 60 cu ft

COMPRESSOR, AIR CFM
- Maximum Delivery 296
- Delivery Idling 127
- Type of Cooling ..... Water

DRAFT GEAR ..... NC-391 with Align. Control

AIR FILTERING DEVICES
- Primary ..... Vortex Self Clean
- Secondary Engine Air Intake ..... GE Paper
- Engine Room Pressurized ..... Yes
- Main Generator Pressurized ..... Yes

Figure 4.--Floor plan and characteristics of B23-7 locomotive unit.

ANALYSIS

The Accident

The engineer of Extra 8072 North was in compliance with the train dispatcher's instructions when he stopped the train at the Fish Camp Crossing. The head-end crew followed the dispatcher's instructions concerning the work that was to be done at New Johnsonville, i.e., picking up the freight cars, and were awaiting instructions from the dispatcher to move north into New Johnsonville before recoupling the cars and locomotive to the train when the collision occurred. No exceptions can be taken to their response to the dispatcher's instructions.

If any of the crewmembers of Extra 8072 North had heard the radio broadcast which the head brakeman of train No. 586 said he made to the conductor of No. 586 when No. 586 was passing the dragging equipment detector at automatic signal No. 75.6, they might have been able to alert No. 586 to the close presence of Extra 8072 North. It is possible that the topography or other factors prevented reception of the radio signal. Also, the message may not have been transmitted on the proper radio channel because the channel selector switch on No. 586's locomotive radio was found to be in position 2, the position for transmissions to the dispatcher, rather than position 1 for transmissions to the rear of the train and other trains in the area.

The rear brakeman of Extra 8072 North who was inspecting the train, as was required by the carrier's operating rules, by walking northward from the caboose, denied hearing a whistle sounded from a locomotive to the rear of his train. In view of its reported varying loudness, the whistle of No. 586, if sounded as alleged by the head brakeman, may or may not have been loud enough to have been heard by the brakeman of Extra 8072 North.

Because the conductor of Extra 8072 North had no compelling reason to be out of the caboose while the train was stopped, and since the head-end crew of No. 586 did not see him, he probably was still onboard the caboose at the time of the collision although his body was found outside the caboose. If the conductor of Extra 8072 North had heard a radio message from the head brakeman of No. 586 to the conductor of No. 586, and concluded there was a possibility of a collision, he probably would have had time to escape from the caboose. However, the condition of the caboose radio at that time is not known, and it is not known if the conductor's portable radio was on or if it was operable. The rear brakeman of Extra 8072 North said that the caboose radio had failed en route from Nashville and that they had used his portable set. Even without the benefit of a radio warning, the conductor should have been alert to the proximity of No. 586 because he knew the train was called to leave Nashville a short time after Extra 8072 North. Although not required by L&N operating rules, if he had placed torpedoes to the rear of his train, he might have been alerted to the presence of No. 586 in time to escape from the caboose. Further, if the engineer of No. 586, once he was past automatic signal No. 75.6, had blown the whistle periodically or had radioed a message to trains in the vicinity that No. 586 was passing automatic signal No. 75.6, the conductor might have been warned of No. 586's approach and been able to move to safety.

There is no evidence to confirm the engineer's assertion that the dynamic brake on the locomotive of No. 586 was inoperative or that the train airbrakes were not responding correctly to the engineer's brakepipe reductions. In terms of brake performance, the initial terminal brake test and the mechanical inspection given the train at Louisville were considered to be satisfactory to the responsible individuals at that point. Nevertheless, it is apparent that the inspection of the train was either not thorough, the defects were not reported to supervisors by the car inspectors, or no action was taken by

the mechanical department personnel at Louisville to correct the defects, since several cars were later found to have excessive brake cylinder piston travel, brakes cut out, and brakes inoperative. The excessive piston travel of the magnitude measured at Gorman on some of the cars should not have developed in the approximately 270 miles the train traveled from Louisville to the point of the accident and back to Gorman. Therefore, the Safety Board concludes that the train was allowed to depart the initial terminal at Louisville with cars that had brake cylinder piston travel beyond the travel limits allowed by the Federal regulations. The L&N management should insure that car inspectors properly report defects to their supervisors and that mechanical supervisors enforce the requirements of the Federal regulations and not allow defective cars to leave an initial terminal.

However, despite the discrepancies revealed in the postaccident train brake inspection, the defects apparently did not prevent the brakes from operating adequately. The engineer who had operated the same equipment earlier as No. 277 from Louisville to Nashville was satisfied with the response of both braking systems when he used them. The locomotive inspection report for No. 586 did not have any notation entered upon it about questionable brakes, nor did the engineer of No. 277 inform or suggest to the engineer of No. 586 that he had experienced any bad or marginal braking responses. With the exception of the freight cars that were found to have excessive brake cylinder piston travel, the postaccident inspection and tests did not reveal any mechanical condition that would account for malfunctioning brakes. The manner in which the train responded to braking demands en route from the accident site to Gorman and from Gorman to New Johnsonville on December 28 and 29, respectively, further reduces the credibility of the report of improperly operating brakes made by the engineer of No. 586. The road foreman of engines said that he used the train's air supply liberally during the trip, allowing only minimal time for the system to recharge, and he easily stopped the train short of the point of impact.

When the engineer of No. 586 tried the locomotive's dynamic brake just after leaving Nashville and obtained a wheel slip-slide indication light, he should have tried the brakes for a longer period of time and manually applied sand to the rail even if the automatic sander was on. The engineer said he increased the dynamic load slowly as he applied the dynamic brake, but nevertheless, despite his best judgment, he could have increased the loading too fast. If the resistive load to the traction motors, which in the dynamic brake mode operate as generators, is applied or increased too rapidly, the initial reaction of the locomotive commonly is for the wheels to slide. If sand is applied to the rails when a slide occurs, in most instances the wheel slide will stop. The engineer said that he was taught that he should not use the dynamic brake if a wheel slip-slide was indicated. The Safety Board must conclude that either he was not taught what to expect in the way of a response from the initial application of the dynamic brakes -- and his training background based on course content as described by his supervisors does not indicate this -- or he did not understand what he had been taught. His performance record does not suggest the latter. Even if the engineer decided it was too risky to continue to try to get an effective dynamic brake response on the downgrade at Shops Hill, he still could have tried the dynamic brake at a later time and place to determine if it was inoperable.

Except in the case of a broken brakepipe line, it is unlikely that a train's airbrake system will deteriorate almost instantaneously, without giving some advance symptomatic evidence or warning. The engineer said he began to lose the effective response of the train's airbrakes at the south end of Pursley when he did not get a proper brakepipe air exhaust. He also said that the air pressure indication gauges indicated a response corresponding to the initial and incremental brakepipe pressure reductions he had made. This is an indication that the airbrake system was responding correctly to his braking

demands. However, since the brakepipe air exhaust is a positive indication which is relied upon by locomotive engineers that a brakepipe reduction has been effective in applying more braking effort, he may have doubted the effectiveness of his brakes. The air pressure indication gauges do not give an indication of how much braking effort is being applied by the train's airbrakes. If the engineer had repeatedly made brakepipe reductions to slow the train and then released the brakes for only a few minutes, as he said he did, he could have gradually depleted the air reserve, because the airbrake system may not have had time to replenish the lost air. A reduced air reserve would account for the lack of brakepipe air exhaust, which the engineer said was apparent after the train passed Pursley. If this occurred, it is an indication of his misusing the airbrake system.

Since some of the cars in the train were equipped with the type ABD and ABDW brake valves, the brakepipe air exhaust would have been reduced further in intensity and duration by the time the emergency brake application was made, because each time the train brakes are released, these brake valves allow air from the emergency air supply reservoir on each freight car to transfer into the brakepipe to aid in quickly restoring the brakepipe pressure. Thus, once the brakes are released and the brakepipe pressure is being restored, some of the air volume in the brakepipe is used to restore the pressure in the emergency reservoir. Even though the air indication gauges on the locomotive may show the brakepipe pressure to be maximum, the brakepipe may not be fully charged. If the brakes had been handled as the engineer said he used them, the emergency air reserve probably could have been considerably reduced, and thus, only capable of producing an insignificant exhaust and very little increase in braking effort. Also, when an emergency brake application is made, the ABD and the ABDW brake valves vent part of the brakepipe air to the atmosphere, which again could account for a weak brakepipe air exhaust on the locomotive such as the engineer said he got when he made the emergency brake application approaching automatic signal No. 75.6. However, the road foreman of engines said that when he operated No. 586's train over the same territory traveled earlier by the engineer of No. 586, he did not develop any braking problems, even while being liberal with the use of the air.

Had the engineer of No. 586 placed the throttle to the idle position when the train passed the approach aspect displayed by automatic signal No. 73.6 at a speed of about 35 mph, the 0.5-percent grade would have in itself stopped or nearly stopped the train in the nearly 2-mile distance before the point of impact. Had the engineer reduced the throttle setting more while descending the grade north of Pursley, his train's speed would have been further reduced. There is no evidence that No. 586 was operated in this manner in either instance, but rather the evidence is that the throttle was in some power position until the impact. Further, the tests performed by the road foreman of engines between Gorman and the accident site indicated that without the throttle in some power position the train probably would have stalled as it moved upgrade past milepost 74.5.

An engineer's use of train airbrakes by making small brakepipe reductions that are held for a short time and then released can result in a reaction commonly known as a false gradient. For example, when an engineer makes a 12-pound brakepipe reduction, the reduced pressure occurs first at the front of the train and takes several seconds to propagate throughout the train. If the engineer releases the brakes after the brakepipe reduction has been only partially accomplished and before the system has had time to stabilize at the reduced brakepipe pressure, and then shortly makes another brakepipe reduction, once more the front of the train will have its brakepipe pressure reduced while the rear portion of the brakepipe is at a higher pressure. When this happens, the higher pressure at the rear of the train will cause the airflow to reverse its direction to equalize the lower air pressure and replace the volume of air lost from the front of the train. At some point in the train, the air turbulence caused by this induced counterflow may

produce a transient high pressure that momentarily causes the air pressure in the brake pipe to exceed the car reservoir pressure and result in a release of the brakes on that car because the air pressure in the brake pipe and the air pressure in the car reservoir become unequal momentarily. The effect of a brake release on that one car causes the same reaction upon the brake system as a brake release from the locomotive. When the engineer releases the train brakes on the locomotive, the change in the brakepipe pressure is detected by brake valves on the first car following the locomotive. Accordingly, the first car releases its brakes and each following car, in the same manner, detects the release of the brakes on the car ahead and so a chain reaction is established, resulting in the brakes releasing on all of the cars throughout the train. As a result, the sensing devices on the locomotive will indicate that the airbrakes are applied when in reality there are no effective brakes. This could have occurred with train No. 586 if the engineer was applying and releasing the train's airbrakes in the foregoing manner.

The engineer of No. 586 remarked several times during the company's hearing that he made a minimum service airbrake application and that the train did not slow its speed. During his training as a student engineer material was presented from which he should have learned that the intent of a minimum service brakepipe application is to "adjust slack and set the brakes up," and it is not to be expected that a minimum service brake application will retard the train in a significant manner, especially when power is still being used. Further, the engineer's stated handling of the dynamic brake and his use of the automatic train brake and the locomotive brake indicates that either he did not understand fully the use of these brakes or that he failed to retain this information from his training.

The automatic brake handle being found in the handle off position and the dynamic brake control lever being found in the fully applied position do not comport with the head-end crew's testimony. The impact forces created by the locomotive's striking the rear of Extra 8072 North, which was standing with its airbrakes set in a heavy application, and the forces developed during the rolling and pitching of the unit could have caused the automatic brake handle and the dynamic brake control to have moved. Further, it is possible that a person in leaving the operating position hurriedly could have brushed against the automatic brake handle and moved it from the emergency position to the handle off position.

The credibility of the testimony of the engineer and the head brakeman is made questionable by the conflict in the head brakeman's testimony about where the train's emergency brakes were applied. Since the first and only sand was found commencing at the point of impact, and the application of sand is automatically made when the train brakes apply in emergency no matter how the emergency application is initiated, it appears that the automatic brake handle was not used before the collision to apply the emergency brakes as described by the engineer. The train's airbrakes most likely applied in emergency when the anglecock on the brakepipe line on the lead unit was broken upon impact.

The postaccident inspection of all the locomotive units indicated that sand was available on each unit, and it is likely that it would have been dispersed earlier if the train airbrakes had been applied in an emergency application as the train approached automatic signal No. 75.6. Further, the position of the rear end of the train with respect to the point of impact when the emergency brake application was made, according to the testimony of the rear-end crew, establishes that no emergency brake application was made in approach to automatic signal No. 75.6. Though slack action, if considered, may have caused a different positioning of the locomotive from the location determined by the computations based on the information presented in the facts, the slack would not have changed the position so extensively that it would discredit the finding that there was no

emergency brake application made in approach to automatic signal No. 75.6. Whether or not there was a brakepipe air exhaust when the emergency brakes were applied would not have affected the automatic application of sand. Also, if the automatic brake handle had been in the emergency position, there would have been no flow of current through the excitation breaker at the time of impact and it would not have been tripped, whereas it was found in the tripped position after the accident. The likelihood of the breaker's being jarred into a tripped position is remote.

Much of the testimony and evidence presented as a result of this accident investigation causes the Safety Board to be strongly suspicious that the head brakeman rather than the engineer was operating the train before and during the time the train was approaching the area of the accident. This theory is supported by the following factors: the engineer's account of his actions in operating the train, which indicates that he misused the train's airbrakes; the engineer's reported operating techniques, such as "fanning" the independent locomotive brake when he decided the train was not slowing or stopping, which were not consistent with the manner in which a proficient engineer would be expected to operate; the engineer's not taking advantage of gravity or rolling friction on the ascending grade to slow the train, but instead applying power; the lack of automatically dispersed sand approaching automatic signal No. 75.6 where the engineer claims to have made an emergency brake application; the engineer being the first man out of the operating compartment when the caboose of Extra 8972 North was sighted, notwithstanding the fact that the head brakeman was reported to be on his feet in the center of the operating compartment and the awkward position a man in the operator's seat would be in to leave that seat quickly and move through the door behind him; the improper position of the operating controls found following the collision; the engineer's statement that he was too busy to radio his conductor on the caboose that No. 586 was passing the dragging equipment detector at automatic signal No. 75.6, when apparently he was only fanning the independent brake; the head brakeman's claim that he blew the whistle when he was aware of an impending collision; the fact that the head brakeman had operated locomotives and freight trains before and had an ambition to become a locomotive engineer; and the fact that the engineer was rated a proficient engineer by his supervisors, who had not found it necessary to accompany him on a trip because there were no reports or indications that he was experiencing operating problems.

Since the Safety Board cannot determine conclusively that the engineer was not operating the locomotive at the time of the accident, it must accept the foregoing as circumstantial and base its findings on the factual evidence at hand. However, the Safety Board concludes that, contrary to the engineer's testimony, he was not fully alert when the train passed automatic signal No. 75.6 and that he was startled into reality when he suddenly saw the caboose of Extra 8072 North ahead. When he was fully alerted to the caboose, he made one frantic effort to stop the train and then left the operating compartment.

Train Operations

It can be expected that at some time while an engineer is operating a locomotive, he or she may have to check equipment or use toilet facilities. It is operationally inconvenient and expensive to stop a train while an engineer goes back to a trailing unit to check a malfunctioning component or takes a break. Yet L&N brakemen are not trained or qualified to operate a locomotive nor are they instructed in the use of the locomotive or train airbrakes. Thus, situations may arise even when the engineer is in the operating compartment that would require a head brakeman to slow or stop the train while he is seated at the controls. Moreover, the L&N operating rules prohibit unauthorized individuals, such as head brakemen, from operating a locomotive. The rules also require

the engineer to remain in the operating compartment of the train while it is underway if no other qualified person is there to operate the locomotive. Further, to comply with the requirement of the State statute, a person will always have to be in the operating compartment. The L&N is apparently fulfilling the requirements of the State statute by ensuring that a crewmember remains in the operating compartment, but in doing so the L&N is acquiescing in the practice of allowing unqualified head brakemen to sit in the operating position while a train is underway in circumstances where there is no assurance that control settings will not have to be changed by an untrained person.

The engineer should not leave the operating compartment to check relays or locomotive control settings while the train is in motion unless a minimally qualified person, i.e., one who could stop the train safely if necessary, is present and remains in the operating compartment. If the L&N is going to utilize head brakemen to fulfill this function, the brakemen should be trained on the train's airbrake system and taught how to safely slow or stop a train.

The dispatcher was not required to pass information to No. 586 concerning the location of Extra 8072 North. The operating rules require that an engineer operate a train by the signal aspects displayed by the wayside signals. Generally, the consensus of operating supervisors of railroads is that passing information to locomotive engineers that is available to them from the signal system, though intended to be helpful, may tend to cause them not to respect the wayside signal aspects as they should. Nevertheless, since the dispatcher volunteered information to No. 586, he should have first received an acknowledgment of his call from No. 586. He should not have transmitted the message without having first made contact with an individual on the train for whom the message was intended. There is a danger that another locomotive engineer might receive and act upon an undirected transmitted message.

The engineer and head brakeman of No. 586 said that they did not receive the radio message. The conductor and rear brakeman said they heard the message, but that it was garbled. In fact, their understanding of the message was not the meaning the dispatcher intended. Since the message was garbled, the conductor should have asked the dispatcher to repeat it, or he could have asked the engineer to contact the dispatcher for a clarification of the message. Since the conductor understood that the message was a communication to his train and he did not hear the engineer acknowledge the message, he did not fulfill the responsibility assigned to the person in charge of the train by L&N operating rule No. 886. The radio transmission from the dispatcher should have alerted the conductor to the fact that an unusual circumstance might exist, and he should have taken action to get clarification of the message.

Neither the conductor nor the rear brakeman monitored the brakepipe air pressure gauge mounted in the caboose, so they could not verify the engineer's claim that he was required to use more air than he thought he should have. The conductor did not check the speed of his train at any point even though he had been issued a train order restricting the speed of his train to 40 mph. Again, it appears that the conductor was not responsive to his responsibility of being in charge of the train.

On September 10, 1976, as a result of an accident investigation, 8/ the Safety Board recommended that the FRA "Promulgate rules to require enginecrews to communicate fixed signal aspects to conductors while trains are en route on signalized track. (R-76-50)" A similar recommendation was issued to the Association of American

8/ Railroad Accident Report--"Head-on Collision of Two Penn Central Transportation Company Freight Trains near Pettisville, Ohio, February 4, 1976" (NTSB-RAR-76-10).

Railroads (AAR) on March 3, 1981: "Encourage member railroads to establish rules that require enginecrews to communicate fixed signal aspects to conductors while trains are en route on signalized track. (R-81-48)" 9/ The status of both recommendations is currently "Open—Unacceptable Action." The FRA has not adopted such a requirement, nor has the AAR been given its support to such actions. Despite this, some railroads believe this procedure has merit and have implemented the procedure which requires an acknowledgment from the conductor. 10/ The Safety Board continues to believe that such a procedure reinforces the alertness of the entire crew and enables any traincrew within radio coverage to be informed of the current situation. If such a procedure had been followed in this instance, the accident might have been avoided.

The Safety Board believes that since it is a common practice for a northbound train to stop in the vicinity of the Fish Camp Crossing and for it to stand there for varying periods of time, precautions should be taken to protect the rear of the train beyond the protection afforded by the automatic wayside signals. Even though flag protection is not required, it would seem that it would be prudent to require the rear-end crew to either drop fusees at appropriate intervals or affix warning torpedoes to a rail. In this case, lighted fusees may not have been noticed by the head-end crew of No. 586; however, the explosion of torpedoes, if they had been placed on the rail, might have alerted the inattentive engineer and would have afforded him an opportunity to use emergency braking before the collision. In addition, the explosion of torpedoes could alert occupants of a caboose to the proximity of an approaching train and give them sufficient time to leave the caboose, to evaluate the situation, and to leave the area if necessary. Additionally, an engineer could be required to blow the locomotive whistle periodically or radio broadcast a "to whom it may concern" message or both after the locomotive of a train has passed an automatic signal displaying a stop and proceed or a restricting proceed aspect. If the enginecrew is alert, such a procedure would call the attention of a person on a standing caboose, if a standing train is the cause of the restrictive signal, to the approaching train and provide one more safety advantage.

In general, the response from the railroad industry to suggestions to provide flag protection or some other procedure to complement protection afforded by automatic signals has not been supportive. The viewpoint seems to be that if employees would obey the rules, the accidents would not happen. The Safety Board recognizes that this viewpoint has some merit, but the fact is that the employees are not obeying the rules and accidents are happening. The Safety Board continues to believe that some complementary flagging action is needed, in addition to better training and monitoring of employees, for the protection of crewmembers of standing trains that will provide safety backup when operating rules are violated.

Since most railroads now operate trains by the indications of automatic signals, flag protection for standing trains under most circumstances is no longer required. The Safety Board has investigated more than 25 rear-end collisions 11/ where crewmembers on the

9/ Railroad Accident Report--"Side Collision of Norfolk and Western Railway Company Train No. 86 with Extra 1589 West near Welch, West Virginia, September 6, 1980" (NTSB-RAR-81-2).

10/ Railroad Accident Report—"Head-on Collision Between Baltimore & Ohio Railroad Company Train No. 88 and the Brunswick Helper near Germantown, Maryland, February 9, 1981" (NTSB-RAR-81-6).

11/ These include the following: Railroad Accident Reports--"Rear-end Collision of Two Southern Pacific Transportation Company Freight Trains, Indio, California, June 25, 1973" (NTSB-RAR-74-1); "Rear-end Collision of Two Consolidated Rail Corporation Freight Trains, Muncy, Pennsylvania, January 31, 1979" (NTSB-RAR-79-6); "Rear-end Collision of Two Union Pacific Freight Trains, Ramsey, Wyoming, March 29, 1979" (NTSB-RAR-79-9).

locomotive or in the caboose were killed. Where flag protection is not required, the rear-end crewmembers generally remain on the caboose. They are dependent for their safety on the engineer's operating a following train obeying the operating rules. However, when the engineer fails to operate the train in accordance with the operating rules, the caboose and its occupants are unprotected and in great jeopardy. In this accident, the occupant of a caboose was killed. In many other instances when a rear-end collision occurs, the lightweight caboose rides up over the striking locomotive unit, shears the body and components off the locomotive unit frame, and the occupants of the locomotive are killed. Because of the great risk to both locomotive and caboose crews when rear-end collisions occur, the Safety Board believes that the railroad industry should adopt redundant methods to reduce or eliminate these risks.

The Safety Board has addressed the hazards of railroads allowing trains to move past signals displaying the appropriate aspect to indicate, most probably, an occupied block. On February 17, 1976, as a result of several accident investigations, the Safety Board recommended that the FRA "Promulgate regulations to prohibit trains from operating in occupied blocks except through the authority of a train order or by some other procedure with similar safeguards. (R-76-6)" 12/ Other recommendations on this subject have been made by the Safety Board. Recommendation R-76-6 was closed in an "Unacceptable Action" status. The Safety Board's recommendation issued to the FRA on the same date, "Establish guidelines for and require carriers to establish radio procedures to insure that trains which stop in restricted visibility areas will notify by radio or flag trains to the rear. (R-76-7)" 13/ has been classified "Closed--Acceptable Alternate Action." The Safety Board does not understand the reluctance of the railroad industry and the FRA to provide protection for the rear of a train that is standing on the main track at an unknown location while the operating rules of railroads describe at great length how the front of a train shall be protected when the head of the train is moved away and must later return to the train. The crewmembers of that train can be expected to know where the head end of the train is located, but the crewmembers of a following train do not know where the rear end of a preceding standing train is located.

Training

According to the engineer of No. 886, the engineer training program was heavily oriented toward on-the-job training. He may not have considered postpromotional reviews and instructional information as training. L&N supervisors described this initial and continuing training course for engineers as well presented, informational, and instructive. The latest training aids, such as train simulators, films, viewgraphs, and demonstrations of train handling and braking techniques are used. Supervisors rated the course highly and as being adequate. However, the L&N should review its engineer training program for course content and testing procedures to be certain it provides an engineer trainee with the skills he will need to become an effective, safe engineer.

The L&N road foremen of engines should be required to ride with all operating engineers to monitor their operating techniques. L&N supervisors should establish a schedule that permits them to make trips with each engineer at frequent intervals. It would be important to accompany an engineer as soon as possible after a review class is held and especially if new braking techniques are being introduced. The road foremen should not be burdened with other duties to the extent that they interfere with their monitoring the performance of regularly assigned engineers.

12/ Railroad Accident Report--"Penn Central Transportation Company Train Collisions, Leetonia, Ohio, June 6, 1975" (NTSB-RAR-76-2).
13/ Ibid.

The train crewmembers (except the engineer) involved in this accident said that they had not received any training in the use of train airbrakes. All crewmembers should have a personal working knowledge gained from actual operation of the emergency brake valve on the locomotive, and all of them should understand how to apply a train's brakes from a caboose. They also should be instructed in the importance of monitoring the caboose brakepipe air pressure gauge.

Crashworthiness

The locomotive operating compartment of the lead unit of No. 586 was not deformed in this collision because the colliding equipment was deflected to the side. In most instances in a collision situation involving a light vehicle such as a caboose, the caboose tends to ride up over the locomotive and destroys the locomotive operating compartment. Although this did not occur in this collision, the head-end crew probably exercised good judgment when they jumped from the locomotive, even with the attendant risks. Despite the nondeformation of the operating compartment, whether or not they could have survived in the operating compartment during the violent movement of the locomotive following the impact is debatable because of possible injuries that might have been incurred from being thrown about.

Because the caboose of Extra 8072 North was not crushed or mechanically deformed, occupants of the caboose probably would have survived unless they incurred injuries from being thrown about inside the caboose following impact. Since it was never determined if the conductor of Extra 8072 North was within the caboose, attempting to leave it, or near the caboose on the ground at the time of the accident, the injury-producing event that caused his death is not known. The cause of the caboose fire could not be determined, but it is probable that it was caused by the fuel oil heater used to heat the caboose.

Rescue Efforts

The Humphrey County emergency personnel reacted in a timely manner in responding to the needs of the accident victims, aided by the ambulance service advising the sheriff's department of the accident. Apparently, the rescue personnel knew the local area well enough so that they had no problem locating the accident site or the access road nearby. The benefits of the familiarity of local areas by emergency personnel was addressed in the Safety Board's report of an accident on the Seaboard Coast Line Railroad at Lakeview, North Carolina, in 1980. 14/

CONCLUSIONS

Findings

1. The crew of Extra 8072 North was following the instructions of the dispatcher, and they were in compliance with the operating rules when they stopped their train at the Fish Camp Crossing.

2. An initial terminal brake inspection and test was performed and reported as satisfactory. However, train No. 536 left the Louisville Terminal with cars having excessive brake cylinder piston travel and brakes cut out and inoperative.

14/ Railroad Accident Report--"Head-on Collision Between Amtrak Train No. 82 and Seaboard Coast Line Extra 2771 South, Lakeview, North Carolina, April 2, 1980" (NTSB-RAR-80-8).

3. The dynamic brake of No. 586 probably was operative even though the engineer of No. 586 said he considered it to be ineffective after his one attempt to use it just after leaving Nashville.

4. Despite the several cars that had excessive brake cylinder piston travel, brakes cut out, and the stuck bleeder valve, the airbrakes on No. 586 were adequate to stop the train effectively as demonstrated in the course of the train's movements between Louisville and Nashville and following the accident.

5. The airbrakes of No. 586 were mechanically capable of stopping the train if they had been operated properly.

6. The air pressure gauges on No. 586 indicated that the airbrake system was functioning properly in response to the brakepipe reductions.

7. The absence of brakepipe air exhausts accompanying brakepipe reductions beginning at Pursley resulted from misuse of the airbrakes.

8. No. 586 could have been stopped before it struck the caboose of Extra 8072 North if the airbrakes had been used properly or if the throttle had been shut off when the engineer stated he was aware of a poor braking response.

9. The engineer and headbrakeman of No. 586 were not fully alert as the train passed the two restrictive automatic signals protecting standing train Extra 8072 North.

10. When the crew jumped from the locomotive, the speed of No. 586 was greater than the 30 mph permitted by the restricted speed rule.

11. The conductor of No. 586 did not fulfill his responsibilities when he failed to take measures to clarify a radio message he understood was addressed to his train.

12. The train dispatcher erred in not getting an acknowledgment from a crewmember on No. 586 before he transmitted his message.

13. An emergency brake application was not made by the engineer of No. 586, and none occurred until the locomotive collided with the caboose of Extra 8072 North and a pressure drop due to a break in the brakepipe line initiated the application.

14. The locomotive of No. 586 was still in a power mode when it struck the caboose of Extra 8072 North.

15. A protective system complementary to the signal system should be used when trains are stopped in automatic signal territory.

16. No one should be allowed to sit in the operating position of a locomotive with the responsibility for the forward progress of the train unless they have been trained to safely slow or stop the train.

17. The engineer should not be permitted to leave the locomotive operating compartment unless a person, who as a minimum understands how to operate

the locomotive and train brake systems, is available to operate and control the movement of the train.

18. The automatic signal system was operating correctly as designed.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the lack of alertness of the engineer and head brakeman of train No. 586 in approaching the area of the accident and the failure of the engineer of train No. 586 to properly use the automatic train brakes to control the speed of the train in compliance with the speed requirements of the wayside automatic block signal aspects, so that the train could be stopped before it struck standing train Extra 8072 North. Contributing to the cause of the accident was the failure of the head brakeman to cause the speed of the train to be brought into conformance with the automatic block signal aspects, and the failure of the conductor to request clarification of a radio message from the dispatcher notifying the crewmembers of train No. 586 that Extra 8072 North was stopped ahead when he did not understand the message.

RECOMMENDATIONS

As a result of its investigation of this accident, the National Transportation Safety Board recommended:

--that the Louisville and Nashville Railroad Company:

Establish a complementary protective system to the automatic block signals for trains stopped in automatic block signal territory against a following train. (Class II, Priority Action) (R-82-98)

Determine if unqualified employees are operating locomotives with or without cars. If so, initiate corrective action so that Louisville and Nashville employees will be in conformance with the company operating rule that requires a qualified locomotive engineer to be present in the operating compartment of the locomotive while the train is in operation. (Class II, Priority Action) (R-82-99)

Require an engineer to radio the aspects displayed by all the wayside automatic and interlocking home signals affecting movement of the train to the conductor, and have the conductor acknowledge the aspect called. (Class II, Priority Action) (R-82-100)

--that the Federal Railroad Administration:

Provide complementary flag protection in signal territory when a train stops, such as affixing a torpedo to the rail and placing a fusee if appropriate. (Class II, Priority Action) (R-82-101)

In addition to the requirement of current operating rules, require engineers to blow the locomotive whistle periodically and broadcast a one-time unaddressed and undirected radio message when the locomotive of a train has passed a restricted proceed or stop and proceed signal aspect until the cause of the restrictive signal is determined. (Class II, Priority Action) (R-82-102)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ PATRICIA A. GOLDMAN
Vice Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ G.H. PATRICK BURSLEY
Member

/s/ DONALD D. ENGEN
Member

August 23, 1982

APPENDIXES

APPENDIX A

INVESTIGATION

The National Transportation Safety Board received notice of this accident from the National Response Center of the U.S. Department of Transportation in Washington, D.C., where it had been reported by the L&N Railroad Company about 12:30 p.m. on December 26, 1981. Investigators from the Safety Board's Washington Headquarters and Kansas City, Missouri, field office were dispatched to the scene.

Representatives of the Federal Railroad Administration monitored the mechanical inspections and tests performed on the locomotive and freight equipment and the wayside signal equipment. Their assistance and sharing of test results were greatly appreciated and the information was used advantageously.

APPENDIX B

TRAINCREW INFORMATION

Allen Maurice Carr, Engineer No. 586

Allen Maurice Carr, 30, was employed by the L&N Railroad Company as a brakeman on April 4, 1974. He was promoted to road conductor and yard foreman on May 17, 1976. He entered the L&N's locomotive engineer training program as an apprentice engineer on August 15, 1978, and completed the program on October 14, 1978. He was promoted to locomotive engineer on February 6, 1979. He attended an operating rules class during April 1981, and was given a satisfactory rating. His operating record as an engineer was good.

He had been off duty for more than 3 days before he reported for duty on December 28, and at the time of the accident he had been on duty about 2 hours 40 minutes. He said that the trip from Nashville to Bruceton on December 28 was the first trip he had made over the Nashville division in almost 60 days, but he had made 85 trips over the division during 1981.

Donald Ray Burgess, Conductor No. 586

Donald Ray Burgess, 32, was employed by the L&N Railroad Company on June 5, 1974, as a trainman-switchman. He became a switchman on January 26, 1976. He was promoted to road conductor and yard foreman on May 17, 1976. He qualified for this position by on-the-job training. He attended an operating rules class during the spring of 1981, and was given a satisfactory rating. His operating record as a conductor/foreman was good.

He had been off duty 13 hours 10 minutes before reporting for duty on December 28, and he had been on duty about 2 hours 40 minutes at the time of the accident.

Wallace Anthony McCoy, Head Brakeman No. 586

Wallace Anthony McCoy, 29, was employed by the L&N Railroad Company on July 11, 1974, as a switchman-trainman. He became a trainman on December 10, 1974. He qualified for his position by on-the-job training. He had not taken a promotion to road conductor or foreman. He attended an operating rules class during May 1981, and he was given a satisfactory rating. His performance record as switchman and trainman was good. He had applied twice for engineer's training school but had not been accepted.

He had been off duty 5 days before reporting for duty on December 28, and he had been on duty about 2 hours 40 minutes at the time of the accident.

Ronald Lee Dixon, Rear Brakeman No. 586

Ronald Lee Dixon, 42, was employed by the L&N Railroad Company on December 21, 1951, as a switchman. He was promoted to yard foreman on April 1, 1963. His service record does not indicate his promotion to conductor but in his deposition before Safety Board investigators he said he was promoted to conductor during the summer of 1979. He attended an operating rules class during the spring of 1981, and he was given a satisfactory rating. He qualified for his position by on-the-job training. His performance record as a foreman and conductor was good.

He had been off duty 13 hours before he reported for duty on December 28, and had been on duty about 2 hours 40 minutes at the time of the accident.

APPENDIX C

EXCERPTS FROM LOUISVILLE & NASHVILLE RAILROAD COMPANY OPERATING RULES

DEFINITIONS:

CENTRALIZED TRAFFIC CONTROL SYSTEM (CTC). - A block signal system under which train movements are authorized by block signals whose indications supersede the superiority of trains for both opposing and following movements on the same track.

SIGNAL ASPECT. - The appearance of a fixed signal conveying an indication as viewed from the direction of an approaching train.

SIGNAL INDICATION. - The information conveyed by the aspect of a signal.

SPEED - MEDIUM. - A speed not exceeding 30 miles per hour.

SPEED - RESTRICTED. - Proceed prepared to stop short of another train, obstruction, or switch not properly lined, looking out for broken rail, not exceeding 15 miles per hour.

RULES:

34. All members of a crew in cab of engine must, and other crew members will, when practicable, communicate to each other by its name the aspect of each signal affecting the movement of their train. Signal aspects must be seen before being communicated to other members of crew. . . .

106. Both the conductor and the engineer 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, but this does not relieve other employees of their responsibility under the rules.

106 (a). When safety of trains and observance of rules are involved, all other crew members are responsible to the extent of their ability to prevent accident or violation of the rules.

When the conductor or engineer fails to take action to stop the train, and an emergency requires, other crew members must take immediate action to stop the train.

106 (b). Conductors and engineers must see that their subordinates are familiar with their duties, ascertain the extent of their experience and knowledge of the rules, and instruct them, when necessary, in the safe and proper performance of their duties.

106 (c). When the conductor is not present, brakeman on engine must promptly obey instructions of the engineer relating to the safety and protection of the train, and must immediately call attention of the engineer to any apparent failure to observe train orders, or to comply with any rules or instructions.

108. IN CASE OF DOUBT OR UNCERTAINTY, THE SAFE COURSE MUST BE TAKEN.

261. On portions of the railroad, and on designated tracks so specified in timetable, unless otherwise provided, trains will be governed by block signals whose indications will supersede the superiority of trains for both opposing and following movements on the same track, but do not dispense with the use or the observance of other signals and of train orders whenever and wherever they may be required.

266. When a block or interlocking signal indicates "Stop," or a block signal indicates "Restricted Proceed," one or more of the following conditions may exist in the block, or interlocking limits:

(a) Train or other obstruction.
(b) A main track switch not set to normal position.
(c) Opposite switch of crossover not set to normal position.
(d) A car or engine on a siding or side track within fouling distance of a main track.
(e) A broken rail.
(f) Draw of a drawbridge not in position for movement of a train.
(g) Failure of the signal.

285. INDICATION - PREPARE TO STOP AT NEXT SIGNAL. TRAIN EXCEEDING MEDIUM SPEED MUST AT ONCE REDUCE TO THAT SPEED.
NAME - APPROACH

291. INDICATION - PROCEED AT RESTRICTED SPEED.
NAME - RESTRICTED PROCEED

705. Radios used in connection with train operation will be tested by members of both head and rear-end crew at point where train is originally made up and again as soon as practicable at any point after changing crews. . . .

707. Radio communications must be promptly acknowledged; however, acknowledgment may be delayed if it would interfere with other duties relating to safety.

708. *. . . An employee transmitting or acknowledging radio communication must begin with positive identification which must include the initials of the railroad, name and location of office or stations, and when applicable, the identity of the train, engine number, location, or the precise radio unit. . . . *

886. The general direction and government of a train is vested in the conductor, and all other persons employed thereon must obey his instructions, except when such instructions imperil the safety of train or persons, or involve violation of rules. Any misconduct or neglect of duty of employees on the train must be promptly reported.

1001. They [engineers] are under the direction of the conductor of the train with respect to its operation and must comply with his instructions, except when such instructions imperil the safety of train or themselves, or involve violation of rules. . . .

1010. They [engineers] must not permit unauthorized persons to operate the engine. The fireman or other authorized employee on the crew may be permitted to do so with the permission and the presence of the engineer, who will be responsible for the proper operation of the engine and handling of the train. Road foremen of engines are authorized to operate the engine to instruct or for other purposes.

APPENDIX D

SUMMARY OF
LOUISVILLE & NASHVILLE RAILROAD COMPANY
TRAINING PROGRAM FOR APPRENTICE ENGINEERS

After notice of intent to accept applications for apprentice engineers is posted,

1. Trainmen or switchmen with at least one year's seniority may apply in letter form to the Superintendent. Everyone that applies will be interviewed.

2. A panel consisting of the Superintendent, Assistant Superintendent, line of road Trainmaster, Office Trainmaster, Road Foreman of Engines, Employment Officer and local chairman of the Brotherhood of Locomotive Engineers examines each applicant's personal file and then each applicant is personally interviewed. Each applicant is rated on a scale of one to ten. Then with past work history, safety record, attitude taken into consideration, and following a strict rule examination, the amount of trainees needed are selected.

3. The applicants selected are given a sixty day leave of absence from their craft. More or less a probationary period. Then they meet in the classroom with the Road Foreman of Engines. There they are given locomotive instruction manuals, air brake books and a work schedule. If the trainees have a personal preference regarding a certain engineer to train with in the beginning, this is taken into consideration. If they have no preference then they have an engineer selected for them. All engineers are consulted in advance concerning the training program. We have found that some engineers take a special interest in certain trainees and give them special treatment and extra help.

4. Classes are held Monday thru Saturday either in the training room at the roundhouse or the assembly room at the General Office Building. The trainees are indoctrinated to Safety, Dynamic Brakes, Air Brakes and trouble shooting. Slides on all types of locomotives are shown. Beginning with the second week, trainees go on the road with an engineer that permits them to handle the train under his close supervision. Classes are still [held] twice weekly both in the classroom and on engines at the roundhouse. We are continually going over any problems the trainees have and show additional training slides regarding train handling and locomotives. Tests are given after each class and questions missed are discussed.

5. On or before the sixty day leave of absence has expired, each trainee receives a mechanical examination given by the employment officer. Passing grade is eighty-five percent. Should the trainee fail this examination or should the Road Foreman of Engines determine that the trainee is not meeting all the requirements of the service, the trainee is removed from the program and returned to his original seniority as trainman or switchman.

6. The trainees that remain are then required to train on every job on the division. This is repeated over and over until the Road Foreman of Engines decides the Apprentices are qualified. Some apprentices of course require more training than others. There is no specific amount of training time involved. It will vary according to the ability of the members of each class. Some classes on the system run as long as a year or even longer. On the average it is around five months. As long as trainees are in the program, classes are held once a week when possible to follow up

on training procedures. These apprentices are learning by continually doing the job over and over. The apprentices are of course working with various engineers. All through the program the engineers are contacted regularly to determine the progress of his pupil. In addition, the Road Foreman of Engines rides with these apprentices. This is sometimes done both with and without the student's knowledge.

Training Aids Used

1. Instructional manuals on locomotives and air brakes.
2. Simulator of locomotive controls with track profile.
3. Slides and films.
4. On the job training.
5. Air brake rack.

The only change since Mr. A. M. Carr [the engineer of train No. 586] was in the Training Program is the addition of some films on train handling in the newly acquired Re-Training Van.

Mr. Carr was shown these films and received a lecture on Air Brakes, Dynamic Brakes and Train Handling just prior to the accident at New Johnsonville, Tennessee.

/s/ T. D. Duggan
Road Foreman Engines
Nashville Division

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