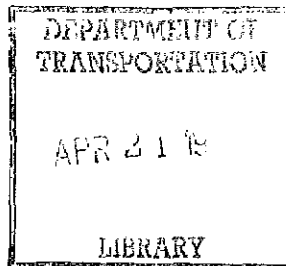


PB85-916313



NATIONAL TRANSPORTATION SAFETY BOARD



WASHINGTON, D.C. 20594

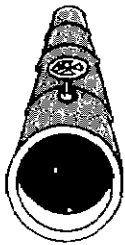
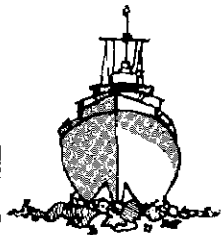
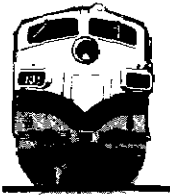
RAILROAD ACCIDENT REPORT *2110.*

HEAD-ON COLLISION OF CHICAGO,
SHORE AND SOUTH BEND RAILROAD
TRAINS NOS. 123 AND 218
GARY, INDIANA
JANUARY 21, 1985

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NTSB/RAR-85/13.

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TECHNICAL REPORT DOCUMENTATION PAGE

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16. Abstract About 6:51 p.m., c.s.t., on January 21, 1985, eastbound Chicago, South Shore and South Bend Railroad (South Shore) train No. 123 and westbound South Shore train No. 218 collided head-on on the eastward main track about 1,490 feet west of the west end of the Gary Station platform at Gary, Indiana. The eastward main track was being used for single-track operation for about 3.5 miles between the end of the double track east of Gary Station and Clark Crossover west of Gary Station because damage caused by cold weather breaks to the catenary propulsion power system over the westward main track made the track unusable by electrically propelled trains. The lead cars of the self-propelled units of each train were crushed and derailed. Seventy-nine passengers, 6 crewmembers, and 2 off-duty employees were injured in the collision. The South Shore estimated the damage to be about \$2,433,000. The National Transportation Safety Board determines that the probable cause of this accident was the failure of the dispatcher to coordinate the movement of the two trains properly; the lack of a clear provision in General Notice No. 62 for a meeting of two opposing trains scheduled to depart Gary Station at the same time; and the mistaken determination by the crew of eastbound train No. 123 while at Clark Road Station that there was sufficient time for the train to reach Gary Station and clear the single track before the scheduled departure of westbound train No. 218.			
17. Key Words Head-on collision; MU Trains; catenary; pantograph; single track operation; general order, train order; OS circuit stop and proceed signal aspect; deadman control; operating rules; flat time		18. Distribution Statement This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161	
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E R R A T A

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* MADE TO THE PREVIOUSLY PUBLISHED *
* REPORT IDENTIFIED AS FOLLOWS *

RAILROAD ACCIDENT REPORT

NTSB/RAR-85/13 (PB85-916313)

The cover page on this report should be corrected to read
as followed

HEAD-ON COLLISION OF CHICAGO,
SOUTH SHORE AND SOUTH BEND RAILROAD
TRAINS NOS. 123 AND 218
GARY, INDIANA
JANUARY 21, 1985

November 27, 1985

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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

RAILROAD ACCIDENT REPORT

Adopted: October 21, 1985

HEAD-ON COLLISION OF
CHICAGO SOUTH SHORE AND SOUTH BEND RAILROAD
TRAIN NOS. 123 AND 218
GARY, INDIANA
JANUARY 21, 1985

SYNOPSIS

About 6:51 p.m., c.s.t., on January 21, 1985, eastbound Chicago, South Shore and South Bend Railroad (South Shore) train No. 123 and westbound South Shore train No. 218 collided head-on on the eastward main track about 1,490 feet west of the west end of the Gary Station platform at Gary, Indiana. The eastward main track was being used for single-track operation for about 3.5 miles between the end of the double track east of Gary Station and Clark Crossover west of Gary Station because damage caused by cold weather breaks to the catenary propulsion power system over the westward main track made the track unusable by electrically propelled trains. The lead cars of the self-propelled units of each train were crushed and derailed. Seventy-nine passengers, 6 crewmembers, and 2 off-duty employees were injured in the collision. The South Shore estimated the damage to be about \$2,433,000.

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the dispatcher to coordinate the movement of the two trains properly; the lack of a clear provision in General Notice No. 62 for a meeting of two opposing trains scheduled to depart Gary Station at the same time; and the mistaken determination by the crew of eastbound train No. 123 while at Clark Road Station that there was sufficient time for the train to reach Gary Station and clear the single track before the scheduled departure of westbound train No. 218.

INVESTIGATION

Events Preceding The Accident

Track Conditions.--The Chicago, South Shore and South Bend Railroad (South Shore) provides propulsion power for its multiple-unit, electrically powered commuter trains through a 1,500-volt d.c. catenary system ^{1/} spanning both main line tracks between Gary, Indiana, and Chicago, Illinois. On January 19, 1985, a low ambient temperature of minus 22° F in the Gary area caused several tensile stress breaks in the catenary system over both tracks between Gary Station and Clark Crossover, which is about 2.7 miles west of Gary Station. The breaks between those locations made the catenary system unusable for normal service by electrically propelled trains.

^{1/} An overhead wiring system from which propulsion power is drawn by means of a pantograph.

On January 20, 1985, train orders were used to move eastbound and westbound trains through the area on the eastward main track using diesel-electric locomotive units in shuttle service. By about 4 a.m. on January 21, 1985, the catenary over most of the eastward main track had been repaired, and trains were moved on the eastward main track by electric power using train orders. About 10:15 a.m., the South Shore Superintendent of Transportation, who is located at Michigan City, Indiana, issued General Notice No. 62, which specified that the eastward main track would be used for single-track operation of eastbound and westbound trains under single-track operating rules between Clark Crossover at milepost (MP) 61.6 and the east end of the double track at MP 58.1, which is about 0.8 mile east of Gary Station.

The notice eliminated the requirement for the train dispatcher to issue a train order to move each train between the track limits specified in the notice. All the area covered by the notice was within Gary yard limits. (See figure 1.) The notice was posted about 10:15 a.m. on January 21, 1985, at the reporting point for traincrews and enginecrews in Michigan City. About the same time, copies of the notice were forwarded by a train messenger to be posted at the Randolph Street Station in Chicago.

Also, on January 21, 1985, the Superintendent of Transportation issued General Notice No. 61 specifying a drop pan ^{2/} area between MP 59.4 and MP 60 on the eastward main track where the catenary could not be used because of damage. Automatic wayside block signal 591, which governs eastbound train movements on the eastward main track, is located at MP 59.42, which was within the drop pan limits. Signal 591 was not removed from service, and it would have displayed a stop-and-proceed aspect (see appendix C, rule 291) as its most restrictive aspect if:

- (a) a train were occupying the eastward main track at Gary Station,
- (b) a train were between signal 591 and Gary Station,
- (c) a switch on the eastward main track between signal 591 and Gary Station were open,
- (d) the inside switch just east of Gary Station leading from the ADD track to either the eastward or westward main tracks were aligned to permit a train movement from the ADD track to the eastward main track (the switch normally is aligned from the ADD track to the westward main track),
- (e) the eastward main track switch leading to the ADD track (through the inside switch) either was unlocked or was open,
- (f) a broken rail was in the signal block, or
- (g) there was a malfunctioning signal.

Train No. 213.--At 12:40 p.m. on January 21, 1985, a crew consisting of a conductor, an engineer, and a collector/brakeman reported at Michigan City for their assignment. The crewmembers compared the time shown on their watches with the time shown on the standard clock at Shops and on each other's watches when they reported for

^{2/} Usually a damaged section of the catenary system that requires the engineer to lower the pantographs while passing beneath that section.

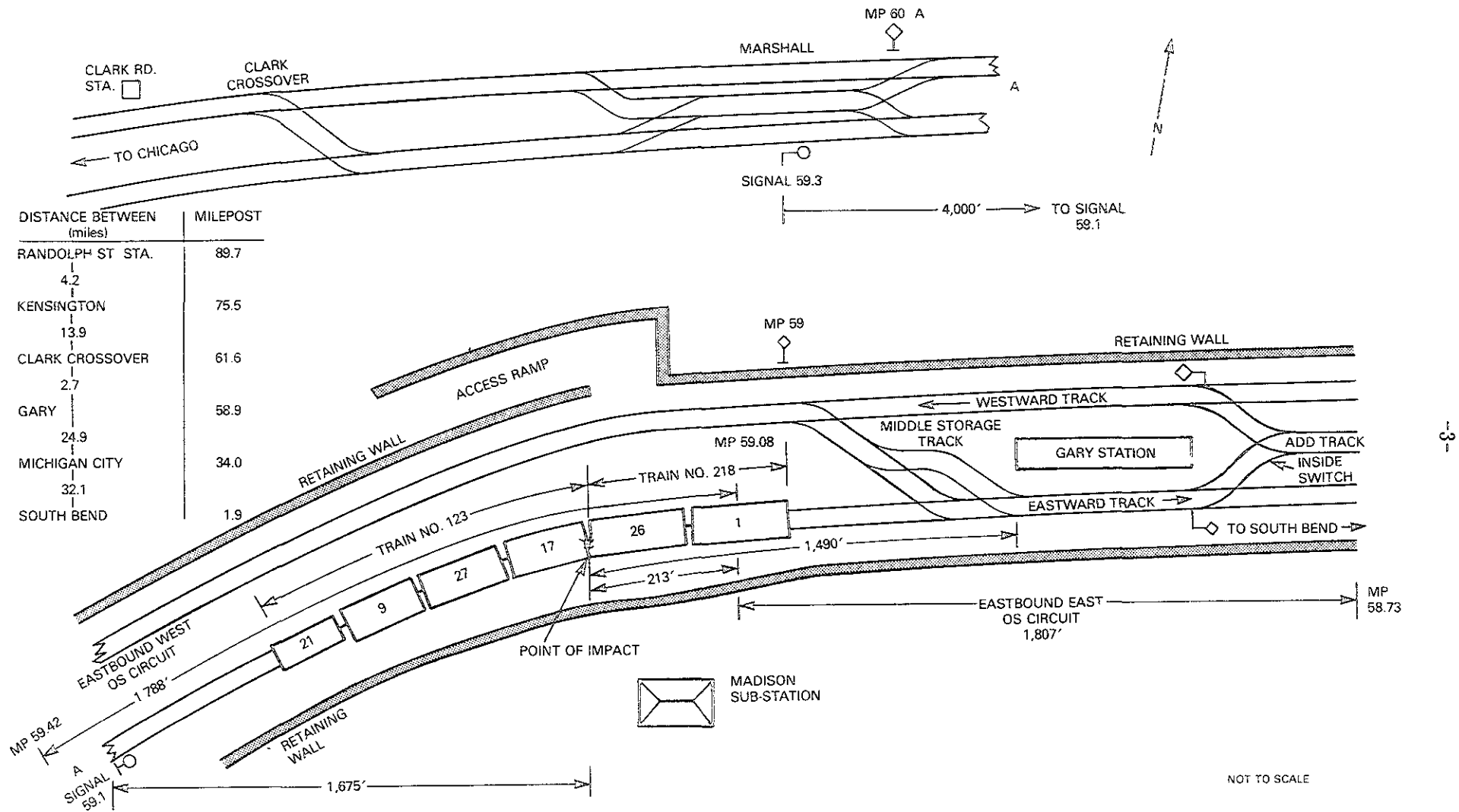


Figure 1.--Plan view of accident site.

work. They said that the times shown on their watches were "acceptable" in both instances. The crew deadheaded ^{3/} to Randolph Street Station where they arrived about 2:10 p.m. The crew was assigned to operate train No. 213 to Gary. At 2:57 p.m., the dispatcher issued clearance card No. 210 to the conductor of train No. 213 specifying no train orders. At 3:15 p.m., after a satisfactory brake test, train No. 213, consisting of three multiple-unit electric cars, departed Randolph Street Station for Gary. The crew was aware of General Notice Nos. 61 and 62.

The trip toward Gary was unremarkable until the train passed Clark Crossover and the engineer could see automatic wayside signal 593 located west of Gary Station at MP 60.17. ^{4/} Signal 593 was displaying an approach aspect (see appendix C, rule 285), which indicated to the engineer that he must reduce the speed of his train to 30 mph and be prepared to stop at the next signal, signal 591, because it could be displaying a stop-and-proceed aspect. The engineer said that he reduced the train's speed to 30 mph to comply with the speed requirement of the approach aspect and at the same time he radioed the dispatcher about the approach signal aspect. He said that the dispatcher asked him for the block (signal) number, that he told the dispatcher the number, and that the dispatcher said "okay."

When the engineer of train No. 213 was able to see signal 591, he said that it was displaying a stop-and-proceed (red) aspect. The engineer said that about the time he saw signal 591, he was between MP 59.4 and MP 60 and dropped the train's pantographs in compliance with the drop pan order specified in General Notice No. 61. The train's forward momentum was sufficient to carry it beyond the drop pan area, where the pantograph could be raised again to draw power. If the engineer had stopped the train in the drop pan area, the train would have had to be towed from that point because the pantographs could not be used to draw propulsion power from the damaged catenary. The engineer said that he called the dispatcher and said, "I've got a 591 red, it's right in the pan drop, stop and proceed, what should I do?" He said that the dispatcher replied, "Well, you sure. . . can't stop. You are in the middle of a pan drop. You will be dead, so what are you telling me? You can't stop, you are going to have to whistle and proceed." The engineer of train No. 213 said that after this communication with the dispatcher he slowed the coasting train's speed to about 20 to 25 mph, blew two blasts on the whistle as the train approached signal 591, and continued past the signal. After clearing the drop pan area, he raised the train's pantographs and proceeded into Gary Station where the train arrived at 4:05 p.m. The engineer said that later during the tour of duty, while in Chicago, he told the conductor about his conversation with the dispatcher concerning the stop-and-proceed aspect displayed by signal 591.

The dispatcher later denied that he had a conversation about signal 591 with the engineer of train No. 213, and he said that he did not authorize the engineer of train No. 213 to pass signal 591 without stopping. The normal operating procedure for a train coming upon a signal displaying a stop-and-proceed aspect is for the engineer to stop the train, blow two blasts on the whistle, and then proceed past the signal at restricted speed. ^{5/} The dispatcher took no exception to the arrival of train No. 213 at the Gary Station. A trouble report maintained by the dispatcher and/or the telephone switchboard operator had no entry indicating a failed signal for either signal 593 or signal 591 on January 21, 1985.

^{3/} A crew in pay status but not operating a train in an assigned position.

^{4/} Signal numbers do not correspond with milepost indicators.

^{5/} Definition--Proceed prepared to stop short of train or obstruction expecting to find broken rail or open switch, or anything that may require the speed of a train to be reduced, not to exceed fifteen (15) miles per hour.

After train No. 213 arrived at Gary Station, the equipment was moved onto the ADD track 6/ to clear the eastward main track, and a fourth car was added. About 4:10 p.m., the conductor telephoned the dispatcher to report the arrival of train No. 213 at Gary and to obtain a clearance card for the crew's next assignment, train No. 216, scheduled to depart Gary at 4:45 p.m. for Chicago. At 4:10 p.m., the dispatcher issued clearance card No. 215 to westbound train No. 216 to the conductor specifying "no train orders." About 4:35 p.m., the equipment for train No. 216 was moved from the ADD track onto the eastward main track at the station platform and after passengers boarded, the train departed Gary on schedule at 4:45 p.m. The required brake tests were performed at Gary with acceptable results.

Eastbound train No. 115 en route from Chicago was scheduled to depart Gary Station for Michigan City, at 4:45 p.m., the same departure time as train No. 216. The crewmembers of train No. 216 did not discuss the location of train No. 115 among themselves or with the dispatcher. The crewmembers said later that train No. 115 was usually 5 to 7 minutes late and that train No. 216, because of its westward direction, was the superior train. 7/ However, after train No. 216 left Gary Station, and was near MP 61, the engineer radioed the engineer of train No. 115 to inquire about the train's location. At that time train No. 115 was west of Clark Crossover and did not arrive at Clark Crossover until after train No. 216 had crossed to the westward main track. Train No. 216 arrived in Randolph Street Station at 5:35 p.m. The crew's next assignment was to operate eastbound train No. 123 to Michigan City.

The Accident

Train No. 123.--At 5:47 p.m., the dispatcher issued clearance card No. 219 to the conductor of train No. 123 specifying "no train orders." The crew was aware that General Notice Nos. 61 and 62 were still in effect. At 5:58 p.m., train No. 123 departed Randolph Street Station, after a reportedly satisfactory brake test, with the crew operating the same four-car set of equipment they had operated inbound as train No. 216. En route to Gary, train No. 123 was delayed several minutes at Kensington Interlocking while moving from the Illinois Central Gulf Railroad (ICG) onto the South Shore track because of signal trouble at the Kensington Interlocking. Also, when train No. 123 arrived at State Line Interlocking, the engineer radioed the dispatcher that he had a stop signal. The dispatcher contacted the operator at the State Line Interlocking, who changed the signal to proceed, and the train proceeded toward Gary.

Just east of Kensington Interlocking, it is customary for the engineer of a South Shore train to radio the South Shore dispatcher when the train has entered onto the South Shore track. The dispatcher recorded the time the engineer of train No. 123 reported onto the South Shore track as 6:25 p.m. The dispatcher later stated that this reporting time is not significant in figuring a train's running time, 8/ because of variations in the reporting and recording of these times. According to the dispatcher the time only serves to let the dispatcher know that the train is on the South Shore line.

6/ A storage track located just east of the Gary Station and between the two main tracks used to store equipment. (See figure 1.)

7/ Rule S-71, South Shore Timetable No. 5, effective 4:01 a.m., Sunday, October 31, 1982, reads "westward trains are superior to eastward trains of the same class."

8/ The train's schedule specifies the time a train should require between stations. In most instances a train can run between two stations in less time than is shown in the schedule. If a train is late, the dispatcher can calculate the time a train can be expected to arrive at a station by knowing the actual running time versus the scheduled running time.

The engineer of train No. 123 said that while the train was stopped at Clark Road Station about 0.2 mile west of Clark Crossover to discharge passengers, he referred to his timetable to verify the scheduled 6:50 p.m. departure time from Gary Station for westbound train No. 218. Further, he verified the scheduled 6:50 p.m. departure time from Gary Station eastbound to Michigan City for train No. 123 and checked the time train No. 123 was due to pass Clark Crossover. He confirmed that train No. 123's scheduled time at Clark Crossover was 6:42 p.m. He said that he then checked his watch for the time, which he remembered as being 6:44 p.m. or 6:45 p.m. The engineer said that after the passengers detrained he looked back at the conductor, who was on the ground, for a signal and that the conductor was pointing to his watch. The engineer said that he understood the conductor's action to be a reference to time and that to him it meant the conductor believed that sufficient time was available for train No. 123 to continue to Gary Station and arrive by 6:50 p.m. He said that he believed this meant he could depart Clark Road Station, pass Clark Crossover, continue into Gary Station, and clear the track for train No. 218. At the same time he too concluded that there was sufficient time to operate train No. 123 to Gary Station and arrive there before 6:50 p.m. He estimated that it would take a maximum of 3.5 minutes to proceed into Gary Station from Clark Crossover. He departed Clark Road Station, continued past Clark Crossover, and proceeded toward Gary Station. (Even though a conductor gives a proceed signal to an engineer, the engineer does not have to leave that location unless the engineer believes that the train can reach the next clearance point or station in time to clear the track for an opposing superior train. (See appendix C, rule 1005.))

The conductor testified that when he checked the time on his watch at Clark Road Station it was 6:45 p.m. He said that this allowed train No. 123 five minutes to proceed to Gary Station and to clear the eastward main track at Gary Station for train No. 218. He testified that he believed 5 minutes was sufficient time for this move. Therefore, he gave the engineer a proceed signal. Neither man said initially in their interviews how they expected to clear train No. 123 from the eastward main track for train No. 218, but they said that they expected train No. 218 to be in the ADD track until train No. 218's scheduled 6:50 p.m. departure time. Later, the conductor and engineer said that they had expected to back onto the storage track west of Gary Station to clear the eastward main track for train No. 218, either unloading passengers before getting in the clear or after train No. 218 had left.

The engineer said that when train No. 123 approached signal 591, it was displaying a stop-and-proceed aspect. However, he said that he believed the circumstances at that time were the same that had confronted him earlier in the day on train No. 213, so he did not call the dispatcher. He said that he dropped the train's pantographs and sounded two blasts on the whistle, and that the train coasted past signal 591 at an estimated speed of between 25 and 30 mph. (In later testimony, the engineer said that the speed was 15 to 17 mph.)

Almost immediately after train No. 123 passed signal 591, the train came to the end of the drop pan area, and the engineer operated the control to raise the pantographs. He said that he looked back over the train to see if all the pantographs had raised properly, and that when he looked forward again he saw a train's headlight in front of him at a distance he estimated to be from 1,000 to 1,200 feet. He said that he may have grabbed the radio receiver (handset) to call the other train, but he did not use it. Instead, he released the deadman control foot pedal and ran back into the passenger compartment. He said he believes that he shouted a warning to the passengers, but he was not certain. He said that after reaching the passenger compartment, he started to seat himself in a coach seat, but that he was suddenly thrown into the seat when the trains collided.

Train No. 218.--At 2:45 p.m., on January 21, 1985, a crew consisting of a conductor, an engineer, and a collector/brakeman, reported for work on their regular assignment at Michigan City. The crewmembers compared the time shown on their watches with the time shown on the standard clock at Shops and on each other's watches when they reported for work. They said that the times shown on their watches were either correct or within an allowable 30-second deviation and that the times on their individual watches compared satisfactorily. The crew deadheaded to the Randolph Street Station where they arrived at 4:30 p.m. The crew was assigned to operate eastbound train No. 121, destined to Michigan City, as far as Gary.

At 5:12 p.m., the dispatcher issued clearance card No. 218 to the conductor of train No. 121 specifying "no train orders." At 5:28 p.m., after a proper brake test, train No. 121, consisting of six multiple-unit electric cars, departed Randolph Street Station for Gary, where it arrived about 6:35 p.m., 10 minutes late. The crew's next assignment was to operate westbound train No. 218, scheduled to leave Gary Station at 6:50 p.m., from Gary to Chicago.

According to the testimony of the dispatcher and conductor of train No. 218, the conductor telephoned the dispatcher about 6:40 p.m. to obtain a clearance card for train No. 218. At 6:41 p.m., the dispatcher issued clearance card No. 220 to the conductor of train No. 218 specifying "no train orders." The crew was aware that General Notice Nos. 61 and 62 were in effect. The conductor said that when he received the clearance card, he asked the dispatcher if "he [westbound train No. 218] should lay back and allow [eastbound] train No. 123 to come into Gary." The conductor wanted to know if he should be given instructions or a train order to wait for train No. 123, which he knew was due to depart Gary Station eastbound for Michigan City at 6:50 p.m., the same time train No. 218 was scheduled to depart westbound for Chicago. The conductor said that the dispatcher replied, "you've got your orders, you [train No. 218] are the superior train; if he comes in [into Gary Station] it's his head." The conductor said that the dispatcher then gave him verbal permission to bring the equipment for train No. 218 out of the ADD track and to occupy the eastward main track at Gary Station.

The dispatcher later testified that he saw no conflict between train Nos. 123 and 218 because he believed that train No. 123 was about 10 to 11 minutes late. Later in his testimony, he said that he could verify only that train No. 123 was 7 minutes late and that he anticipated some delay because of the drop pan section. He said that based on his belief that eastbound train No. 123 was late, he believed it would not proceed east of Clark Crossover until after westbound train No. 218 arrived at that location and crossed over to the westward main track to clear the eastward main track.

The conductor informed the engineer and collector/brakeman of train No. 218 of his conversation with the dispatcher. The conductor gave instructions to a mechanical department employee (a car inspector) to bring the equipment for train No. 218 from the ADD track up to the switch leading to the eastward main track. About 6:45 p.m., the crew boarded the equipment for train No. 218, which consisted of two multiple-unit electric cars, and moved it onto the eastward main track at the Gary Station platform so passengers could board and the train would be ready to depart on schedule at 6:50 p.m. No flag protection was established to protect the equipment. The car inspector and the engineer made a satisfactory brake test on the equipment.

The crewmembers testified later that after only three passengers boarded the rear car, train No. 218 departed Gary Station westbound about 6:50:20 p.m. Immediately after the train left the station, a running brake test was made by the engineer and acknowledged by the collector/brakeman, which signified to the engineer that the brakes were operating properly.

The engineer said that when train No. 218 was about 1,000 feet west of Gary Station, while in a 2°39' curve to the left and at the beginning of a 1.92-percent descending grade westward, he saw the headlight of an approaching train on the eastward main track. He said that he placed the train brakes into emergency and ran back into the passenger compartment, which was occupied only by the conductor. He shouted to the conductor to "hit the floor," and then he dropped to the floor just before the trains collided.

The collision occurred about 6:50:42 p.m. about 1,490 feet west of Gary Station while train Nos. 123 and 218 were moving about 30 mph and 15 mph, respectively. The lead car of each train was derailed as a result of the collision. The front of each car was crushed severely in the vestibule area. When the two trains collided, the catenary power was disrupted. The propulsion power monitoring system indicated that power was disrupted at 6:50:42 p.m. 9/ The engineer of train No. 218 radioed the dispatcher of the accident, who in turn called for emergency assistance.

Injuries to Persons

<u>Injuries</u>	<u>Crewmembers</u>		<u>Off-duty</u>	<u>Passengers</u>	<u>Total</u>
	<u>No. 218</u>	<u>No. 123</u>	<u>employees</u>		
Fatal	0	0	0	0	0
Nonfatal	3	3	2	79	87
None	0	0	0	26	26
Total	<u>3</u>	<u>3</u>	<u>2</u>	<u>105</u>	<u>113</u>

Damage

The forward vestibule areas of the two lead cars were crushed on impact. Frame and body deformation was evident to a depth of about 8 feet into the passenger compartment of each unit. (See figures 2, 3, and 4.) The two lead cars were estimated to be a total loss, while the trailing cars received only minor damage. Damage to the track was negligible, and there was no damage to the catenary or signal systems.

The South Shore estimated the damage to be:

<u>Car No.</u>	<u>Damage</u>
1	\$ 8,000
26	1,200,000
9	5,000
17	1,200,000
21	5,000
27	15,000
	<u>\$2,433,000</u>

9/ Specifically, the recorded time was shown as 1850.7 (6:50:42) on the monitoring equipment.



Figure 2.--East view of first and second cars of train No. 123 (foreground) and train No. 218 (background).

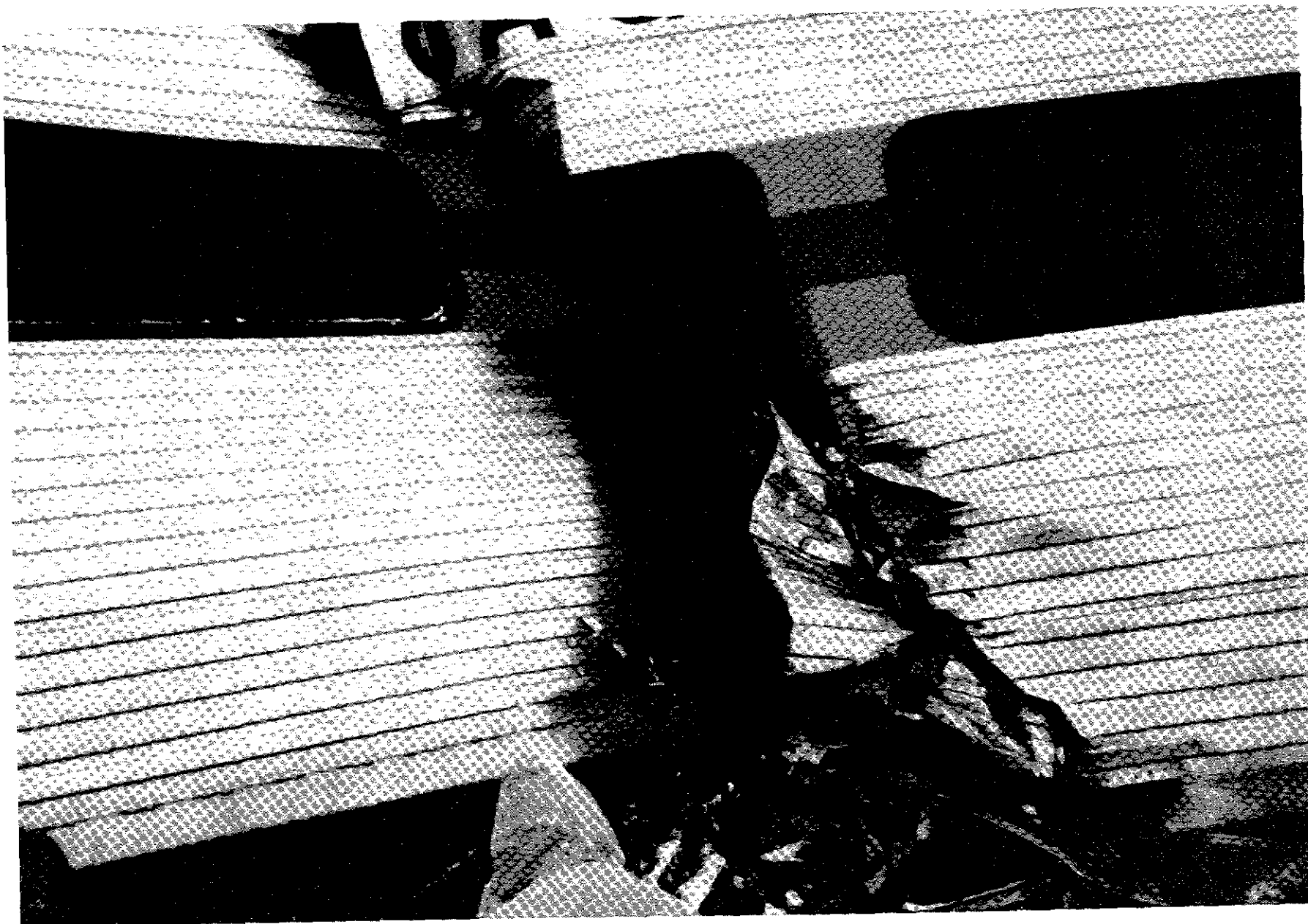


Figure 3.--Lead units of train Nos. 123 (left) and 218 (right).

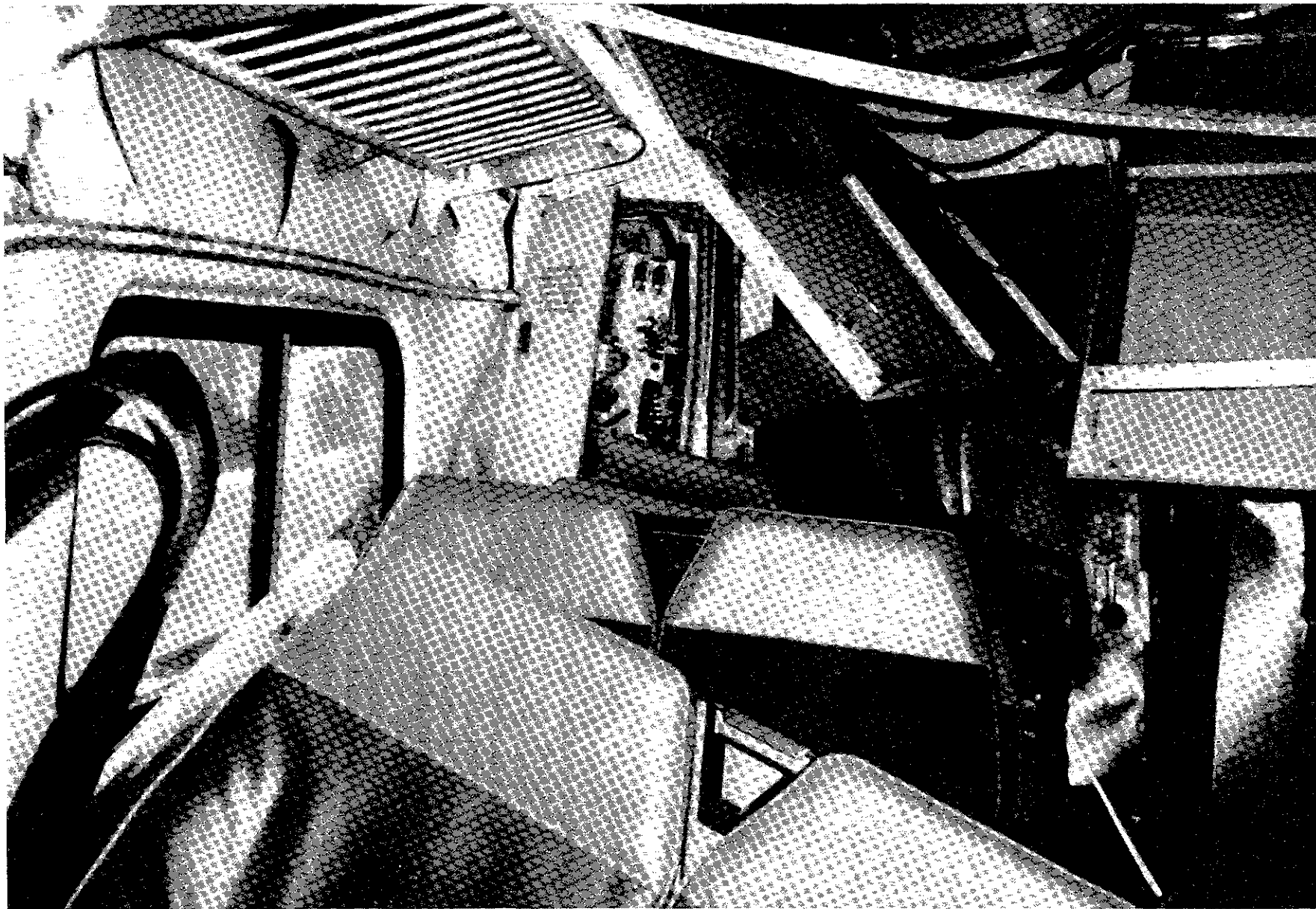


Figure 4.--Interior of lead car of train No. 123.

Crewmember Information

The crewmembers of each train and the dispatcher were all qualified for their respective positions in accordance with South Shore operating rules. Before reporting for duty on January 21, 1985, all crewmembers and the dispatcher had the required rest specified by the Federal Hours of Service Law, 49 CFR 228.19. In addition, all train crewmembers and the dispatcher testified that they were satisfied with their assignments, and that they were physically rested and alert before and while on duty on January 21.

The dispatcher had been qualified as a dispatcher since November 1979, and on January 21, 1985, he was working his regularly assigned 3 p.m.-to-11 p.m. shift. He had served as a collector/brakeman and an engineer, and in April 1980 he was promoted to the position of dispatcher.

Some South Shore train and enginecrew employees told Safety Board investigators that they were reluctant to communicate with the train dispatcher because he was curt and gave them the impression that they were not to bother him. The chief dispatcher, who had been in that capacity only for about 4 weeks, said that he had observed this discourteous communications manner in the dispatcher and that about the time of the accident he was planning to speak to him about his attitude.

The crewmembers of each train were working regular assignments, except the engineer of train No. 123, who had been an emergency 10/ engineer since October 30, 1980, and an extra train dispatcher since April 27, 1984. He had served as a collector/brakeman and worked as an engineer in freight and passenger service. He also worked each Friday from 3 p.m. to 11 p.m. as a train dispatcher. He testified that the irregular work routine had not caused him any concern and that he believed he performed his job safely. (For additional crewmember/dispatcher information, see appendix B.)

Training

Training for South Shore operating employees is accomplished by on-the-job training (OJT). All employees in train and engine service begin training as collectors/brakemen in passenger service. The trainees begin training by studying the first 35 pages of the operating rules book, which includes operating rule 99 and the current timetable, and by becoming familiar with the work in passenger and freight service. The trainees are assigned to one or more senior employees for OJT. These instructor employees are selected on the basis of their performance record, congeniality, and ability to instruct and communicate effectively. The senior employees selected to train newly hired employees are not given any specific training as instructors to prepare them for their roles as instructors, and they are not given additional pay for training junior employees. After the trainee works up to 15 days with the senior employees, and if the trainee is considered qualified by the senior employees, each instructor signs a letter of introduction previously presented to him by the trainee. The letter of introduction given to the trainee by the Superintendent of Transportation identifies the trainee and specifies that he is authorized to be on the property and that he is to be trained as a new employee.

The trainee is assigned next to work in freight service as a head brakeman for 10 to 20 days. The trainee is then tested orally by the Superintendent of Transportation or an assistant on the training received, which includes questions on the portion of the operating rules the trainee was assigned to learn. There is no definite policy governing the

10/ The South Shore refers to extraboard personnel as emergency crews. They fill job vacancies resulting from vacations, illnesses, etc.

procedure to be followed if a trainee fails the tests. However, if the trainee does not show an aptitude for the work to be performed as a railroad employee, he is dismissed. If he passes this first test, he still must serve a 60-day probationary period to prove himself. Except for the OJT program, there is no formal training curriculum established, and no specific list of tasks or skills to be mastered is provided to either the instructor or the trainee.

Following his initial OJT, the trainee must work 8 to 12 months as a collector/brakeman or head brakeman, after which the trainee must pass an oral and written examination on the operating rules. A passing grade of 85 percent is required for the trainee to continue OJT. There are no specific questions pertaining to the operating rules that must be answered correctly for the trainee to obtain a passing grade. Those employees who fail the test are returned to OJT, and they continue to study the operating rules and test material. The questions missed on the failed test are not reviewed with the employee. A retest must be taken within a week. The retest is the same test given the first time. A second failure results in dismissal. If the employee passes the test, a company officer reviews with the trainee those questions he missed, if any. Following successful completion of this phase of training, the trainee must perform 1 day of OJT with a qualified rear brakeman to qualify as a rear brakeman in freight service. Following the OJT as a rear brakeman, another test is given the trainee consisting of 171 written questions and additional oral questions. The same passing qualifications and test review procedures apply to this test as to that which follows the initial OJT. After 1 or 2 years, the employee may be required to take a promotion to the position of either conductor or engineer. If vacancies exist in both categories, the employee may choose a position; otherwise, the employee can be assigned to a vacancy in either category by a supervisor.

To prepare and qualify for promotion to the position of either conductor or engineer, the employee is given a still different test from the one following his initial OJT and qualification as a rear brakeman. This test is composed of a 687-question examination on operating rules given as a take-home test. In format it consists of the operating rules with the omission of key words which the employee must supply. Then the employee is examined on the rules by a company officer, rule by rule. The employee must answer 85 percent of the questions correctly to pass the examination.

If the employee has elected or has been appointed to become a conductor, the employee receives 3 to 5 days OJT from a senior passenger conductor. Following this training, the employee receives OJT under the supervision of a senior freight conductor for 12 to 30 days. Completion of this training qualifies the employee as a conductor, and the employee's name is placed on the list of emergency (extraboard) conductors. Advancement thereafter is in accordance with seniority and ability.

The engineer trainee undergoes a similar training procedure under the supervision of a qualified senior engineer. The employee is placed in passenger service for 15 to 20 days in OJT. After passing this phase of training, the employee receives OJT training in freight service for about 30 days. During the OJT, the Road Foreman of Engines monitors the employee's progress by direct observation. The OJT is followed by an oral examination covering operating rules, and the location of switches, crossovers, and signals. Completion of this training qualifies the employee as an engineer, and the employee's name is placed on the list of emergency (extraboard) engineers. Advancement thereafter is in accordance with seniority and ability as judged by operations management.

Conductors and engineers may be promoted to train dispatcher as the need arises. Train dispatchers are selected on the basis of their performance on their assigned job, on their attitude, knowledge of operating rules, and personality as observed by operations management personnel. No formal evaluation tests are given. This is an optional advancement for management-approved train service employees when a vacancy occurs. The dispatcher trainee puts in an average of 120 to 150 hours of OJT. Following OJT in the dispatcher's office, the trainee is examined orally on the operating rules by a company officer. Completion of this training qualifies the employee as a dispatcher, and the employee's name is placed on the list of emergency (extraboard) dispatchers. Vacancies that occur in operations management usually are filled from the dispatcher's office.

All employees are required to be reexamined on the operating rules every 2 years. A passing grade of 85 percent is required for an employee to remain in company service. The biennial rules examination consists of a 100-question, multiple-choice test which is prefaced with a slide-tape presentation of actual occurrences on the railroad which highlight applications of rules. If an employee fails the reexamination, he is required to be reexamined. His reexamination can be taken immediately, and he has three opportunities to pass.

Train Information

The multiple-unit electric cars involved in the accident were built between 1981 and 1983 by Sumitome Corporation of America and Nippon, Sharyo, Seizo, Kaisha, Ltd. of Japan. The cars are powered from a 1,500-volt d.c. catenary system. Four electric traction motors produce a total of 640 horsepower per car. The average emergency braking rate for stops from all speeds of 70 mph or less with a full seated passenger load is 2.5 mphs. ^{11/}

The car bodies are 85 feet long, are constructed of stainless steel, and seat 93 passengers. Operating controls are located at each end of the car. The airbrakes are controlled by a type 26B-1 airbrake control valve. The total braking system includes an airbrake blended with dynamic brakes. The cars were built and tested to comply with applicable standards prescribed by the Federal Railroad Administration (FRA) or the Association of American Railroads (AAR).

The cars are equipped with a public address system, an intercom system for intracrew communication, and a radio with three operable frequencies. The cars are equipped with a deadman control operated by a foot pedal at the engineer's operating position. The deadman control foot pedal is interconnected with the throttle so that when both are released, an emergency brake application will be made. First aid kits are provided for each car and stored in each end vestibule. An emergency tool kit for each car is stored under the first passenger seat on the noncab side of the car at the "B" end (brake end).

The seating arrangement of each car is such that about one-half of the seats face in one direction and one-half face in the opposite direction. Doors into the vestibules are located at each end of the passenger compartment. Side doors provide access to the vestibules. A pair of side sliding doors is located in the middle of the car on each side. An emergency window exit is at each end of the car on opposite sides, and two emergency window exits are on either side near the center of the car. Instructions for opening the doors manually in the event of power failure are posted. Windows are glazed with safety glass. When catenary power is lost, emergency lights in the cars are powered by

^{11/} Deceleration rate in miles per hour per second.

rechargeable storage batteries. The emergency lights in the two lead cars did not function after the collision because the crushing deformation of the cars severed the cables supplying power to the lights.

The radios were not tested following the accident because the crash damage to the two head cars crushed the radios. However, the radio on train No. 123 had operated satisfactorily earlier during the eastbound trip, and there had been no complaints about the radio on train No. 218.

Track Information

In a westerly direction from Gary Station, the double-track main line is built on a contained fill about 25 feet above the street level. Protective handrails are provided along the tops of the retaining walls. The track is constructed of 115-pound, RE continuous-welded rail set on 13-inch tie plates and 7-inch by 9-inch by 8-foot 6-inch wood crossties. The main tracks are built on about 31-foot centers at the point of the accident because of a center track which ends just east of the point of collision. The catenary system in the area of the accident is supported over the tracks on steel structures.

The catenary system was installed about 1906, originally as a 6,600-volt a.c. system. It was rebuilt between 1926 and 1929 as a 1,500-volt d.c. compound-catenary system. The catenary is aligned approximately to follow the centerline of the track. A 9-inch deviation is tolerated to either side of the track centerline. The trolley wire is maintained approximately 22 feet above the top of the rail (ATR).

The South Shore patrols the catenary system at 6-month intervals, and deficiencies are noted and repaired. Anomalies, such as trolley wire tension in cold weather and sag in hot weather, are watched constantly, and action is taken to protect the system when irregularities are observed. Excessive sag can create a need for drop pan orders. The contact wire is renewed as required.

General Notice No. 61 was issued because of a break, caused by cold temperatures, that occurred in the trolley wire at MP 59.68 in Gary. Breaks are prone to occur because of metal fatigue or at heavy wear locations such as at station platforms, where trains are continually starting, or at overhead bridges and at points where the catenary varies in height ATR. Most breaks occur in the trolley wire itself, with some occurring in the secondary messenger. The primary messenger almost never breaks. (For additional catenary information see appendix D.)

Method of Operation

South Shore operating rule No. 3 requires that train and enginecrew employees compare their company-approved standard watches with a standard clock when going on duty. Standard clocks are located at Shops in Michigan City where the crews report for duty and at the dispatcher's office. The standard clocks are set automatically each day at 6 a.m. and 6 p.m. by an automatic time-synchronizing signal. The time indicated by the standard clock varies by only 3 or 4 seconds per time-set period. If a trainman's watch is more than 30 seconds fast or slow, it must be set to indicate the correct time. In addition, members of a traincrew are required to compare the time indicated by their watches with the time shown by each other's watches at the beginning of a tour of duty and to synchronize them if necessary.

Trains are operated over the double track main line of the South Shore between Kensington Interlocking on the ICG at 115th Street in Chicago and the east end of the double track east of Gary by the aspects of automatic wayside color light signals, and by timetable, train orders, and general notices. Between the east end of the double track at Gary and South Bend, Indiana, train movements are governed by the aspects of automatic wayside color light signals and single-track operating rules, which include timetable, train orders, and general notices.

Special instruction rule 83a contained in timetable No. 5, effective 4:01 a.m., Sunday, October 31, 1982, provides for a delay of 3 minutes for a train leaving South Bend if the schedule of two trains would cause them to meet at South Bend. The timetable for the single-track portion of the South Shore between Gary and South Bend does not indicate any eastbound and westbound trains due at the same station at the same time unless there is a siding shown. The timetable indicates where a scheduled meet with an opposing train will occur. The meeting time is shown in bold print, and the train being met is indicated. (See appendix E.)

The headblock (home) signals 12/ are provided with lightout protection and arranged so that if a bulb burns out in the green (clear) proceed position, the yellow (approach) aspect will be displayed. This decreases the possibility of a dark signal, which in most cases would require a train to stop.

The train dispatcher is located at Michigan City. The dispatcher does not have control facilities to operate track signals or switches, but does control train order signals at Gary and at Shops in Michigan City by which he can signal an engineer to stop a train and have a crewmember call him for instructions. The dispatcher is provided with a dedicated dispatcher's telephone and company and AT&T dial-telephone circuits. He can communicate with the train engineers by radio. The South Shore does not have a tape monitor on the dispatcher's communications circuits.

The South Shore does not have manned reporting stations along the line to report the time a train passes a given location. In some instances during the day, a ticket agent may report a train's passing at his station, but at night there are no ticket agents on duty. However, the dispatcher can obtain the time a train passes a given location by calling the train's engineer. When a train arrives at Gary, Michigan City, Randolph Street Station, or South Bend, the train's conductor reports to the dispatcher the train's arrival time. In addition, the dispatcher can obtain the time a train enters or leaves the "OS" 13/ track sections (referred to as the "OS time") at the power substations from the propulsion power monitoring equipment. (The controls and an information printout unit for the equipment are in the dispatcher's office.) When a train is scheduled to leave its initial station, the conductor is required to contact the dispatcher, which usually is done by telephone, to determine if the dispatcher has any train orders or special instructions for the train. The dispatcher gives the conductor train orders orally and/or gives a clearance card specifying either the train orders for that train or that there are no train orders.

When the main track is kept in service and short spans of the catenary system are not usable for electric train operation, the dispatcher must issue a "drop pan" train order, or provide such information on a clearance card. An engineer is expected to allow the train to attain enough speed so that it will coast through a drop pan area with

12/ The signal at the entrance to a signal block indicating a condition affecting the movement of a train.

13/ The recorded time a train passes a designated location.

the pantographs lowered. If a drop pan area spans a wayside signal, the signal may be taken out of service by a train order or a general notice. South Shore's Superintendent of Transportation said, however, that a signal is never taken out service if the signal is operating properly. If time permits, or if the drop pan order will be needed for an extended time, a general notice is issued specifying the limits of the drop pan area.

According to operating rule No. 291 an engineer is required to stop a train for a stop-and-proceed signal aspect even if it is in a drop pan area. According to the train dispatcher, there is no provision in the rules which allows a train to pass a stop-and-proceed signal aspect in a drop pan area, and he testified that he did not have the authority to authorize a train to pass a stop-and-proceed signal aspect. South Shore's rules examiner said that while a train dispatcher cannot orally countermand an operating rule, he can issue a train order or message over the Superintendent of Transportation's name and modify or bypass an operating rule. Moreover, the dispatcher can issue a "call order" to a train, which directs a member of the traincrew to call the dispatcher before the train moves past a designated location.

Under single-track operating rule No. S-71 (Timetable Special Instructions) on the South Shore, a westbound train is superior to an eastbound train, i.e., an eastbound train must clear the main track if it meets a westbound train of the same class. Opposing trains of the same class 14/ are allowed to meet on "flat time," which means that an eastbound inferior train complies with operating rule No. S-71 if it clears the main track at a designated point before a westbound superior train is scheduled to leave that same point. For trains of the same class, no clearance margin of time is required. South Shore operating officers said that train No. 123 should have cleared the track for train No. 218 at Clark Crossover (by remaining west of the crossover) or at Marshall, or at the west end of Gary Station before 6:50 p.m., the scheduled departure time of train No. 218. (See figure 1.)

According to the South Shore rules examiner, equipment for a scheduled train cannot be brought out to occupy the single main track before the train's scheduled departure time without instructions from the dispatcher. A scheduled train has no right to occupy the track until its scheduled time. The crewmembers involved in this accident said that it is a practice at Gary Station that passenger equipment is brought onto the appropriate main track ahead of the train's scheduled departure time so that passengers can board and the train depart on time. The dispatchers regularly authorized the traincrews at Gary Station to bring the equipment for the train they are scheduled to operate onto the main track ahead of the scheduled departure time.

If equipment is moved onto the main track ahead of a train's scheduled departure time, flag protection must be provided to the front and to the rear of the train on single track and to the rear on double track when operating with the current of traffic. Special instruction No. 975 in the current timetable and operating rule No. 99 specify the conductor's responsibility in supervising a traincrew, including his responsibility to ensure that flag protection is provided under circumstances where it is required. The train crewmembers involved in this accident did not remember ever providing flag protection when equipment was brought onto the main track at Gary Station before a train's scheduled departure time.

14/ Trains are assigned a class by timetable. A first-class train is superior to a second-class train, etc.

There is a programmed 3-minute delay before the eastward main track switch leading to the ADD track can be aligned to divert an eastbound train from the eastward main track onto the ADD track if a train is between MP 60.29 (west of Gary Station) and the switch. The timing cycle is started when the switch lock is removed from the hasp, thus unlocking the switch. When the switch is unlocked, signal 591 immediately displays a stop-and-proceed aspect, and signal 593 displays an approach aspect. The timing cycle is intended to prevent the switch's alignment from being changed to the ADD track immediately ahead of an eastbound train that already might have passed signal 591.

Meteorological Information

At 6:50 p.m. on January 21, 1985, it was dark with some blowing snow. The temperature was 12° F with visibility about 5 miles, and the wind was from 270° at 10 knots gusting to 20 knots. Data provided by the National Weather Service at Gary indicates that the temperature dropped from about 28° F during the afternoon of January 18 to minus 22° F by about 6 a.m., on January 20. The temperature rose from minus 22° F to 15° F by about 1 p.m. on January 21. The lowest temperature recorded from January 18 through January 21 was minus 22° F.

Medical and Pathological Information

South Shore operating officers requested a toxicological test of both engineers, but not of the dispatcher or other crewmembers. Blood and urine samples were drawn at 10:40 p.m. and 11 p.m. on January 21 from the engineers of train Nos. 218 and 123, respectively. The test results were negative for alcohol and drugs for the engineer of train No. 218. The test results were negative for alcohol but positive for acetaminophen for the engineer of train No. 123. Acetaminophen is a drug used as a pain suppressant in some commonly used patent medicines. It does not have adverse human behavioral effects at therapeutic levels.

Of the 87 persons injured in the accident, 9 passengers and 2 crewmembers were admitted to area hospitals, while 70 passengers, 2 off-duty employees, and 4 crewmembers were treated and released. The nature of the injuries received by those injured were reported to be concussions, multiple bruises, lacerations, and fractures of the arms, legs, and thighs.

Survival Aspects

The forward outside body shell of the vestibule on each lead car was crushed so that the vestibule was compacted. The first rows of seats for a distance of about 8 feet were squeezed together. The sides of the cars bulged outward near the impacted ends. The luggage racks in the forward ends of the cars bent, and some became detached. The seats in the cars, except for those in the crush areas, did not separate from their floor moorings. No seat cushions were knocked loose in any seats behind those affected by the crushing forces. Passengers could not exit through the forward ends of the lead cars, but the doors to the rear and the side doors could be opened manually by following the emergency sequence indicated in the printed information on the coach walls.

The engineer of train No. 218 informed the dispatcher of the collision using the radio at the rear of the second car of his train. The dispatcher immediately notified emergency personnel who arrived in about 15 minutes. Rescue efforts were difficult because the trains collided where the track was about 25 feet above street level. However, a ramp on the north side of the track structure provided adequate access. Units from the Gary fire and police departments and those of several surrounding communities responded quickly, gave first aid, and evacuated the injured to local hospitals.

Tests and Research

All signal equipment was found to be operating properly on January 21, 1985.

Sight and distance tests were conducted about 9 p.m. on January 24, 1985. Two cars of the same design as the cars involved in the accident were positioned at the point of impact, simulating train Nos. 123 and 218. The weather was clear, and the temperature was in the low 20s° F.

At the beginning of the tests, the two cars were backed away from each other at 50-foot intervals, and the view of each engineer toward the other train was evaluated. The backoff continued until the two cars were 1,000 feet apart. Positive identification as a train was established at distances from 50 to 500 feet apart. The identification of a car as a train was less positive at distances of from 500 to 700 feet apart.

Interstate 90 parallels the railroad at the accident site, and headlights from highway vehicles intermingled with the headlights of rail traffic. In addition, mercury vapor lights at a nearby steel mill facility were conspicuous in the background near the accident site. These were lighted on the night of the accident.

On March 7, 1985, the South Shore operated train No. 113, consisting of four cars in revenue service, for a running time test between Clark Crossover and Gary Station. The speed authorizations in effect on January 21 were observed. The temperature was 38° F, and the rails were dry. The 2.7 miles were covered in 4 minutes 20 seconds, with all wayside signals displaying clear proceed aspects.

Also on March 7, about 4:50 p.m., revenue train No. 115, with four cars, was operated between Clark Crossover and Gary Station with the engineer observing the drop pan requirements between MP 59.4 and MP 60 and the restrictive signal aspects displayed by signals 593 and 591 that confronted the engineer of train No. 123 on January 21. Under these conditions, with the temperature about 37° F, the running time between Clark Crossover and Gary Station was 4 minutes 45 seconds, including the required stop at signal 591, which was assumed to be displaying a stop-and-proceed aspect.

Other Information

A substation supervisory system, identified by its trade name as QEI, gives the train dispatcher various supervisory control functions and indication features for the system that provides power to the catenary. The dispatcher can use the system to remove and/or restore power at substations by opening/closing circuit breaker switches. The system has a "typer unit" in the dispatcher's office which prints out the time that faults occur in the system. The time on the "typer unit" printout is indicated to the nearest 0.1 minute. In addition, the year, month, and date are shown. A color cathode ray tube displays the same information that is printed on the "typer unit" printout.

The 3 p.m.-to-11 p.m. dispatcher on duty when this accident occurred testified that he monitors the time indicated by the QEI system by comparing it to the time indicated by the standard clock in the dispatcher's office or by comparing it with a standard time source obtained by telephone from Chicago. If it varies as much as 15 seconds, he resets it to the correct standard time. The printout time record is not used to record train passing times.

The QEI system records OS times on approach and departure circuits for the substations on each track. When a train actuates the approach circuit and when the train leaves the circuit, the time is printed on the "typer unit" printout. For the Madison Substation, near the accident site, the eastbound west OS time circuit extends 1,788 feet from MP 59.42 to MP 59.08 and the eastbound east OS time circuit extends 1,807 feet from MP 59.08 to MP 58.73 (0.16 mile east of Gary Station). ^{15/} The printout for the OS times does not identify the train by number, but the dispatcher can correlate these times with a train and obtain a passing time.

The "typer unit" printout for January 21, 1985, recorded several times associable with the accident. At 18:45.8 (6:45:48 p.m.) the printout indicates that a westbound train actuated the eastbound east OS time circuit for the Madison Substation. The train was identified by a South Shore officer as the equipment for train No. 218 entering onto the eastward main track from the ADD track at Gary Station. At 18:50.2 (6:50:12 p.m.) the printout indicates that an eastbound train actuated the eastbound west OS time circuit 0.62 mile west of Gary Station. The train was identified as train No. 123 approaching Gary.

The collision occurred approximately 213 feet west of the east end of the eastbound west OS time circuit. Because the QEI system records time in tenths of a minute, a recorded time can lag the event by up to 6 seconds (0.1 times 60 seconds). In addition, there can be a 2- to 3-second scanning time delay. Because of these factors, the speed of train No. 123 for the approximately 1,575 feet only can be placed in the range of 25 mph to 35 mph based upon the times recorded by the QEI system.

ANALYSIS

Train Operations

General Notice No. 62 specified that the eastward main track would be used for single-track operations and that single-track operating rules would be in effect to govern train movements until the catenary over the westward main track was repaired. Basically, the operation of trains under the authority of General Notice No. 62 was no different than when train orders were used before the issuance of the notice. As a matter of operational expediency, the Superintendent of Transportation issues a General Notice in the format of General Notice No. 62 when one of the two main tracks in double-track territory is to be used for single-track operations for an extended time. Since single-track operating rules are used regularly between Gary and South Bend, and operating employees are qualified on them, by issuing a General Notice to establish single-track operation for a given length of track, the superintendent can avoid delay to trains and reduce the workload of the train dispatcher.

The most serious problem arising from the establishment of single-track operation between Clark Crossover and the east end of the double track related to the concurrent scheduled departure of eastbound and westbound trains at Gary Station. Under double-track operating rules and procedures, this arrangement did not present a problem because each train occupied its own directional main track. Also, equipment for an originating scheduled train could enter onto a main track at Gary Station without difficulty because trains would be moving in only one direction on each track. The South Shore superintendent who prepared General Notice No. 62 said that when the notice

^{15/} The directions east and west refer to directions from the substation. The eastbound west OS time circuit extends westward from the Madison Substation and usually would be activated by an eastbound train.

was issued, he did not overlook the concurrent scheduled departure times and possible conflicts for opposing trains at Gary. He said that the intent of General Notice No. 62 was to define the limits of the single-track operation, and to establish single-track operating rules to govern train movements. Further, he said that he expected the traincrews and the dispatcher to resolve any operating conflicts that might arise during the movement of trains, such as the concurrent departure times of two trains at Gary Station, by use of the appropriate operating rule(s). Operating rule S-71 establishing the superiority of trains was one of the rules he expected to be used in resolving a possible conflict such as was present for train Nos. 123 and 218. The dispatcher apparently discerned no problem with continuing the established practice of allowing equipment to enter a track early to load passengers at Gary Station since General Notice No. 62 had not specifically prohibited the equipment of a westbound train from occupying the eastward main track before its scheduled departure time.

The crewmembers of train Nos. 123 and 218 as well as the dispatcher, being qualified on the South Shore operating rules, understood that westbound trains were superior to eastbound trains of the same class. They also understood that there was no minimum time factor involved in the main track clearance requirements for trains of the same class. It appears that the crewmembers of each train, the dispatcher, and the operating officers depended exclusively upon the rule governing the superiority of trains to deal with any conflicts of opposing trains.

Throughout the industry railroad operating rules officers differ in their understanding and application of the rules as to when equipment becomes a train. Some maintain that the equipment becomes a train subject to all relevant rules when the conductor receives a clearance card from the dispatcher or operator. Others believe that the equipment does not become a train until its scheduled departure time at a station. By definition in the South Shore operating rules, the equipment for train No. 218 was a train (see appendix C). However, train No. 218 had no operational rights until the timetable schedule authorized those rights at 6:50 p.m.

According to the South Shore operating rules, where one time is shown in a timetable for a train at a station, it is the departure time unless it is otherwise indicated. Thus, the times shown in the timetable for train Nos. 123 and 218 at Gary Station are departure times (see appendix E). However, the rules further state (rule No. 5, see appendix C) that where there is neither a siding nor fixed signals, the time indicated for a train applies where traffic (passengers) is received or discharged. Since there was no siding or a fixed signal at Gary Station, the application of this rule resulted essentially in an impasse, because it allowed both trains to be at the station platform at the same time. In consideration of the "flat time" meet permissible by the South Shore operating rules, this situation should have been addressed in General Notice No. 62.

The Safety Board believes that South Shore rule S-83 was applicable in this situation. Rule S-83 states, "A train must not . . . pass from one of two or more tracks to single track, until it has been ascertained whether all trains due, which are superior, have arrived or left." The conductor of train No. 218, in calling the dispatcher before moving the equipment for his train onto the eastward main track, did attempt to locate train No. 123, but the dispatcher did not provide him this information. While South Shore rule 93 allows inferior trains to use the main track within yard limits if superior trains are not delayed, rule 93 precluded train No. 218's equipment from entering the eastward main track at Gary Station until 6:50 p.m., because until that time train No. 123 was the superior train. The dispatcher erred in authorizing train No. 218's equipment to occupy the eastward main track without knowing the location of train No. 123. Since train No. 123 was not scheduled to depart Gary Station until 6:50 p.m., and so long as it arrived

there at or before 6:50 p.m., nothing would have been gained by train No. 123 clearing the eastward main track west of Gary Station before the passengers were discharged. The passengers could have been unloaded and train No. 123 could have left Gary Station at 6:50 p.m. (flat time) and continued toward Michigan City.

This analysis is predicated on on-time train performance, which should have been the basis for the instructions contained in General Notice No. 62, and emphasizes the importance of considering every possible aspect of train operations in formulating temporary deviations from standard procedures. Even though it had superior rights until 6:50 p.m. according to the rules, train No. 123 was 3 to 4 minutes late on its schedule, and it should not have attempted to reach Gary Station in the face of train No. 218's scheduled departure time at 6:50 p.m. The Safety Board concludes that General Notice No. 62 was not sufficiently explicit in dealing with the operating conflicts that could and did arise.

South Shore operating rule 83a provides for a delay of 3 minutes for a train leaving South Bend if the schedule of two trains would cause them to meet at South Bend. If a rule such as rule 83a, which is applicable only to the single-track operation at South Bend, had been put into effect at Gary by General Notice No. 62, or if a similar provision to eliminate the consequences of crewmembers misjudging the time by several minutes had existed, train No. 123 might have reached Gary Station safely. Rule 3, requiring the adjustment of the watches of crewmembers, would permit up to a 1-minute error in time if the times indicated by the watches were 30 seconds slow in one instance and 30 seconds fast in another. Thus, a rule similar to rule 83a, providing for a 3-minute delay in the scheduled departure time from a station if the schedule of two trains would cause them to meet at that point, would have provided a margin of safety and at most caused train No. 218 to depart Gary at 6:53 p.m., 3 minutes late. This extra time would have allowed train No. 123 to have arrived at Gary Station safely. Also, if eastbound trains, and train No. 123 in particular, had been issued a "call order" 16/ for the conductor or engineer of train No. 123 to call the dispatcher before the train passed Clark Crossover, the accident could have been prevented.

Since the South Shore dispatcher's communication circuits were not tape-monitored, there is no record of the communications that occurred at any time during the evening of January 21. The Safety Board has investigated several accidents 17/ in which communications between the dispatcher and engineer or interlocking operators were recorded by a tape recorder. These records, which also provide the time of the communications, have been invaluable in improving operating practices and in accident reconstruction. The South Shore should consider installing a tape monitor in the dispatcher's office to record and preserve communications between the dispatcher and mobile units or telephones.

The Dispatcher

The dispatcher's actions in some regards and lack of action in other regards indicated that he believed the crew of train No. 123 knew their train was the inferior train and that they were governed by rule S-71 (see appendix C) that required an inferior train to clear the main track for a superior train. He did not allow any margin for error.

16/ A form 19 train order issued by the dispatcher for a train crewmember to call the dispatcher before passing a specified location.

17/ Railroad Accident Reports--"Rear-end Collision Between Control Trains OIPI-6 and ENPI-6X, near Saltsburg, Pennsylvania, February 26, 1984" (NTSB/RAR-85/02); "Head-on Collision of National Railroad Passenger Corporation (Amtrak) Passenger Train Nos. 151 and 168, Astoria, Queens, New York, July 23, 1984" (NTSB/RAR-85/09).

The dispatcher was indifferent to the location of train No. 123 according to the conductor of train No. 218 when the conductor asked the dispatcher about his responsibility as conductor of train No. 218 if the two trains met. The dispatcher said that he believed train No. 123 was delayed at Kensington Interlocking and State Line Interlocking and would be running about 7 to 11 minutes late. Also, he said that he anticipated an additional delay for train No. 123 at the drop pan area between MP 59.4 and MP 60. However, this delay would have occurred after train No. 123 passed Clark Crossover. The dispatcher did not make any allowance for the possibility that train No. 123 might make up some of the lost time between State Line Interlocking and Clark Crossover.

It is apparent that when the conductor of train No. 218 was talking to the dispatcher, the dispatcher did not know the location of train No. 123, which seemingly should have dictated his trying to contact the engineer of train No. 123 to determine the train's location. Except under unusual circumstances a dispatcher is expected to and should know the location of a first-class passenger train to a closer tolerance than 7 to 11 minutes. A dispatcher should be able to predict a train's arrival at a given location fairly accurately because he knows the existing conditions, the performance characteristics of an engineer, and the range of running times of a train between various points. The dispatcher in this case should have had a good knowledge of running times based on his experience both as an engineer and as a train dispatcher.

If the time that engineers report their trains onto the South Shore tracks at Kensington Interlocking cannot be used reliably to calculate running times of trains, South Shore operating officers should establish a specific reporting point. The dispatcher incorrectly assumed that train No. 123 would be 7 to 11 minutes late when he allowed the equipment for train No. 218 to occupy the eastward main track at the Gary Station platform before 6:50 p.m. Since it was accepted practice to permit the equipment for a train to occupy the westward main track before a train's scheduled departure time under a normal double-track operation, the dispatcher apparently saw no problem in permitting No. 218's equipment to occupy the eastward main track in a similar manner. However, in a proper application of the rules he should not have given the conductor of train No. 218 permission to bring the equipment onto the eastward main track without a message or train order. The train and engine crews operating into and out of Gary Station knew that it was the practice to bring the equipment onto the westward main track before a train's scheduled departure time; therefore, the crewmembers of train No. 218 apparently did not believe it was unusual or unsafe for their equipment to occupy the eastward main track ahead of the scheduled departure time. This belief was strengthened by the conversation the conductor of train No. 218 had with the dispatcher concerning train No. 123. If train No. 123 had entered Gary Station at 6:50 p.m. or earlier, it would not have been able to clear the main track without some shifting moves because train No. 218's equipment would have been blocking the main track. In part, the dispatcher's job in this situation was to deal with the ambiguity created by General Notice No. 62 by making a positive command decision. Instead, he allowed the ambiguity to remain and did not act to resolve the conflict between train Nos. 123 and 218 as operations management had anticipated.

The dispatcher had two resources available to him for determining the location of train No. 123. He could have contacted the engineer of train No. 123 by radio. Also, the QEI printout would have provided him with an approximate location. He did not use either source of information.

The QEI system can be used to provide the dispatcher useful information about train movements. For example, the dispatcher could and should record passing times of trains at designated points on his train sheet so they will be available for immediate reference; this can be accomplished by use of the QEI "typer printout."

The Safety Board has found a dispatcher's lack of knowledge of train locations to be a factor in previous accidents. On May 28, 1982, following its investigation of a head-on collision between two trains in Beverly, Massachusetts, 18/ the Safety Board issued Safety Recommendation R-82-27 to the Boston and Maine Corporation:

Enforce Boston and Maine Corporation operating rule 222 that requires operators to promptly report and the dispatcher to promptly record train passing times at locations where passing reports are required.

In that accident, the dispatcher did not record promptly the OS times of trains as they passed reporting points. In the absence of proper and prompt recording of OS times, it was difficult for him to keep in mind the approximate locations of his trains. Consequently, he allowed two opposing trains onto the same track and they collided. The Safety Board believes that if the South Shore dispatcher had recorded the passing times of train No. 123 past the QEI OS points, he would have been able to respond to the request of the conductor of train No. 218 for the location of train No. 123.

The dispatcher also failed to respond fully to the requirements of his position before the Gary accident when he did not determine the cause, if any, for the stop-and-proceed signal aspect displayed by signal 591 when the engineer of train No. 213 inquired about it earlier in the day. While the engineer of train No. 213 should not have gone past the signal without stopping, the dispatcher must share with the engineer the responsibility for the rules violation, whether he authorized the engineer of train No. 213 to operate past the stop-and-proceed signal aspect without stopping or not, because he did not report to his supervisor that train No. 213 did not stop at the signal, as operating rule 291 required. (Since the dispatcher was not called upon to provide a diesel locomotive to tow train No. 213 into Gary, he had to have been aware of the fact that train No. 213 did not stop at signal 591.) The difficulty the engineer of train No. 123 had earlier in obtaining positive guidance from the dispatcher, when he was operating train No. 213 and encountered the stop-and-proceed signal aspect, led to his not calling the dispatcher again when he operated train No. 123 through the signal just before the collision. While the dispatcher may have discouraged engineers and conductors from calling him because of his discourteous manner, the engineer of train No. 123 said this was not a factor in his decision not to inquire about the signal. The engineer most likely did not call the dispatcher about the stop-and-proceed signal when he observed it while operating train No. 123 because he did not expect any new or additional information from the dispatcher concerning the signal. On the other hand, the dispatcher denied the conversation related to the stop-and-proceed aspect displayed by signal 591; moreover, the trouble report failed to confirm the engineer's report of the signal abnormality.

The South Shore should have had a provision for the dispatcher to move a train past a stop signal in a drop pan area when the alternative was to stop the train and have it towed to a point where the catenary was usable or to the next station. Nevertheless, the Safety Board believes that the dispatcher did not comprehend his authority when he stated that he could not allow a train to pass a stop-and-proceed signal aspect without stopping. Normally, the full authority for the operation of trains vested in the Superintendent of Transportation to move trains as expeditiously and safely as possible is delegated to the dispatchers. If an unusual situation develops, the dispatcher can issue train orders or messages and validate them by signing the superintendent's initials or name. These instruments then become valid operating instructions even if contradictory to an

18/ Railroad Accident Report--"Head-on Collision of Boston and Maine Corporation Extra 1731 East and Massachusetts Bay Transportation Authority Train No. 570 on Former Boston and Maine Corporation Tracks, Beverly, Massachusetts, August 11, 1981" (NTSB/RAR-82/01).

operating rule. Such a means could have been used to move train No. 213 past signal 591 while it was displaying a stop-and-proceed aspect. If, on the other hand, the dispatcher was correct when he assumed that on the authority given to him by the Superintendent of Transportation he could not countermand an operating rule by using a train order or a message, the South Shore operating officers should publish revised dispatching procedures so that the dispatchers and operating crewmembers will understand the action to be taken when a train encounters a signal displaying a stop-and-proceed aspect in a drop pan area.

Train No. 218 Crewmembers

The conductor of train No. 218 attempted to determine from the dispatcher if he needed a train order for a meet with train No. 123, or if train No. 218 should wait at Gary Station for train No. 123's arrival. Since the dispatcher was the conductor's direct supervisor for authorizing train movements, the conductor proceeded as required when the dispatcher stated that train No. 218 was superior to train No. 123, and that train No. 218's equipment could occupy the eastward main track. By his actions, the dispatcher demonstrated his belief that the crew of train No. 123 would clear the eastward main track for train No. 218. The conductor should have pursued his concern and insisted on his right to be advised of the location and movement plans of train No. 123.

Likewise, the engineer of train No. 218 appears to have expected the crewmembers of train No. 123 to wait at Clark Crossover according to the operating rules concerning the superiority of westbound trains. He accepted the authority he was given to occupy the eastward main track at the station platform without considering the possibility of train No. 123's arriving at Gary Station before or at 6:50 p.m. However, the engineer of train No. 218 could have used his radio and acted on his own behalf and authority to contact the engineer of train No. 123 to determine his location and plans. When train No. 123 had not arrived at Gary Station by 6:50 p.m., by timetable train No. 218 was authorized to leave the station, which according to the engineer's estimate was not until about 6:50:20 p.m.

The collector/brakeman of train No. 218 displayed the same complacency shown by the other crewmembers in respect to train No. 123. He was the junior crewmember and he appears to have accepted the judgments of the conductor, engineer, and dispatcher.

Train No. 123 Crewmembers

The engineer of train No. 123 should have talked directly with his conductor no later than the time the train reached Clark Crossover, where the two of them should have made a decision concerning meeting train No. 218. The engineer thought that he understood from the motion the conductor made toward his watch at Clark Road Station that they had sufficient time to proceed to Gary Station and arrive by 6:50 p.m. In addition, the engineer thought it was the conductor's intent for him to proceed into Gary Station because it was the conductor's responsibility to stop the train at Clark Crossover or make arrangements to clear the eastward main track at Marshall or the west end of Gary Station if there was not sufficient running time available for proceeding to Gary Station. However, South Shore rule 1005 (see appendix C) charges the engineer with the responsibility of not leaving a station even on the conductor's signal if in his judgment he does not have sufficient time to reach the next clearance point safely.

The engineer's estimate of a 3.5-minute running time between Clark Crossover and Gary Station proved to be incorrect. If the time the conductor and engineer observed when train No. 123 was at Clark Road Station was correct, then they had sufficient running time (5 minutes) between Clark Road Station and Gary Station. The running time

tests indicated that a normal running time between Clark Crossover and Gary Station was 4 minutes 20 seconds. Replicating the conditions and circumstances that the engineer of train No. 123 encountered on January 21, it took the test train 4 minutes 45 seconds for the same run. Also, the engineer of train No. 123 apparently did not consider the possibility of a delay because of the drop pan requirement or of encountering restricting signal aspects. He should have been concerned about delays because of the drop pan area and the potential for a stop-and-proceed aspect being displayed by signal 591, since these conditions had existed earlier when he operated train No. 213 through that area.

More importantly, it appears that the time the conductor and engineer observed at Clark Road Station was either incorrectly observed, incorrectly remembered, or incorrectly stated in their testimony. Both men indicated that they had checked their company-approved standard watches with the standard time clock at Michigan City, and that the time indicated by their watches compared closely with the standard clock and each other. Yet the QEI printout shows that train No. 123 actuated the west OS time circuit for the Madison Substation at 6:50:12 p.m. Based on the 6:45 p.m. time indicated by the conductor and engineer that they had observed at Clark Road Station, it took train No. 123 about 5 minutes to cover approximately 2.3 miles from Clark Road Station to the west end of the OS time circuit at the Madison Substation, which was an average speed of about 27.6 mph between those two locations. Even though the engineer of train No. 123 questions the time determined to be the time of the accident, the facts in their entirety point to 6:50:42 p.m. The engineer of train No. 218 said that he departed the station at Gary about 6:50:20. The time given by the conductor of train No. 218 as to when the equipment was brought onto the eastward main track is substantiated by the QEI system. Therefore, the Safety Board concludes that the time the conductor and engineer reportedly observed at Clark Road Station was incorrect.

The engineer of train No. 123 made up some of the time lost on the schedule at Kensington and State Line Interlockings between State Line and Clark Crossover. A 5-minute running time between Clark Road Station and the west end of the OS time circuit for the Madison Substation is not consistent with the engineer's train handling between Kensington Interlocking and Clark Road Station. The engineer should not have had any problem accelerating the train to the authorized track speed after leaving Clark Road Station given the accelerating capability of the equipment. Again, based on the foregoing data, the Safety Board concludes that the conductor and engineer left Clark Road Station at a time later than 6:45 p.m. as stated in their testimony.

The engineer of train No. 123 exercised poor judgment in assuming that the stop-and-proceed signal aspect displayed by signal 591 for train No. 123 was for the same reason as the stop-and-proceed aspect he encountered while operating train No. 213. Moreover, had he inquired of the dispatcher about the stop-and-proceed signal aspect for train No. 123, train No. 218's engineer might have overheard the radio message and been alerted to the oncoming train's location. An inquiry might have alerted the dispatcher to the fact that train No. 123 was east of Clark Crossover, in which case he might have taken note of the situation and acted to have prevented the accident. The fact that the engineer of train No. 123 was a qualified train dispatcher might have influenced him in his decision and misled him into believing that he knew how the dispatcher would cope with the restricting signal. Therefore, he felt no need to call the dispatcher about the stop-and-proceed signal aspect displayed by signal 591 for train No. 123. The decision not to call was not based on a hesitancy to call.

Since the latest time train No. 123 could have passed Clark Crossover and cleared the eastward track for train No. 218 by 6:50 p.m. was critical, the conductor should have given the decision to go to Gary or stay at Clark Crossover his full attention and consulted with his engineer. Had the conductor of train No. 123 delegated the

responsibility for detrainning the passengers for Clark Road Station to the collector/brakeman, he could have given the engineer positive guidance on the meet with train No. 218. The hand motion made by the conductor at Clark Road Station as described by the engineer was not a clearly executed directive in view of the significance of the question to be resolved, i.e., where to clear the track for train No. 218. The conductor should have given the engineer positive guidance on this question.

The collector/brakeman made one attempt over the intercom to call to the attention of the engineer their meet with train No. 218, but he received no response. Since he shared responsibility with the conductor and engineer for the safe operation of the train, he should have pursued the information and should not have concluded that the decision made by his senior crewmembers was adequate and correct. His acceptance of the decision can probably be best explained by his limited experience and peer pressure.

Once train No. 123 passed Clark Crossover, any of the three crewmembers could have taken action or caused action to have been taken to prevent the accident. The radio could have been used to contact the engineer of train No. 218 to advise him of the planned movement and location of train No. 123. The conductor or engineer could have stopped the train and established flag protection at 6:50 p.m. when they realized that they were operating on train No. 218's time. The train could have cleared the eastward main track at Marshall. Therefore, the Safety Board concludes that if any of the seven principals involved in this accident had acted to locate one or the other train or to advise all concerned of the move train No. 123 was planning to make, the accident would have been avoided.

Training

The South Shore's rules reexamination required of all employees is intended to reinforce their knowledge of and their ability to apply the operating rules. However, as was the case here, some of the operating rules may be used infrequently by a given crew assignment. Consequently, frequent reexamination on such rules is essential to keep employees constantly familiar with their use and application. (Since the accident on January 21, 1985, the South Shore has changed from a biennial to an annual rules reexamination.) Since traincrews and dispatchers will encounter varying train operations governed by the operating rules during a 2-year period, the Safety Board believes that the South Shore's change to an annual rules reexamination should keep employees more familiar with infrequently used rules.

The Safety Board has found during several accident investigations that employees often can quote the rules and achieve a perfect score on the rules examination, yet not understand how to apply the rules in actual circumstances. ^{19/} South Shore operating officers should revise their training materials to include a method for ensuring that employees understand when an operating rule needs to be applied and how to apply the rule. The annual reexamination should test an employee's knowledge of the application of the rules both by observation and simulation.

^{19/} Railroad Accident Reports--"Head-on Collision of Amtrak Trains Extra 769 East and No. 195, Bristol, Pennsylvania, March 29, 1982" (NTSB/RAR-82/05); "Head-on Collision of National Railroad Passenger Corporation (Amtrak) Passenger Trains No. 151 and 168, Astoria, Queens, New York, July 23, 1984" (NTSB/RAR-85/09); "Head-on Collision of Burlington Northern Railroad Freight Trains Extra 6714 West and Extra 7820 East, Wiggins, Colorado, April 13, 1984, and Rear-end Collision of Burlington Northern Railroad Freight Trains Extra 7843 East and Extra ATSF 8112 East, near New Castle, Wyoming, April 22, 1984" (NTSB/RAR-85/04).

OJT can be an excellent means of teaching a trainee the requirements of a job and helping the trainee develop the skills needed to perform the tasks of the job. But the success of the system depends on the capability of the instructors conducting the trainee's OJT and the uniformity of evaluation. The Safety Board notes that South Shore operational officers select the instructors for a trainee's OJT based on the instructor's skill and record, but that the instructors are not monitored and trained to ensure that their methods are correct and consistent. Since the instruction of a trainee is the delegated responsibility of different senior employees and the tests administered to a trainee may be given by different supervisors, the Safety Board believes that the South Shore operations management should develop and put into effect a comprehensive standard training curriculum and examination, covering specific job tasks and skills, to ensure that all employees are knowledgeable of the critical elements of the position before a trainee or senior employee is advanced to a more responsible position.

Survival Factors

The car equipment performed well from a crashworthiness standpoint. The cars did not override, but in fact the two lead cars coupled. The major impact forces were expended in crushing the vestibules and the front part of the cars.

The engineers escaped serious injury because they vacated their operating compartments just before the collision. Neither engineer could have survived the crash if he had remained at the controls of his train because the cabs were crushed upon impact. The crushing resistance absorbed most of the impact forces.

Since train No. 123 was approaching Gary Station, passengers were standing in preparation for detraining. This made them more vulnerable to injury by impact forces, and the fact that they were standing undoubtedly is responsible for the number of bruises, lacerations, and fractures reported.

The value of the deadman control was demonstrated in this accident because even though the engineer of train No. 123 did not apply the train brakes in emergency, the brakes went into emergency automatically seconds after he released the deadman foot pedal control. This immediate braking action was desirable under the circumstances and showed the value of a deadman control or a similar device.

The Safety Board has investigated a number of accidents in which a device similar to the deadman control might have prevented the accident or decreased its severity. Although most of these accidents were caused by the incapacity of the engineer because of his being asleep, the need for such safety backup devices was demonstrated. The Safety Board issued Safety Recommendation R-73-8 on March 14, 1973, to the FRA following the investigation of an accident in Pennsylvania in 1972: 20/

In cooperation with the Association of American Railroads, develop a fail-safe device to stop a train in the event that the engineer becomes incapacitated by sickness or death, or falls asleep. Regulations should be promulgated to require installation and maintenance of such device.

20/ Railroad Accident Report--"Head-On Collision of Two Penn Central Freight Trains, Herndon, Pennsylvania, March 12, 1972" (NTSB/RAR-73/03).

The recommendation was superseded by Safety Recommendation R-84-31 issued to the FRA as a result of the Safety Board's investigation of an accident in Indiana in 1983: 21/

Develop and promulgate a requirement that locomotives operated in main track service be equipped with an alerting device which will stop a train if the engineer fails to respond to an alarm indicating that he or she has fallen asleep or has become incapacitated.

The FRA responded to Recommendation R-84-31 that it was planning a "Locomotive Cab Safety Inquiry" project and that the question of a deadman safety control or similar device would be considered at that time. Based on that response, Recommendation R-84-31 was classified as "Open--Acceptable Action."

CONCLUSIONS

Findings

1. The train crewmembers and the dispatcher had passed the company operating rules examination, and they were qualified for their respective positions.
2. Single-track operating procedures were not new to the employees involved in this accident since the operation of trains between Gary and South Bend regularly was conducted using single-track operating rules.
3. General Notice No. 62 did not provide for train operations on a single track when an eastbound and a westbound train were scheduled to depart a station at the same time.
4. The crewmembers of each train understood that train No. 218 was superior to train No. 123 by timetable direction.
5. The conductor of train No. 218 made an effort to determine his responsibility insofar as meeting with train No. 123 was concerned.
6. The dispatcher did not act responsibly when he made no attempt to determine the location of train No. 123 when the conductor of train No. 218 contacted him.
7. Train No. 123 passed Clark Crossover with insufficient time to reach Gary Station to clear the track for train No. 218.
8. The determination made by the engineer and conductor that there was sufficient available travel time to reach Gary Station when train No. 123 departed Clark Road Station was based on incorrect time observations.
9. According to rule 99 the crew of train No. 123 should have stopped and established flag protection against train No. 218 at 6:50 p.m.
10. The equipment for train No. 218 should not have been allowed to occupy the main track at Gary Station before 6:50 p.m.

21/ Railroad Accident Report--"Rear-End Collision of Seaboard System Railroad Freight Trains Extra 8051 North and Extra 1751 North, Sullivan, Indiana, September 14, 1983" (NTSB/RAR-84/02).

11. The passing times obtainable from the QEI system could have been used advantageously by the dispatcher to keep abreast of the locations of trains under his control.
12. The engineer of train No. 123 should not have passed signal 591 displaying a stop-and-proceed aspect without stopping.
13. Radio was not used by either traincrew or the dispatcher to determine the location or plans of train Nos. 123 and 218.
14. The car equipment performed well in this crash situation.
15. The South Shore relies on OJT for training operating personnel but does not have a comprehensive curriculum to train and evaluate employees.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the dispatcher to coordinate the movement of the two trains properly; the lack of a clear provision in General Notice No. 62 for a meeting of two opposing trains scheduled to depart Gary Station at the same time; and the mistaken determination by the crew of eastbound train No. 123 while at Clark Road Station that there was sufficient time for the train to reach Gary Station and clear the single track before the scheduled departure of westbound train No. 218.

RECOMMENDATIONS

As a result of its investigation of this accident, the National Transportation Safety Board recommended that the Chicago, South Shore and South Bend Railroad:

Provide for a 3-minute delay similar to that in rule 83a for all operations involving single-track operating rules at locations where the arrival and departure times of opposing trains are in conflict. (Class II, Priority Action) (R-85-106)

Require that "call orders" be issued to traincrews to call the dispatcher before a train enters the single-track section when single-track operating procedures and rules are established temporarily in double-track territory. (Class II, Priority Action) (R-85-107)

Install a tape-monitoring system to record and preserve a record of communications to and from the dispatcher on the dispatcher's telephone and radio circuits. (Class II, Priority Action) (R-85-108)

Establish a reliable reporting system to provide the dispatcher more accurate passing times of trains entering upon the Chicago, South Shore and South Bend tracks at Kensington Interlocking for use in estimating the movement of trains. (Class II, Priority Action) (R-85-109)

Modify the power-monitoring system so that the time trains pass the substations can be identified more readily, and require the dispatcher to record those times promptly on his train sheet. (Class II, Priority Action) (R-85-110)

Provide written instructions to operating personnel concerning the action required when a train encounters a stop-and-proceed signal aspect in a section of track where no propulsion power is available. (Class II, Priority Action) (R-85-111)

Develop a comprehensive curriculum covering the critical elements and job skills, including communication skills and manner for each position, and require that an employee pass a uniform examination before being advanced to a new position. (Class II, Priority Action) (R-85-112)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ PATRICIA A. GOLDMAN
Vice Chairman

/s/ G.H. PATRICK BURSLEY
Member

October 21, 1985

APPENDIXES

APPENDIX A

INVESTIGATION

Personnel in the National Transportation Safety Board's Chicago Field Office heard a news media report of the collision on January 21, 1985, and a field investigator was dispatched to the scene immediately. The following day an investigator-in-charge was assigned from the Safety Board's Washington, D.C., headquarters. He arrived at the scene early on the afternoon of January 22, and he was joined later by a team from headquarters comprised of a human performance specialist, an operations specialist, and a survival factors specialist.

On April 14, 1985, the Chief, Railroad Accident Division, and staff members of the Safety Board took depositions at Michigan City, Indiana. Parties to the deposition proceeding were the Federal Railroad Administration, the Chicago, South Shore and South Bend Railroad, the American Train Dispatchers Association, and the United Transportation Union. Sworn testimony was taken from 10 witnesses.

APPENDIX B

CREWMEMBER INFORMATION

Engineer, Train No. 123

James C. Thompson, 32, was employed by the Chicago, South Shore and South Bend Railroad as a collector/brakeman on January 3, 1980, and his seniority dates from January 17, 1980. He was promoted to engineer on October 30, 1981, and worked his first assignment as a train dispatcher on April 27, 1984. He successfully passed his last operating rules examination on May 11, 1984. His last triennial medical examination was passed on June 28, 1982. He had satisfactorily passed the operating efficiency and rules compliance tests he was given.

Conductor, Train No. 123

John D. Gardner, 52, was employed by the Chicago, South Shore and South Bend Railroad as a collector/brakeman on March 26, 1962. After a brief absence during which time he was employed by the Elgin, Joliet and Eastern Railroad, he was reemployed by the South Shore on March 11, 1965. He was qualified for passenger service on April 24, 1962, and was promoted to conductor on July 23, 1966. He satisfactorily passed his last operating rules examination on May 10, 1984, and his last triennial medical examination on November 11, 1982. He had satisfactorily passed the operating efficiency and rules compliance tests he was given.

Collector/Brakeman, Train No. 123

Robert T. Clay, 30, was employed by the Chicago, South Shore and South Bend Railroad as a collector/brakeman on August 9, 1980, and his seniority dates from August 25, 1980. He qualified as a rear brakeman on February 24, 1981, and was promoted to engineer on April 25, 1983. He satisfactorily passed his last operating rules examination on May 22, 1984, and his last triennial medical examination on July 18, 1983. He had satisfactorily passed the operating efficiency and rules compliance tests he was given.

Engineer, Train No. 218

Jon N. Miller, 45, was employed by the Chicago, South Shore and South Bend Railroad as a collector/brakeman in 1975. After a brief period of service as a trainman, he entered engine service in 1976. He satisfactorily passed his last operating rules examination on May 15, 1984, and his last triennial medical examination on March 21, 1984. He had satisfactorily passed the operating efficiency and rules compliance tests he was given.

Conductor, Train No. 218

Dennis A. Burke, 35, was employed by the Chicago, South Shore and South B

pril 15, 1975. He qualified as a conductor on November 7, 1975. He satisfactorily passed his last operating rules examination on May 9, 1984, and his last triennial medical examination on June 2, 1982. He had satisfactorily passed the operating efficiency and rules compliance examinations he was given.

Collector/Brakeman Train No. 218

Michael E. Lenoir, 33, was employed by the Chicago, South Shore and South Bend Railroad as a collector/brakeman on August 23, 1978. He was promoted to rear brakeman on July 2, 1979, and to conductor on July 19, 1980. He satisfactorily passed his last operating rules examination on May 16, 1984, and his last triennial medical examination on December 21, 1984. He had satisfactorily passed the operating efficiency and rules compliance tests he was given.

Dispatcher

David L. Riordan, 34, was employed by the Chicago, South Shore and South Bend Railroad on June 15, 1976, as a collector/brakeman. He was qualified for passenger service on June 29, 1976, for rear brakeman in freight service on December 30, 1976, and promoted to engineer on June 6, 1978. He established his seniority as a train dispatcher on November 12, 1979. He satisfactorily passed his last operating rules examination on May 10, 1984, and his last triennial medical examination on March 17, 1979. His disciplinary record has no remarkable events recorded. There are no records of his having been given efficiency or rules compliance tests since he has been working in the dispatcher's office.

APPENDIX C

EXCERPTS FROM CHICAGO, SOUTH SHORE AND SOUTH BEND RAILROAD OPERATING RULES

DEFINITIONS

TRAIN—An engine or more than one engine coupled, with or without cars, displaying markers

REGULAR TRAIN—A train authorized by a time table schedule.

SUPERIOR TRAIN—A train having precedence over another train.

TRAIN OF SUPERIOR RIGHT—A train given precedence by train order.

TRAIN OF SUPERIOR CLASS—A train given precedence by time-table

TRAIN OF SUPERIOR DIRECTION—A train given precedence in the direction specified by time-table as between opposing trains of the same class.

TIME-TABLE—The authority for the movement of regular trains subject to the rules. It contains the classified schedules with special instructions relating to the movement of trains.

SCHEDULE—That part of a time-table which prescribes class, direction, number and movement for a regular train.

MAIN TRACK—A track extending through yards and between stations, upon which trains are operated by time-table or train order, or both, or the use of which is governed by block signals.

SINGLE TRACK—A main track upon which trains are operated in both directions.

TWO OR MORE TRACKS—Two or more main tracks, upon any of which the current of traffic may be in either specified direction.

* * *

5. Not more than two times are given for a train at any station; where one is given, it is unless otherwise indicated, the leaving time; where two, they are the arriving and the leaving time.

The time applies to the switch where an opposing train enters the siding; where there is no siding, it applies to the place from which fixed signals are operated; where there is neither siding nor fixed signal, it applies to the place where traffic is received or discharged.

Schedule meeting or passing stations are indicated by figures in **full-faced type**.

Both the arriving and leaving time of a train are in **full-faced type** when both are meeting or passing times, or when one or more trains are to meet or pass it between those times.

Where there are one or more trains to meet or pass a train between two times, or more than one train to meet a train at any station, attention is called to it by figures in small type.

When trains are to be met or passed at a siding extending between two adjoining stations, the time at each end of the siding will be shown in **full-faced type**.

* * *

S 71. A train is superior to another train by right, class or direction.

Right is conferred by train order; class and direction by timetable.

Right is superior to class or direction.

Direction is superior as between trains of the same class.

* * *

S 83. A train must not leave its initial station on any division, or a junction, or pass from one of two or more tracks to single track, until it has been ascertained whether all trains due, which are superior, have arrived or left

* * *

S 87. An inferior train must keep out of the way of opposing superior trains and failing to clear the main track by the time required by Rule, must be protected as prescribed by Rule 99.

Extra trains must clear the time of opposing regular trains not less than five minutes, unless otherwise provided, and will be governed by train orders with respect to opposing extra trains.

S 88. At meeting points between trains of the same class, the inferior train must clear the main track before the leaving time of the superior train.

At meeting points between extra trains, the train in the inferior time-table direction must take the siding unless otherwise provided

Trains must pull into the siding when practicable; if necessary to back in, the train must first be protected as prescribed by Rule 99, unless otherwise provided.

* * *

S 90. Trains must stop at schedule meeting points, if the train to be met is of the same class unless the switch is properly lined and the track clear.

Trains must stop clear of the switch used by the train to be met in going on the siding.

When the expected train of the same class is not found at the schedule meeting point, the superior train must approach all sidings prepared to stop, until the expected train is met.

The engineer of each train will give Signal 14 (n) at least one mile before reaching a meeting or waiting point and conductor will acknowledge with Signal 16 (k). Should the engineer fail to give Signal 14 (n) the Conductor must take immediate action to stop the train

93 Within yard limits the main track may be used, clearing the time an approaching designated first class train is due to leave the nearest station where time is shown.

* * *

93(b) Trains and engines occupying the main track within yard limits must be protected in accordance with Rule 99 (Flagman) during fogs, storms or other unfavorable conditions, also where the view of an approaching train is obstructed by curvature or other conditions. Trainmen and yardmen will be held for any failure to exercise reasonable precaution in protecting their trains or engines under such conditions.

* * *

99 When a train is moving on a main track at less than one-half the maximum authorized timetable speed for any train at that location, under circumstances in which it may be overtaken, a crew member must put off single burning fuses at rear of train at intervals that do not exceed the burning time of the fusee.

When a train is moving on a main track at more than one-half the maximum authorized timetable speed for any train at that location, under circumstances in which it may be overtaken, crew members responsible for providing protection must consider grade, track curvature, weather conditions, sight distance, and speed of the train relative to following trains, when deciding if burning fuses should be put off.

When a train stops on a main track, under circumstances in which it may be overtaken, protection against following trains on the same track must be provided. A crew member must go back immediately with flagman's signal equipment one-half the required distance where he will place two torpedoes on the rail, and continue to the required distance from rear of train, where he will place two torpedoes on the rail, and place a burning fusee. If no following train is seen or heard, he may return one-half the distance to the rear of his train where he must remain until he has stopped a following train or is recalled. When recalled and no following train is seen or heard, he must leave a burning fusee, and while returning to train, must leave burning fuses at intervals that do not exceed the burning

time of the fusee

When the train departs, a crew member must leave a burning fusee and put off single burning fuses at intervals that do not exceed the burning time of the fusee until train attains a speed not less than one-half the maximum authorized timetable speed for any train at that location

When rules require protecting the front of the train, a crew member with flagman's signal equipment must immediately go forward one-half the required distance, place two torpedoes on the rail, and continue to the required distance from front of train, where he will place two torpedoes on the rail, and place a burning fusee. If no approaching train is seen or heard, he may return one-half the distance to the front of his train, display a burning fusee, and remain at that location until he has stopped an approaching train or is recalled.

Should a train be seen or heard approaching before the crew member has reached the required distance, he must at once place two torpedoes on the rail, leave a burning fusee, and at night, or in obscure weather, or if the view is obscured, he will, in addition, display a lighted fusee and continue toward the approaching train, displaying stop signals until they are answered.

When flagman is recalled he may, if safety to his train will permit, remove from the rail the two torpedoes placed nearest the train.

In placing torpedoes they will be securely fastened to the top of the rail on the Engineer's side at least on hundred feet apart, and when practicable, not closer than five hundred feet from a whistling post.

99(a). Following are the minimum flagging distances corresponding with the maximum authorized speed of approaching trains:

Maximum Authorized Speed	Minimum Flagging Distance
0 - 15 mph	¼ mile
15 - 30 mph	½ mile
30 - 45 mph	1 mile
45 - 70 mph	1 ½ mile

A crew member providing flag protection must not permit other duties to interfere with the protection of his train

* * *

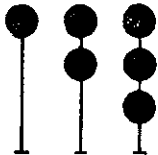
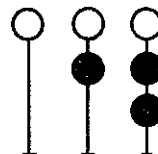
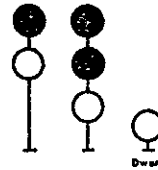
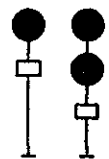
1005. Enginemen must know their time on the road, and will not start from a station, even though they receive a signal from the conductor, unless they can reach the next station in time to properly clear superior trains.

SPECIAL INSTRUCTIONS

S-71 Westward trains are superior to Eastward trains of the same class.

* * *

83a. Trains must not leave South Bend without obtaining train orders or clearance card issued by Train Dispatcher. If meeting point is designated by full face type and opposing train has not arrived, superior train will wait three (3) minutes before leaving South Bend Station

RULE	COLOR LIGHT	NAME	INDICATIONS
281		Clear	Proceed.
285		Approach	Proceed preparing to stop at next signal. Train exceeding medium speed must at once reduce to that speed.
290		Restricting	Proceed at restricted speed.
291		Stop and Proceed	Stop, then proceed at restricted speed.

APPENDIX D

CATENARY INFORMATION

The primary messenger (support wire) is a 0.72 inch diameter cable. The secondary messenger is a 0.629-inch diameter cable. The two trolley or contact wires are 0.482-inch diameter (4/0 AWG). The trolley wire and the catenary messengers are not usually pulled to the same degree of tension. The tension for a 300-foot span of trolley wire at 0° F would be 4,907 pounds, whereas the tension for the same span at 90° F would be 2,659 pounds. A shorter span would entail higher tension forces. The system does not have a constant tension construction. 24/

24/ An arrangement of weights and pulleys in the catenary system which compensates for variations in temperature and maintains a constant tension on the trolley wire.

APPENDIX E

EXCERPT FROM CHICAGO, SOUTH SHORE AND SOUTH BEND RAILROAD TIMETABLE NO. 5

4

EASTWARD TRAINS

FIRST CLASS				STATIONS	FIRST CLASS			
		111	113			213	115	117
DAILY EXCEPT SAT., SUN AND HOLIDAYS					DAILY EXCEPT SAT., SUN AND HOLIDAYS			
		PM L 12 15 S 12 39 PM	PM L 2 15 S 2 39 PM	(RANDOLPH ST) CHICAGO KENSINGTON		PM L 3 15 S 3 39 PM	PM L 3 58 S 4 23 PM	PM L 4 28 S 4 52 PM
		S 12 45 S 12 50 S 12 55 F 1 00 1 02 S 1 05	S 2 45 S 2 50 S 2 55 F 3 00 3 02 S 3 05	HEGEWISCH HAMMOND EAST CHICAGO CLARK X-OVER AMBRIDGE GARY		S 3 45 S 3 50 S 3 55 F 4 00 F 4 02 A 4 05 PM	S 4 29 S 4 33 S 4 37 S 4 45	S 4 59 S 5 04 S 5 09 F 5 13 5 15 S 5 20
		F 1 07 F 1 10 1 12 1 13 F 1 15 1 17 1 20 F 1 22 F 1 24 1 26 F 1 27 F 1 32 1 33 1 35 S 1 40 A 1 45 PM	3 07 F 3 10 3 13 3 14 F 3 15 3 17 3 20 F 3 22 F 3 24 3 26 F 3 27 F 3 32 3 33 3 35 S 3 40 A 3 45 PM	END DOUBLE TRACK MILLER WAGNER { West End East End OGDEN DUNES WILSON { West End East End BAILLY DUNE ACRES TREMONT SIDING TREMONT BEVERLY SHORES TAMARACK SHERIDAN MICHIGAN CITY SHOPS			4 47 F 4 51 4 53 4 54 F 4 56 4 58 5 01 5 03 F 5 05 5 07 F 5 08 F 5 14 5 16 5 20 S 5 25 A 5 30 PM	5 22 F 5 25 5 27 5 28 F 5 30 5 32 5 36 F 5 37 F 5 38 5 40 F 5 41 F 5 45 5 46 5 50 S 5 55 A 6 00 PM
				BIRCHIM HUDSON LAKE NEW CARLISLE OLIVE SOUTH BEND (BENDIX)				