RAILROAD ACCIDENT REPORT

HEAD-ON COLLISION OF TWO PENN CENTRAL FREIGHT TRAINS AT HERNDON, PENNSYLVANIA MARCH 12, 1972

NATIONAL TRANSPORTATION SAFETY BOARD

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Washington, D. C. 20591
REPORT NUMBER: NTSB-RAR-73-3

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This report contains Railroad Safety Recommendations R-73-8 through R-73-12.

16.Abstract

At 5:27 a.m , on March 12, 1972, Penn Central freight train UY-328 (Extra 7095 East) collided head on with Penn Central freight train S-82 (Extra 7828 West) at Herndon, Pa. Train UY-328 consisted of a two-unit diesel locomotive, 104 cars loaded with coal, and a caboose; train S-82 consisted of a two-unit locomotive, 103 cars, and a caboose. Three of the four locomotive units were destroyed and the other was heavily damaged in the accident The engineer and head brakeman on both trains were killed.

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the crew to stop train UY-328 on the siding, in violation of the signal indication. As a result, train UY-328 moved onto the main track immediately in front of train S-82. It could not be determined why the engineer of train UY-328 failed to stop his train on the siding. Among several possibilities, the Board considers it most probable that the engineer and head brakeman had fallen asleep and had failed to see the stop aspect displayed by the signal which directs the movement of trains from the siding onto the main track.

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FOREWORD

The accident described in this report has been designated a major accident by the National Transportation Safety Board under the criteria established in the Safety Board's regulations.

This report is based on facts obtained from the Safety Board's investigation and from the deposition of witnesses. Cooperation in the investigation was received from the Federal Railroad Administration

The conclusions, the determination of probable cause, and the recommendations herein are those of the Safety Board.

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I SYNOPSIS

At 5:27 a.m., on March 12, 1972, Penn Central freight train UY-328 (Extra 7095 East) and Penn Central freight train S-82 (Extra 7828 West) collided head on at Herndon, Pa. Train UY-328 consisted of a two-unit diesel locomotive, 104 cars loaded with coal, and a caboose; train S-82 consisted of a two-unit locomotive, 103 cars, and a caboose. Three of the four locomotive units were destroyed and the other was heavily damaged in the accident. The engineer and head brakeman on both trains were killed.

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the crew to stop train UY-328 on the siding, in violation of the signal indication As a result, train UY-328 moved onto the main track directly in front of train S-82. It could not be determined why the engineer of train UY-328 failed to stop his train on the siding. Among several possibilities, the Board considers it most probable that the engineer and head brakeman had fallen asleep and had failed to see the stop aspect displayed by the signal which directed the movement of trains from the siding onto the main track

II FACTS

Accident Site

Location. This accident occurred in Herndon, Pa., 11.6 miles south of Sunbury, Pa , on that portion of the Penn Central's Harrisburg Division that extends between Sunbury and Rockville, Pa. Railroad direction on this 48.1-mile line is westward from Rockville to Sunbury. Geographic direction, however, is northward. Railroad direction will be used in this report

At the accident site, the Susquehanna River generally parallels the railroad on the south. The main street of Herndon, State Highway 147, parallels the railroad about one block north of the track. Pottsville Street, which extends southward from the main street to the river, intersects the main track and siding about 223 feet west of the east switch of Boyles siding. This crossing is protected by an automatic, flashing-red-light signal Residences and business establishments on Pottsville and Main Streets border the railroad's right-of-way. (See Figure 1.)

Track The single-track line had three remote-controlled passing sidings located at Herndon (referred to in this report as Boyles siding), Millerburg, and Ferry. Each siding was about 3 miles long. The west switches were located 8 4 miles, 22 6 miles, and 36.4 miles, respectively, east of Sunbury. Boyles siding was 3.15 miles long and paralleled the main track on the south. The accident happened on the main track, 520 feet east of the east switch of Boyles siding.

From the west switch, the main track and siding contained a series of curves and tangents up to a point 1,569 feet from the east switch. Then there was a 2° curve to the right for a

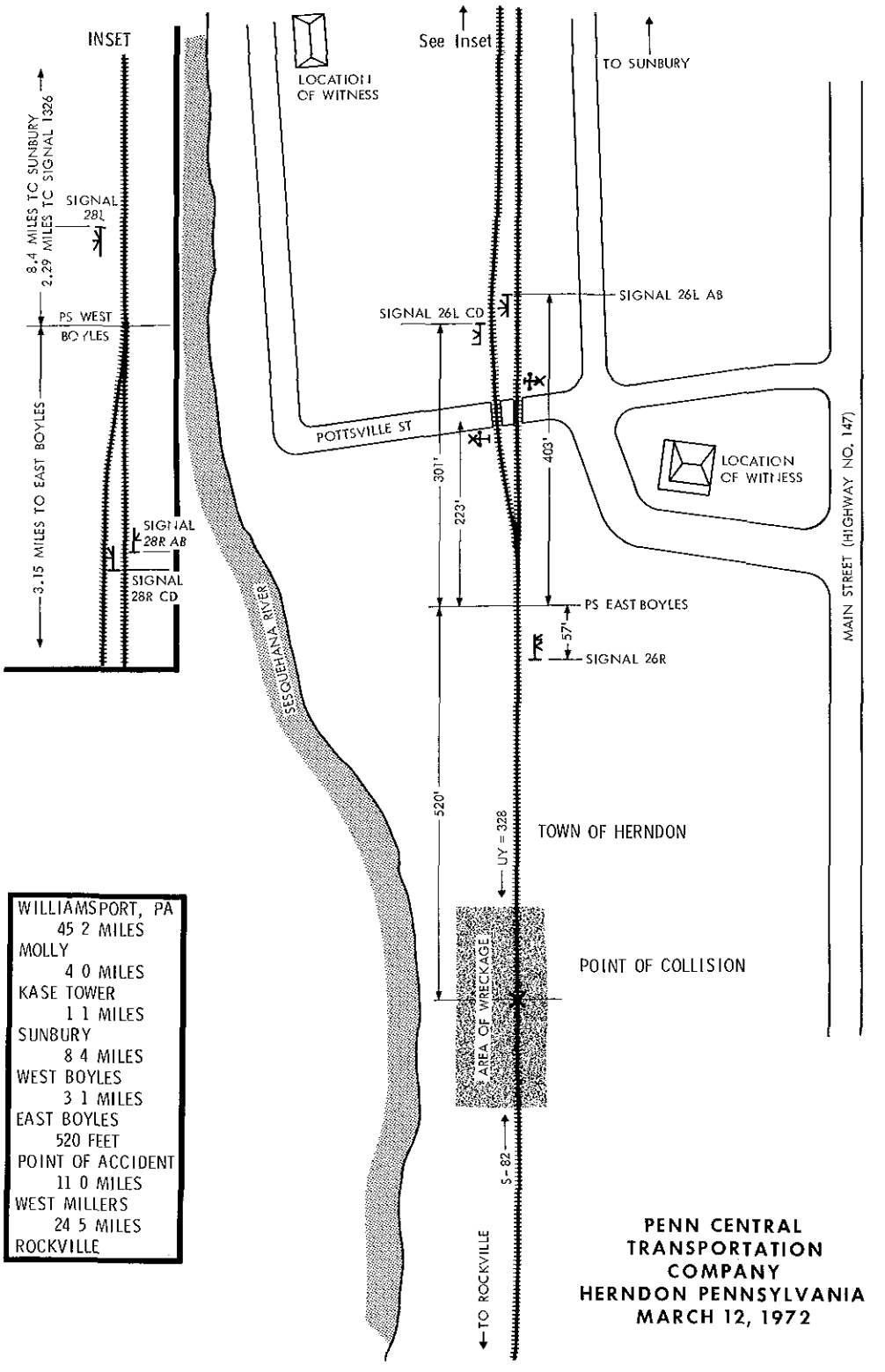

INSET
8.4 MILES TC SUNBURY
2.29 MILES TC SIGNAL 1326
SIGNAL 28L
PS WEST BOYLES
3.15 MILES TO EAST BOYLES
SIGNAL 28R AB
SIGNAL 28R CD
SUSQUEHANNA RIVER
See Inset
LOCATION OF WITNESS
TO SUNBURY
SIGNAL 26L AB
SIGNAL 26L CD
POTTSVILLE ST
301'
223'
403'
LOCATION OF WITNESS
MAIN STREET (HIGHWAY NO. 147)
PS EAST BOYLES
57'
SIGNAL 26R
520'
UY = 328
TOWN OF HERNDON
POINT OF COLLISION
AREA OF WRECKAGE
S-82
TO ROCKVILLE
WILLIAMSPORT, PA
45 2 MILES
MOLLY
4 0 MILES
KASE TOWER
1 1 MILES
SUNBURY
8 4 MILES
WEST BOYLES
3 1 MILES
EAST BOYLES
520 FEET
POINT OF ACCIDENT
11 0 MILES
WEST MILLERS
24 5 MILES
ROCKVILLE
PENN CENTRAL
TRANSPORTATION
COMPANY
HERNDON PENNSYLVANIA
MARCH 12, 1972

Figure 1

distance of 440 feet. Eastward, with the exception of a curve in the siding just west of the east switch, the track was straight to the collision point. The grade for eastbound trains over the siding was undulating but it averaged about 0.02 percent descending.

The main track leading to the point of the accident from the east was laid on a 1° 37′ curve to the left for a distance of 600 feet. Then, it was straight for 957 feet to the point of the accident. The grade for westbound trains ascended about 0.15 percent.

Method of Operation

Trains were operated in both directions over this line by a traffic-control type signal system. Switches and signals directing train movements to and from the sidings were remotely controlled from Kase Tower in Sunbury. The single track between the passing sidings generally was divided into two blocks where the movement of trains in either direction was directed by automatic block signals. Interlockings at each end of Boyles siding were designated as West and East Boyles.

Kase Tower. Kase Interlocking Tower was on the north side of the main track 1.1 miles west of Sunbury. The tower equipment enabled the operator to position track switches and signals at the interlockings. The operator could cause a controlled signal to display either a stop or a proceed aspect. The proceed aspect depended on the occupancy of the track and the position of other switches and signals on the desired route. Lights on an indication panel displayed the position of switches, track occupancy, whether a signal aspect was stop or proceed and other factors governing the movement of trains.

The Tower also was equipped with a time-synchronized graph on which 32 pens recorded the time and direction of switch alignments, the time a controlled signal changed, and the time a train passed a designated point.

The operator controlled the movements of trains on the main track and passing sidings between Rockville and Molly, 4 miles west of Kase Tower. When an eastbound train passed Molly and entered the Kase Tower territory the operator reported the time to the dispatcher in Harrisburg.

Signals Position-light signals between Sunbury and Enola were lighted by commercial power. When commercial power was off, emergency power was provided by standby batteries and the signals were approach-lighted Signals which governed train movements from the controlled sidings were the position-light pedestal type. The stop aspect for all control signals was two horizontal red lights. All other aspects were displayed by white lights on the pedestal signal and amber lights on other position-light signals.

At West Boyles, controlled signal 28L directed eastbound movements on the main track, 28R AB directed westbound movements on the main track and 28R CD directed westbound movements from the siding. At East Boyles, controlled signal 26R directed westbound movements on the main track, 26L AB directed eastbound movements on the main track and 26L CD directed eastbound movements from the siding. The locations of these signals are shown in Figure 1.

Automatic signal 1326, which governed eastbound movements on the main track, was located 2.3 miles west of West Boyles. Automatic signal 1253, which governed westbound movements on the main track, was located 1.9 miles east of East Boyles.

The signal circuits were arranged so that if the operator at Kase Tower positioned the controls for an eastbound train to enter Boyles siding at West Boyles and to proceed to the east end of the siding, while a westbound train proceeded on the main track to West Boyles, the signals would have displayed the following aspects with indications as described in the carrier's operating rules.

Signal	*Aspect*	*Name of Aspect*	*Indication*
		EASTBOUND	
1326		Approach Medium	Proceed approaching next signal at Medium Speed.
28L	 *FLASHING*	Medium Approach	Proceed at Medium Speed preparing to stop at next signal.
26L AB CD		Stop	Stop
		WESTBOUND	
1253		Clear	Proceed
26R		Approach	Proceed prepared to stop at next signal. Train exceeding Medium Speed must at once reduce to that speed.
28R AB CD		Stop	Stop

If a train entered the single-track section between controlled sidings on signal authority, the opposing signals would automatically display stop aspects and they could not be changed until the train cleared the single track at the next siding. If an opposing train passed a stop signal and entered the single track section, all signals immediately would display stop aspects.

Radio system. This portion of the railroad was equipped for radio communication between train crewmembers and tower operators. The train dispatcher did not have radio contact with trains.

Applicable operating rules. General Rules E and G in the Carrier's Rules for Conducting Transportation, prohibited employees from sleeping or using alcoholic beverages, intoxicants, or narcotics while on duty. Trains were operated on controlled sidings according to the requirements of operating Rule 111. The use of radios also was covered in the carrier's rules.

The carrier's definition of "Medium Speed" was a speed which does not exceed 30 m.p.h.

The rules that refer to the circumstances of this accident are listed in Appendix A.

Maximum speed. The maximum authorized speed on this part of the railroad was 40 m.p.h. However, speed was restricted to 25 m.p.h. on a short 0.4-mile stretch, beginning at a point 0.5 of a miles west of West Boyles.

Assembly and Operation of Train S-82

Penn Central train S-82 (Extra 7828 West) was assembled in Enola Yard, across the Susquehanna River from Rockville. The traincrew, which consisted of an engineer, conductor, flagman, and head brakeman, reported for duty at 2:30 a.m., on March 12, 1972. The conductor stated that all crewmembers appeared normal, and that none complained of any physical problems.

Train S-82 consisted of a two-unit locomotive, 70 loaded and 33 empty cars, and a caboose. The train, destined for Wilkes Barre, Pa., weighed 6,379 tons. The airbrakes of the cars in the train were tested by car inspectors before the train was assembled and were found to be functioning properly. After the train was assembled, the conductor instructed the engineer by radio to apply and release the brakes. When this was accomplished satisfactorily, the engineer was informed that the train was ready to proceed.

The train left Enola Yard, moved over the Susquehanna River Bridge, passed Rockville Tower at a speed of 10 m.p.h. at 4:10 a.m., and entered the main track to Sunbury. After the train passed the Rockville area, the engineer increased speed to about 30 m.p.h. The conductor and the brakeman estimated that this speed remained fairly constant until the collision. Crewmembers on a train standing on a siding at Ferry signalled to the caboose of train S-82 that they had observed no defects on the train as it passed. After train S-82 left Rockville, the conductor had no further radio communication, and he heard no such communication between other trains on the line.

Assembly and Operation of Train UY-328

Penn Central freight train UY-328 (Extra 7095 East) consisted of a two-unit locomotive, 104 cars loaded with coal, and a caboose. The train, which weighed 9,810 tons, was assigned to operate between Clearfield, Pa., and a powerplant at York Haven, Pa., a distance of about 225 miles. At the time UY-328 was assembled in Clearfield, the required inspections and brake tests were performed. Reports of the brake tests were given to crewmembers on the locomotive and caboose. The train then proceeded eastward. The crew was scheduled to be changed at Williamsport.

Crew change. Williamsport is located 58.7 miles west of Herndon on the north side of the Susquehanna River. A Penn Central yard is located in suburban Newberry. The Penn Central main line from Clearfield approaches the Williamsport area on the south side of the river. A track branches from this main line at Linden, 5 3 miles west of Williamsport, and extends eastward along the south side of the river, and then connects with the main track to Sunbury. (See Figure 2.)

Train UY-328 was stopped at Linden for the scheduled crew change so that the train could bypass the Newberry yard. The new crew, which consisted of an engineer, a conductor, flagman, and head brakeman, reported for duty at Newberry yard at 1:10 a.m on March 12, 1972. The crewmembers did not work together regularly as a unit. They were selected individually from the extra list. Records indicated that each one had been off duty for the following periods:

Engineer	72 hours 10 minutes
Head Brakeman	33 hours 35 minutes
Conductor	32 hours 40 minutes
Flagman	31 hours 55 minutes

The records also indicated that during the 15-day period before the accident, none of the crewmembers had worked for any long periods of time without sufficient rest.

The only train order the conductor received required that all freight trains which contained 30 or more cars loaded with mineral freight must be inspected every 30 miles unless they passed a hot-box detector or an attended block station. The crew departed for Linden by taxi at about 1:30 a.m. The taxi driver stated that he stopped at an inn enroute to Linden at the crew's request at about 1:50 a.m. The crewmembers spent about 50 minutes at the inn, as indicated by the taxi meter, and then proceeded to Linden.

The driver stated that the windows of the taxi were closed and that he did not detect an odor of alcohol on any of the crewmembers. He said that one of the crewmembers had a portable, transmitting-and-receiving radio which was not used while the crew was in the taxi. The taxi arrived at Linden at about 2:55 a.m.

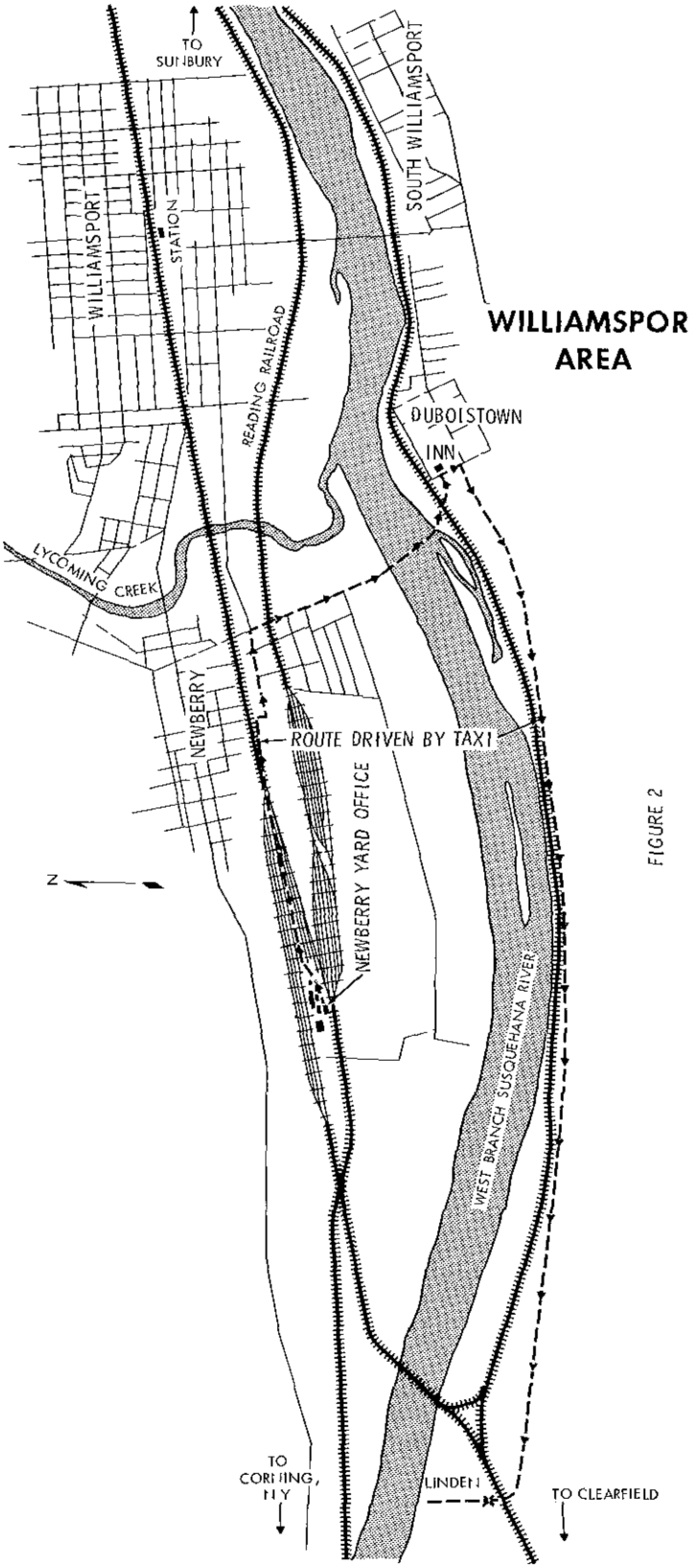

TO SUNBURY
WILLIAMSPORT
STATION
READING RAILROAD
SOUTH WILLIAMSPORT
WILLIAMSPORT AREA
DUBOISTOWN INN
LYCOMING CREEK
NEWBERRY
ROUTE DRIVEN BY TAXI
NEWBERRY YARD OFFICE
N
WEST BRANCH SUSQUEHANA RIVER
TO CORNING, N.Y.
LINDEN
TO CLEARFIELD
FIGURE 2

Figure 2

The conductor stated that after the crew left Newberry, one of the crewmembers wanted to make a telephone call and suggested stopping at the inn for that purpose. He said that they spent about 20 minutes there and that the head brakeman contacted Newberry Tower with a portable radio to determine the location of the train. The conductor also stated that, to his knowledge, none of the crewmembers had anything alcoholic to drink.

The owner of the inn stated that all four men ordered sandwiches. According to the owner, the head brakeman and engineer, both of whom he knew personally, drank soda while the other two men drank a beer.

The taxi arrived at Linden about 5 minutes before the arrival of the train When the crew saw the headlight of the approaching locomotive, the conductor positioned himself on the north side for a pull-by inspection of the train The engineer and head brakeman boarded the locomotive as it passed The conductor and flagman took no exceptions to the condition of any of the cars, and they climbed aboard the caboose Neither the locomotive nor the caboose was equipped with radios. The conductor and engineer had decided that if a defect was observed during the pull-by or on-board inspections, the conductor would apply the air brakes. If the engineer needed the conductor, he would make an emergency application of the brakes.

Operation of train UY-328 between Williamsport and Sunbury. Train UY-328 left Williamsport at 3:05 a.m. At Muncy, 22 miles east of Williamsport, the train passed a westbound train which was standing on a siding. As UY-328 approached the east switch of the siding, the brakes were applied in emergency, and the train came to an immediate stop. Before the conductor could leave the caboose to ascertain the cause of the emergency, the brakes were released and the train proceeded eastward. The reason for the brake application was not determined. The engineer again applied the brakes as the train passed Milton, 14.9 miles east of Muncy. The train did not stop but its speed was reduced enough to indicate that the brakes were effective. The conductor stated that the speed of the train did not exceed 35 m.p.h. between Linden and Sunbury.

After the Kase Tower operator reported that train UY-328 had passed Molly at 4:50 a.m., he was instructed by the dispatcher to permit the train to move eastward on the main track and enter Boyles siding to allow westbound train S-82 to pass.

The operator had one train order (No. 1603) for train UY-328, which restricted the speed of trains to 10 m.p.h. on the Wye track at Rockville. As the train approached Kase Tower, the engineer acknowledged the train order signal, and the operator delivered copies of the order and clearance form to a crewmember on the fireman's side of the locomotive as it passed him slowly. The operator did not see the other crewmember. He inspected the train as it passed him, observed no defects, and delivered copies of the order and clearance to the crewmembers on the caboose.

The Accident

Weather conditions. A weather observer in Sunbury reported that at 7:15 a.m., on the day of the accident the temperature was 35° F, and light rain was falling. The observer reported that he heard thunder between 5 and 5:30 a.m., but that he saw no lightning.

The four crewmembers who survived the accident and several witnesses in Herndon stated that they saw lightning as the two trains approached Herndon.

Routing of trains UY-328 and S-82. Train UY-328 passed Kase Tower at 5:02 a.m. and continued eastward on the main track. The Kase Tower operator had lined the switch at West Boyles and caused signal 28L to display a proceed aspect so that train UY-328 could enter the siding. Under these circumstances, signal 28R AB would automatically indicate stop, and the operator could not change the signal to proceed until UY-328 entered the siding and cleared the

main track. The operator also had lined the switch at East Boyles and caused signal 26R to display a proceed aspect so that train S-82 could move westward on the main track to signal 28R AB. Under these circumstances, signals 26L AB and CD would automatically indicate stop for movement from the siding and on the main track, and the operator could not change them until S-82 had passed East Boyles.

The operator did not inform the crews of either train that arrangements were being made for the trains to pass at Boyles siding. Train UY-328 was not equipped with a radio and, although S-82 was so equipped, the operator made no contact with the train. At times in the past crewmembers had been informed of such meetings when radios were available, but it was not required by the operating rules nor was it the general practice.

Movement of train UY-328 through Boyles siding. The engineer applied the brakes as train UY-328 approached West Boyles. The crewmembers on the caboose did not know whether he was complying with the speed restriction in effect just west of West Boyles or whether he was preparing to enter the siding. The conductor estimated that the speed was reduced to about 25 m.p.h. The crewmembers on the caboose could not see the signal at West Boyles before the locomotive passed it, and they did not know that the train was entering the siding until the caboose moved over the switch. According to the train graph in Kase Tower, the train entered the siding at 5:21 and cleared the main track at 5:23. The engineer released the brakes, and the train continued eastward on the siding at an estimated speed of about 25 m.p.h. The conductor stated that the speed of the train did not fluctuate noticeably and, in his opinion, was not excessive for operations on the siding.

The impact. Signal 26L CD, which governs eastward movements from the siding at East Boyles, should have been indicating stop as train UY-328 approached. However, the engineer did not apply the brakes to stop or slow down the train, and it passed signal 26L CD at 5:26 a.m., according to the train graph. This automatically caused signal 26R on the main track to indicate stop The graph indicated that train UY-328 took 5 minutes to pass over the 16,364 feet of the siding, for an average rate of speed at 37 m.p.h. The train then ran through the switch,[1] which was lined for movement on the main track, entered the main track and proceeded eastward.

Train S-82 passed West Miller, 11 miles east of Herndon, at 5:11 a.m. The train proceeded westward on the main track on signal authority at an estimated speed of about 30 m.p.h. When S-82 was approximately 1,284 feet east of signal 26R, the locomotive of UY-328 passed signal 26L CD. Both trains were then moving at an estimated speed of 30 m.p.h., and they collided about 19 seconds later at a point approximately 520 feet east of the switch point at East Boyles.

Witnesses. A Herndon resident, whose home is located on the west side of Pottsville Street, about 90 feet north of the tracks, saw train UY-328 as it moved eastward from the siding. (See Figure 1.) He stated that he was seated in a bay window facing the track at the time. He heard the locomotive wheels screech as train UY-328 moved around the curve just before the switch. He did not hear the horn blowing or the bell ringing as the locomotive approached the crossing and passed his house. Even though he was approximately level with the control compartment of the locomotive, he could not see the engineer or the head brakeman, because of the darkness. He said that if there had been a fire in the control compartment, he would have seen it. He observed that the locomotive's headlight remained brightly lighted.

He stated that as the locomotive passed his house, he saw what appeared to be a fire in the vicinity of the trucks in the rear of the second

[1] When a switch is lined and secured for movement to any given track and a locomotive or car moves into the switch from another track, the switch points are forced to the opposite side This is referred to as running through the switch

locomotive unit or in the front of the first car. He assumed that a hot box had developed on the axle of the first car and that the crew was taking the car out of the train He estimated that the train was moving about 15 m.p.h. and that the locomotive was idling. Shortly after the locomotive passed he saw a cloud of smoke and flames forming on the track several blocks east of his house. This led him to believe that the axle of the first car had broken and that the car had derailed.

He dressed and went to a fire station about half a block from his home to report the fire. He found that the firemen had already responded to the emergency. Then he went to the railroad telephone near the switch at East Boyles to notify the operator at Kase Tower, but no one answered his calls.

Another resident of Herndon, a woman who lives near the river south of the siding, observed the train as it moved slowly eastward on the siding. She stated that she saw fire coming out from under the center of a coal car on the train. The fire silhouetted the car to the extent that she was able to identify it as a coal car.

An off-duty tower operator, who lives near the river about 200 feet south of the railroad, stated that he was awakened by the excessive noise of the train as it passed over the siding. Before he could get to the window, which faced the railroad, he heard cars running together. After he saw fire, he telephoned the operator at Kase Tower to find out what was happening When the operator told him that the two trains were meeting at Boyles siding, he told the operator what he had seen and heard and he said that he would obtain additional information. He proceeded toward the collision area and saw that train UY-328 had run through the siding switch. The switch point had a gap of about 1½ inches. After determining that there had been a collision, he notified the operator.

Activities of the crew on train S-82. The conductor and flagman of train S-82 were riding in the caboose. The first indication they had of the accident was when the brakes were applied in emergency and a violent impact followed almost immediately. As the train came to a stop, a fire flared up in the front part of S-82. They left the caboose and ran alongside the train toward the fire. As they approached the collision point, they saw derailed cars on fire. When they found derailed hopper cars loaded with coal, they assumed that there had been a collision, because their train contained no such cars. They were concerned about the engineer and head brakeman and they searched through the wreckage for the locomotive. Eventually they found what appeared to be the control compartment of the first unit, with a jacket and some other clothing in it. The heat of the fire forced them to abandon their search for the engineer and the head brakeman.

Activities of the traincrew on UY-328. The conductor of train UY-328 stated that the first indication he had of the accident was the emergency brake application. The caboose then moved eastward about 10 carlengths (500 feet), at which time a violent impact occurred. The caboose continued to move about four more carlengths before it stopped The conductor and flagman saw fire flare up in the front part of the train. They left the caboose, walked eastward alongside the train, and found a derailed car and the truck of a car about 38 cars east of the caboose. About five cars farther on, they found a buckled car which had apparently lost the truck they had seen on the main track. As the two crewmembers proceeded toward the front of the train, the fire became more intense, and they heard the sirens of the Herndon Fire Department. As they approached the area of the collision, the crewmembers saw some derailed boxcars and other derailed cars on fire in the wreckage. They knew that train UY-328 did not contain boxcars and assumed there had been a collision. This was verified when they met the conductor and flagman from S-82. They searched the wreckage for the locomotive but they were unable to find either one of the units before the fire forced them to abandon their efforts.

Accident Losses

Casualties. The engineer and head brakeman of train S-82 were killed Their bodies were found in the damaged control compartment of the lead locomotive unit at about 10 a.m. on the day of the accident. The engineer and head brakeman of train UY-328 also were killed. The remains of the engineer were found near the wreckage of the lead locomotive unit's control compartment about 7 p.m. on the day of the accident. The body of the head brakeman was found some distance from the lead unit's wreckage about 4:25 p.m. the following day.

Train damage. Both locomotive units of each train, 16 cars of S-82, and 29 of UY-328 (26 head cars and the 59th, 60th, and 66th cars) were derailed in the collision. All except six cars were jammed into a pile of wreckage about 250 feet long. UY-328's locomotive units were covered with wrecked cars. S-82's units were found south of the main track partially covered with wrecked cars.

Three of the four locomotive units were destroyed and the other was heavily damaged. Twelve of UY-328's cars were destroyed, six were heavily damaged, and 11 were moderately damaged Twelve of S-82's derailed cars were destroyed or heavily damaged, and the remaining derailed cars were moderately damaged.

The fuel tanks were either punctured or torn from the locomotive units. Diesel oil which spilled over the derailed cars and the surrounding area provided fuel for the fire. The superstructures of UY-328's locomotive units were sheared from their frames. The diesel engine, generator, air compressor and other parts of the units were either demolished or could not be located immediately after the accident The superstructure of S-82's lead unit was heavily damaged and the control compartment was torn from the frame.

The center of UY-328's 60th car buckled upwards when the trains collided. This caused the west end of the 59th car to derail. The force of the impact tore one truck from the 66th car. This was the truck that the conductor and flagman found on the main track.

Track and property damages. About 300 feet of the main track was torn out of the roadbed in the collision and derailment. The siding switch at East Boyles also was damaged.

Ten homes and business establishments in Herndon were damaged by the derailed cars and wreckage-clearance operation.

Estimated cost of damage. The estimated cost of damage sustained by equipment and property was as follows:

Damage to locomotives . . .	$630,000
Damage to car equipment . .	241,700
Loss of lading	82,800
Damage to track	2,000
Damage to property	10,128
Total damage	$966,628

Postaccident Inspection of Equipment

The control compartments of the lead locomotive units of both trains were too damaged to determine the position of the controls. Portions of the 26C automatic brake valve and the SA26 independent brake valve from the lead unit of train S-82 functioned properly when tested.

On train UY-328, the brakes of 79 cars were tested after the cars were moved to Sunbury. The brakes on all cars applied and released, but two cars had piston travels in excess of 10 inches. On train S-82, the brakes of 88 cars were tested after the cars were moved to Enola. The brakes on two cars did not apply, and the brakes on two other cars had piston travel in excess of 10 inches.

The trucks of the locomotive units on both trains and the trucks of the first six cars in train UY-328 were inspected. There was no evidence of any defective parts that could have caused a fire such as the one described by the witnesses. There was no evidence that the brakes were applied in emergency for any appreciable length of time.

The daily inspection reports for all four locomotive units were examined for the 30-day period before the accident. No excessive fumes or smoke in the control compartments had been reported

The inbound engineer at Williamsport reported that the speedometer on the lead unit of train UY-328 was not functioning properly. He stated that it could not be depended upon to indicate the trains speed accurately. He experienced no other difficulties in handling the train between Clearfield and Linden. None of the speedometers on the four locomotive units had speed tapes so there was no means of determining the precise speed of either train before the collision.

Postaccident Test of Signal Circuits

Signal department personnel arrived at East Boyles immediately after the accident and observed that all signals, both eastward and westward, were lit and were indicating stop. Together with a representative of the Federal Railroad Administration, they conducted tests on the signal circuits in all areas of the signal system that could have caused signal 26L CD to display the wrong aspect and permit train UY-328 to enter the main track. None of the tests indicated a deficiency or malfunction in the signal system at East Boyles.

In addition to the above tests, false energy was introduced into the signal circuit at West Miller to determine if either one of the two 26L signals at East Boyles could be changed from a stop aspect to a proceed aspect when the westbound signal, 26R, was displaying a proceed aspect. Signals 26L could not be changed and signal 26R went from a proceed to a stop aspect. Moreover, there was no evidence of damage to the signal system from an electrical storm. All tests indicated that the signal system functioned properly.

The East Boyles switch was inspected after the cars had been removed. The switch point was open about half an inch and the operating rod had been stretched. The controls were positioned to align the switch for movement onto the main track. The switch operating machine was not damaged.

The train graph at Kase Tower was checked for accuracy. The pens that record the passing times of trains at West and East Boyles were found to be in alignment and in proper working order

Locomotive Units

The locomotive units on both trains were the road-switcher type with two four-wheel trucks. The fuel tanks of each unit were mounted below the underframe between the trucks, and they extended from one side of the underframe to the other. The units have cast iron brake shoes.

Most of the cars in train UY-328 were provided with composition brake shoes

Postaccident Investigation of Train Operation

It was determined that during the 30-day period before the accident 96 trains used Boyles siding to pass trains coming from the opposite direction. None of these trains used the siding without passing other trains.

The elapsed time and rate of speed of two trains similar in consist to UY-328 were observed on the run between Linden and East Boyles and compared with the time and speed of UY-328 between these two points on the day of the accident. The operation of train UY-328 compared favorably with these two trains, with the exception of the approach to West Boyles and the run over Boyles siding At those places UY-328 apparently exceeded the speed limit. The record of comparative times and speeds may be found in Appendix B

III. ANALYSIS

Signal System

The signal system installed on this section of the Penn Central's tracks incorporated signal

circuits and concepts used throughout the railroad industry. If the engineer had operated train UY-328 in compliance with the signal indications, he would have stopped the train short of signal 26L CD and train S-82 could have proceeded safely westward on the main track.

The exit of train UY-328 from the siding onto the main track suggests that the crew either misinterpreted signal 26L CD or did not see it. The absence of power failures in the area and the presence of supplementary battery power leads to the conclusion that the signal was functioning properly at that time. Since the switch was aligned for the main track, signal 26L CD could not display any aspect other than stop. These facts, plus the physical evidence that train UY-328 had run through the switch, confirm the belief that train UY-328 passed signal 26L CD while it was indicating stop.

Although the signals functioned properly, the system did not include safeguards to prevent trains from inadvertently passing stop signals. Railroads without automatic train-control or train-stop systems depend entirely upon their employees' compliance with operating rules to prevent such accidents. Fail-safe systems should back up compliance with operating rules to avoid the possibility of human failure.

At the time of the accident, there were no atmospheric conditions which would have obscured the head-end crewmembers' view of the signals.

Method of Operation

Boyles siding was a logical place for trains UY-328 and S-82 to pass, considering the time that the trains entered this section of the railroad, their running times, and the point of collision. The train dispatcher in Harrisburg instructed the Kase Tower operator to establish the routes accordingly, in sufficient time and in the accepted manner.

The tower operator lined the proper switches and caused the affected signals to display the required aspects, in the manner prescribed by Penn Central and in sufficient time to prevent interference with the movements of either train All the indications were that the operator had established the route properly.

Evidence in this case implies that when train movements are governed by signals on this section of the railroad, the Penn Central did not provide the crews with any other advance information. Moreover, Penn Central operating rules assign joint responsibility to the conductor and the engineer for the safe operation of the train. The conductor is expected to take corrective action if the engineer violates authorized speeds. (See Penn Central Rules 106 and 400N-1 in Appendix A.) However, in most cases the conductor rides in the caboose, which sometimes is more than a mile behind the locomotive and which contains no speed indicator.

The conductor of UY-328 did not known the train was going into the siding until the caboose entered the switch. When the train did not decelerate, the conductor assumed that plans had changed and that the train was authorized to continue eastward. This assumption appears to have been a valid one at the time Under the Penn Central's method of operation, the conductor had to depend entirely upon the engineer's compliance with the signal indications.

If, for some reason, S-82 had been detained at the next siding east of Boyles, the route could have been changed for the trains to pass at that siding. Under these circumstances, the tower operator would have changed signal 26L CD to display a proceed aspect and train UY-328 would have been authorized to enter the main track without stopping on the siding The conductor would have had no way of knowing that this had occurred. The four surviving crewmembers all stated that, although it was unusual, some trains have done so in the past.

If train UY-328 had been equipped with radios, the operator could have advised the crews of both trains that they were going to meet and that train UY-328 would be on the siding. As an additional safeguard, the operator could have instructed the engineer of UY-328 to advise him by radio when he came to a stop at East Boyles If the conductor had known that

UY-328 was passing a westbound train at East Boyles, he probably would have used his brake valve to stop the train when it became evident that the locomotive would not stop short of the signal

Because UY-328's speed recorder was not equipped with a tape, it could not be determined with certainty that the speed of the train was in compliance with the restriction immediately west of West Boyles. According to the conductor's testimony, the brakes were applied in the vicinity of West Boyles to comply with the speed restriction or the indication of signal 28L Since the brakes were released after the caboose entered the siding, it would appear that the brakes were applied to comply with signal 28L. This also would indicate that the engineer observed the signal.

The maximum speed authorized on the siding under the medium-speed rule (in effect at this point as indicated by signal 28L) was 30 m.p h. Therefore, train UY-328's average speed of about 37 m.p h. on the siding exceeded the maximum authorized.

The conductor and flagman testified that the train entered the siding at 25 m.p h. and that the brakes were released after the caboose cleared the switch. This testimony, if accurate, would indicate that the train had run about one mile, or 1/3 of the siding, in about 144 seconds. This would have left 2.1 miles to be traversed within 156 seconds to total the 5 minute recorded at Kase Tower In order to do this the train would have had to average about 70.4 feet per second, or 48 m.p h., on the final 2 1 miles of the siding Since it would have been almost impossible for the two-unit locomotive to accelerate the 7,095-ton train to that speed on the curving track, the crew might have been mistaken in estimating the train speed through the West Boyles turnout at 25 m.p h

In view of the conductor's testimony that the speed did not fluctuate noticeably after the train entered the siding, it is more likely that the train went through the turnout at about 37 m p.h. or faster The 37-m p.h speed also would fit the conductor's description of the train's speed as not excessive for siding operations The American Railway Engineering Association (AREA) recommends 36 m.p.h. as a safe operating speed through No 15 turnouts, the type of siding switches at East and West Boyles.[2]

The conductor's description of the brake applications and the timing of the impact leads one to assume that the brakes were applied at about the time that the train entered the main track. Penn Central's Rule 102 requires that when a train is stopped suddenly by an emergency airbrake application or for any other reason, adjacent tracks, as well as tracks of other railroads that may be obstructed, must be protected in both directions until it can be ascertained that they are safe and clear for the movement of trains.

If train UY-328 had been routed onto the siding to permit a following train to pass, and if any of its cars had derailed and blocked the main track, as they did, it would have been imperative that the flagman protect the main track and stop the following train. In this case, the main track was not protected. Both the conductor and flagman proceeded forward from the caboose alongside the train to the wreckage which straddled the main track.

Train S-82 made no stops after it departed from Enola Yard and passed Rockville. The dispatcher had issued instructions which authorized S-82 to proceed to Kase Tower. The speed of the train was about 30 m.p h.

S-82's locomotive was 1,930 feet east of signal 26R when the signal first came into the engineer's view. At that time the signal displayed a proceed aspect. If one assumes that both trains were moving at a speed of 30 m.p h., the locomotive of train S-82 was 1,284 feet east of signal 26R when the signal's aspect automatically changed from proceed to stop as train UY-328 passed signal 26L CD. At this point, train S-82 was 821 feet east of the collision point. When the locomotive of UY-328 entered the main track through the switch, the locomotive of S-82

[2] *AREA Manual For Railway Engineering,* Chapter 5, Part 3, Page 12 "Speeds of Trains Through Level Turnouts" 1956 See Appendix C

was 520 feet east of the collision point. The engineer of S-82 had no more than 12 seconds to take action before the collision When the engineer's reaction time, plus the propagation and buildup time for the brake application, is taken into consideration, it can readily be seen that an emergency application of the brakes immediately after signal 26R changed to stop could not have slowed the train substantially, much less stopped it, before the collision.

The Use of Radios

On this portion of the railroad, there are facilities for radio communication between crewmembers in the locomotive and caboose, between crewmembers on different trains, and between crewmembers on trains and operators in wayside towers The Penn Central does not restrict the use of radios but the system is limited and disorganized, apparently due to a lack of usable radios Trains leave their terminals without a radio in either the caboose or locomotive. Sometimes the engine crew does not know that the rest of the crew does not have a radio unit, or vice versa. Consequently, when crewmembers in the caboose or locomotive attempt to contact each other, they are never certain whether the failure to get a response is due to a radio malfunction or the lack of a radio. Inter-train communication is handicapped in the same manner

There is no rule that requires railroad employees to notify dispatchers, tower operators, or train crews that a given train is operating without a radio. Therefore, an operator is never sure when he can contact a train crew via radio. An adequate number of workable radios could keep the engineer in contact with the conductor who, in turn, could be kept advised of signal aspects and the use of sidings. The conductor also would have an opportunity to monitor the engineer's operation of the train. The operators could inform traincrews of any instructions that would involve the operation of their trains. Effective radio communication would provide a much needed backup system for controlling the movements of trains which depend on the observance of a signal system.

Witnesses

Although one witness was in an excellent position to observe the operation of the train as it left the siding, the darkness made it difficult for him to judge the speed of the train accurately. It is unfortunate that the darkness also prevented him from seeing the crewmembers in the control compartment, because he was probably the last person to observe the locomotive prior to the collision.

This witness reported seeing a fire at the level of the rear trucks on the locomotive or the front trucks on the first car. The investigation conducted after the accident failed to provide any information that would support such a report. The locomotive had cast-iron brake shoes, and the first 10 cars, at least, had composition shoes. During a heavy brake application, the cast-iron shoes would produce sparks around the wheels but the composition shoes would produce few, if any, sparks. Even though the witness stated that, in his opinion, the fire was not the result of a brake application, this possibility still exists.

Another possible cause for such a fire would be the friction produced by the wheels of the locomotive scraping against the switch point when the train ran through the switch. However, as soon as the operating rod was damaged, the tension would have been removed from the switch point, and therefore, the friction would have been relieved.

Another witness (a woman who lived near the siding) apparently saw train UY-328 after the brakes were applied, since she said the train was moving slowly. The conductor stated that the speed of UY-328 was not reduced until after the emergency brake application. The fire that the woman described could have been caused by the emergency brake application or some reaction within the train.

The off-duty tower operator was awakened by the sound of the train's wheels as they left the siding. This would support the report that

UY-328 was moving faster than trains generally move when they are leaving a siding.

Although all of the witnesses and the surviving crewmembers testified that they had observed an electrical storm in the vicinity prior to the accident, no one said that it was severe and most believed that the storm was centered west of Herndon. If lightning had struck the locomotive when the train was in the vicinity of Herndon, one of the witnesses or crewmembers probably would have seen or heard the strike.

Failure to Stop Train UY-328 on the Siding

The indication of signal 28L at West Boyles was for train UY-328 to proceed at medium speed on the siding but to be prepared to stop at the next signal which in this case was signal 26L CD. This medium-speed approach was the most favorable aspect that could have been displayed for a train to enter Boyles siding. It does not indicate whether the aspect of 26L CD, the next signal, will be stop or proceed

Train UY-328 apparently had been operated properly from Williamsport to the restricted-speed area just west of Boyles siding. However, the improper operation of the train through the restricted-speed area and Boyles siding indicated that something had happed to the engine crew At Kase Tower, a crewmember had received the train order from the operator by hand on the fireman's side of the locomotive. This would indicate that both crewmembers in the control compartment were functioning at that time or that the safety device (dead man) was not operating.

Neither member of the locomotive crew complained of illness prior to the departure of the train from Williamsport The surviving two crewmembers did not know of any physical condition that could have incapacitated either one of the crewmembers on the locomotive If either the engineer or the head brakeman had been stricken by illness, the other crewmember could have stopped the train and obtained assistance. It is unlikely that both crewmembers would have become incapacitated by illness at precisely the same time.

On the other hand, both crewmembers could have been overcome by an environmental pollutant such as fumes or smoke from the diesel engine. However, locomotive inspection reports for a 30-day period prior to the accident did not mention the presence of fumes or smoke in the control compartment.

As for the possibility of a lightning strike during the storm reported in the vicinity, the Safety Board has been unable to find any cases of lightning striking a diesel locomotive and injuring the crew in the control compartment. However, the leading diesel unit was so badly damaged that it was impossible to determine whether the unit had sustained damage prior to the accident. If the control compartment had been damaged to the extent that the occupants were incapacitated or if there had been fire in the compartment, either one of these conditions probably would have been observed by the witness who saw the train leave the siding.

As train UY-328 entered the siding and moved eastward, the head brakeman could have fallen asleep and the engineer could have dozed off after releasing the brakes If this happened, and the engineer was asleep when the locomotive approached and passed signal 26L CD, the noise of the wheels and the lateral swaying of the locomotive as it moved over the switch probably would have awakened him If this were the case, when he realized that the train was entering the main track in the face of an approaching westbound train, the engineer would have applied the locomotive brakes immediately Such a heavy application of the brakes could have caused the fire in the wheel area described by the first witness

If an emergency application of the brakes had been made when the front of the locomotive was opposite the house of the first witness, the locomotive would have moved about 242 feet eastward before the application was propagated to the caboose If the train then moved eastward 10 car lengths before impact, as described by the conductor, it would have covered a total

distance of 742 feet from the point of the brake application to the point of collision, which was 656 feet east of the house. An emergency application of the brakes would have automatically deposited sand on the rail of the main track leading to the collision point. No sand was found along either rail.

If the engineer had made a full service application of the brakes, or even if he had fallen asleep or become incapacitated, he may have been able to keep the dead-man control in operation by keeping the pedal depressed until the locomotive was in the vicinity of signal 26L CD. If the device functioned at this time, it would have caused a full service application of the brakes However, the service application would not have been made in sufficient time to be noticed by the crew on the caboose prior to the emergency application caused by the collision. A full service application of the locomotive brakes could produce the same evidence of a fire as that produced by an emergency application. No sand is deposited on the rails during a service application

After the collision, train UY-328 moved eastward about 830 feet, or 20 car lengths. It appears that a service application of the brakes was made as the train moved from the siding and that the emergency application was caused by the collision.

Advantages of Additional Signal-Warning Systems

Continuous cab-signal system A cab-signal system employs a device in the locomotive control compartment which repeats wayside-signal information, or informs the engineer directly of track conditions. The portion of the Harrisburg Division on which this accident happened was not equipped for this system, although many other areas and locomotives, including the leading units involved in this accident, are

In cab-signal territory, when a signal indication becomes more restrictive in the block in which the locomotive is operating, a warning whistle is actuated in the control compartment. The engineer then has 6 seconds to operate an acknowledgement lever, which prevents an automatic brake application. The same situation prevails when the train passes a stop signal

If this part of the railroad had been equipped for cab-signaling and if the engineer had dozed as the locomotive approached signal 26L CD, the sound of the warning whistle probably would have been loud enough to awaken him in time to take effective action. Moreover, the engineer of train S-82 would not have had to depend on his observation of signal 26R, because the warning whistle would have immediately informed him of the change of aspects.

Train-control signal system A train-control signal system expands the benefits of the continuous cab-signal system It not only requires the engineer to acknowledge the change of the signals to more restrictive indications but it also requires him to reduce the speed of the train and maintain it at the prescribed level. If the established speed is exceeded, there is an automatic brake application.

If train UY-328 had been equipped with a train-control system, a warning whistle would have sounded when the train entered the siding at signal 28L. If the engineer did not slow the train to the speed prescribed by the signal, the brakes would have been applied automatically. Moreover, if a positive control for stop signals had been incorporated into the train-control system, the train brakes also would have been applied automatically when the locomotive passed signal 26L CD

Dead-man control devices The safety-control device on the locomotive units involved in this accident required the engineer to keep his foot on a pedal when the locomotive brakes were released If the pedal is not depressed at such times, a warning whistle sounds and, if corrective action is not taken by the engineer within a time limit, there is an automatic brake application. This device can be easily defeated by placing a weight on the pedal or by wedging the pedal in the depressed position with a stick

or bar. Even if an engineer is incapacitated, the weight of his body could hold the pedal in the depressed position. If he falls asleep at the controls, it is doubtful if his body would be sufficiently relaxed to permit the pedal to move to its actuation position

Another safety-control device requires some movement by the engineer within a time limit to prevent an automatic brake application following a warning sound. This device is designed to detect an engineer who has fallen asleep at the controls as well as one who has become incapacitated by illness or an accident. The device is more difficult to defeat than is the device used on the locomotives involved in this accident.

Responsibility of the Engineer and Conductor for Train Safety

The rules of most carriers assign equal responsibility to the conductor and the engineer for the safety of the train. Railroading is the only form of transportation that condones the sharing of responsibility for the safe operation of the conveyance. At sea, the captain of the ship is solely responsible for the safety of the ship at all times Even when a pilot is aboard directing the movements of a ship in a harbor, the captain is not relieved of his responsibility nor can he share it with the pilot In the air, only the pilot or captain is responsible for the operation and safety of the plane

In railroading, although the conductor and engineer share responsibility for the safety of the train, the conductor does not have an equal opportunity to carry out his responsibility. When the conductor is in the caboose of a long freight train, he is unable to observe the aspect of signals before the locomotive passes them Because there is no device in the caboose to indicate the speed of the train, the conductor must rely solely on his judgment. On the Penn Central, train orders can be delivered to the engineer without the conductor's knowledge. In many cases, only the locomotive is equipped with a radio; the conductor, with little information, is in a poor position to monitor the engineer

Since the conductor shares responsibility for the safety of the train, he should be provided with the same information as the engineer. If it is necessary for him to stay in the caboose, he should at least be provided with a two-way radio or intercom system to communicate with the engine crew. If he were required to ride in the control compartment of the locomotive with the engineer, they would be able to share all available information on the operation of the train, as well as to share responsibility for its safety.

IV CONCLUSIONS

1. The automatic brakes of both trains were tested properly and functioned properly en route
2. No defective conditions were found on the locomotive or cars of either train that could have contributed to the accident
3. The switches for Boyles siding were lined properly and the signals were displayed properly for train UY-328 to enter Boyles siding and permit train S-82 to pass on the main track.
4. Train UY-328 was not equipped with radios, even though radios are part of the communication system for this section of the Penn Central.
5. Train S-82 was operated from Enola yard to the collision point in accordance with the carrier's requirements.
6. Train UY-328 was operated from Williamsport to a point approaching West Boyles in accordance with the carrier's requirements
7. Train UY-328 was operated over Boyles siding at a speed in excess of that permitted by the indication of the signal
8 At East Boyles, train UY-328 passed signal 26L CD, which was displaying a stop aspect, ran through the siding switch, which was lined for the main track, and proceeded eastward on the main track.

9 The brakes of UY-328's locomotive were applied as the train entered the main track.

10. When train UY-328 entered the main track, train S-82 was too close for brake applications on either or both trains to prevent the collision.

11. Because the locomotives' diesel-fuel tanks were ruptured, fuel spilled over the derailed equipment and caught fire.

12 There is no backup warning system in the event that signal information is not received by the engine crew.

13 According to the carrier's rules, the conductor and the engineer are equally responsible for the safety of the train. However, the conductor on the caboose is not in a position to receive the same information as the engineer on the operation of the train

14. The dead-man control device on the locomotive unit was inadequate.

V PROBABLE CAUSE

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the crew to stop train UY-328 on the siding, in violation of the signal indication. As a result, train UY-328 moved onto the main track directly in front of train S-82. It could not be determined why the engineer of train UY-328 failed to stop his train on the siding. Among several possibilities, the Board considers it most probable that the engineer and head brakeman had fallen asleep and had failed to see the stop aspect displayed by the signal which directed the movement of trains from the siding onto the main track

VI RECOMMENDATIONS

The National Transportation Safety Board recommends that:

1. The Federal Railroad Administration (FRA), 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, use, and maintenance of such a device. (Recommendation No R-73-8)

2. The FRA include in its present investigation of the safety of locomotive-control compartments a study of environmental conditions that could distract crews from their duties or cause them to fall asleep at the controls Regulations should be promulgated to correct any undesirable conditions disclosed. (Recommendation No R-73-9)

3. The FRA promulgate regulations to require that a railroad equipped with radio communication facilities install radios in appropriate parts of trains and maintain them in operating condition , unless all personnel involved are notified to the contrary by appropriate railroad procedures, such as a train order or general order. (Recommendation No R-73-10)

4. The FRA, in the promulgation of regulations governing railroad operating rules, where responsibility for safe operation of the train is assigned jointly to the engineer and the conductor, require that they be located and informed so that they can make quick, effective decisions. (Recommendation No. R-73-11)

5. The Penn Central Transportation Company establish a backup communications system in the event that signal information is not received by appropriate crewmembers. (Recommendation No R-73-12)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JOHN H. REED
Chairman

/s/ LOUIS M THAYER
Member

/s/ ISABEL A BURGESS
Member

FRANCIS H. McADAMS AND WILLIAM R HALEY, MEMBERS, filed the attached dissent

March 14, 1973

McADAMS and HALEY, Members, DISSENTING:

Although we agree with the report insofar as it states the facts, conditions, and circumstances of this accident, we do not agree with the last sentence of the probable cause. We do not believe the evidence will sustain the determination that the most probable reason for the engineer and head brakeman's failure to see the stop aspect displayed by the signal was that they had fallen asleep. It is our view that the reason for this failure is unknown

APPENDIX A

EXCERPTS FROM THE PENN CENTRAL RULES FOR CONDUCTING TRANSPORTATION EFFECTIVE APRIL 28, 1968

The rules herein set forth govern the railroads operated by Penn Central and must be observed by all employes whose duties are in any way affected thereby. They supersede all previous rules and instructions inconsistent therewith.

Special instructions may be issued by proper authority.

Approved:

J. B ADDINGTON
Vice President-Operations

GENERAL RULES

E. Employes must devote themselves exclusively to the Company's service while on duty, render every assistance in their power in carrying out the rules and special instructions and promptly report to the proper official any violation thereof.

To enter or remain in the service, employes must be of good moral character and must conduct themselves at all times, whether on or off Company property in such manner as not to bring discredit upon the Company.

Gambling, making bets, fighting or participating in any illegal, immoral or unauthorized activity while on duty or on Company property is prohibited.

Books, magazines, or papers other than Company instructions must not be read while performing service

DEFINITIONS

SPEEDS

NORMAL SPEED–The maximum authorized speed

LIMITED SPEED–Not exceeding 45 miles per hour

MEDIUM SPEED–Not exceeding 30 miles per hour.

REDUCED SPEED–Prepared to stop short of train or obstruction

SLOW SPEED–Not exceeding 15 miles per hour.

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

NOTE–Speed applies to entire movement

OPERATING RULES

NOTE–Rules with a prefix "S" are for single track; those with prefix "D" are for two or more tracks.

14 ENGINE WHISTLE OR HORN SIGNAL

NOTE–The signals prescribed are illustrated by "o" for short sounds; "–" for long sounds. The sound of the whistle or horn should be distinct, with intensity and duration proportionate to the distance signal is to be conveyed.

SOUND	INDICATION
(1) – – o –	(1) Approaching public crossings at grade, to be prolonged or repeated until crossing is reached unless otherwise provided.
	(1a) WHISTLE SIGNS
	W Rule 14(1) to be sounded at whistle sign.
	W/MX Rule 14(1) to be sounded at whistle sign for multiple crossings and prolonged or repeated until last crossing is reached
	W/R Rule 14(1) not to be sounded except in an emergency.

NOTE–In sounding 14(1) the forward facing horn must be used. The rear facing horn will be used when forward facing horn is inoperative.

(2) Approaching locations where men may be at work on tracks, bridges and other points.

17 The headlight must be displayed brightly to the front of every train by day and by night. When an engine is running backward a white light must be displayed by night on the leading end.

Headlight must be dimmed:

(a) When standing on main track in yards or standing or moving on yard tracks where other engines are employed.
(b) Approaching stations where train orders or messages are to be received.
(c) Approaching junctions, terminals or meeting points.
(d) On two or more tracks when approaching train in opposite direction.
(e) When standing or moving on main track at meeting points.

The headlight must be extinguished when a train has stopped clear of main track to meet a train, or is standing to meet a train at end of two or more tracks or a junction.

30. The engine bell or warning signal must be sounded when an engine is about to move, when running through tunnels, while approaching and passing public crossings at grade and when passing a train standing on an adjacent track or in an emergency. Where a momentary stop and start, forward and backward, is part of a switching movement, and movement over public crossing at grade is not involved, the engine bell or warning signal need not be sounded.

34. All members of the crew must, when practicable, as soon as the next signal ahead affecting the movement of their train or engine becomes clearly visible, communicate the indication to each other by name, and thereafter continue to observe the signal and call any change of indication until it is passed

If train or engine is not operated in accordance with the signal indication, or other condition requiring speed be reduced, other members of the crew must communicate with crew member controlling the movement at once and if necessary stop the train.

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

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

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

111 Unless otherwise specified in the

timetable, trains and engines using a siding may proceed at Restricted Speed and will not protect against following movements.

A siding of an assigned direction must not be used in the reverse direction without proper signal indication, authority of the employe in charge, or in an emergency under flag protection

Trains or engines using a controlled siding will operate in accordance with signal indications.

OPPOSING AND FOLLOWING MOVEMENT OF TRAINS BY BLOCK SIGNALS

261 On portions of the railroad, and on designated tracks so specified in the timetable, trains will be governed by block signals whose indications will supersede the superiority of trains for both opposing and following movements on the same track.

262 A train for which the direction of traffic has been established, must not move in the opposite direction without proper interlocking or manual block signal indication, or train order.

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

264 Except as affected by Rule 261 all Rules for Conducting Transportation remain in force.

CONDUCTORS

400N-1 Report to and receive their instructions from the Superintendent or other designated officer. They must obey the instructions of train master, station masters, station agents, yard masters, and operators within their jurisdiction, and from officers of other departments on matters pertaining to those departments.

Conductors have general charge of the train to which assigned and all persons employed thereon are subject to their instructions. They are responsible for the prompt movement, safety and care of their respective trains and the passengers and commodities carried, for the vigilance and conduct of the men employed thereon and for the prompt reporting to the Superintendent of conditions that interfere with the prompt and safe movement of trains.

They must know that members of crew providing protection as required by Rule 99 are familiar with their duties and that their trains are properly equipped and inspected; also that Air Brake Rules have been complied with and that the prescribed signals are displayed.

ENGINEMEN

400N-3. Report to and receive instructions from the Superintendent or other designated officer. They will be governed by current mechanical, electrical and air brake instructions pertaining to the safety, inspection, preparation, and operation of trains and engines. They must comply with the orders of the Road Foreman of Engines, Trainmaster or other designated officer within their jurisdiction.

They must obey the instructions of Station Masters, Station Agents, Yard Masters, and Operators within their jurisdiction; and the conductor in charge of their train as to general management of their train, unless by so doing they endanger its safety or commit a violation of the rules.

They must be qualified on type of engine to which assigned including any devices or auxiliaries attached thereto. At a point where no mechanical forces are on duty and except on through trains, they will check the prescribed form in the cab to be sure that the unit or units of the engine consist have been inspected within the previous 24 hour period for road service or within one calendar day in yard service.

If the engine unit or units are not within date they will make an inspection. After making inspection, they will then record date, time and

location on the prescribed form in the cab and prepare and sign regular work report.

At points where mechanical forces are employed and on duty, they will accept the inspection of the mechanical forces, except air brake test, as to the condition of the engine.

They will at the end of the trip make written report on the prescribed forms.

They will be responsible for the observance of all signals controlling movements accordingly and the regularity of speed between stations, exercise discretion, care, and vigilance in moving the engine with or without cars to prevent injury to persons, damage to property, and lading, avoiding collisions and derailments. While acting as pilot they will operate the engine unless otherwise instructed and when in charge of the engine to which no qualified conductor is assigned or is disabled they must perform the duties of and conform to the rules relating to conductors. They will require the assistance of crew members in any duties relative to the prompt and safe movement of their trains, engine and cars, promptly reporting irregularities or failures.

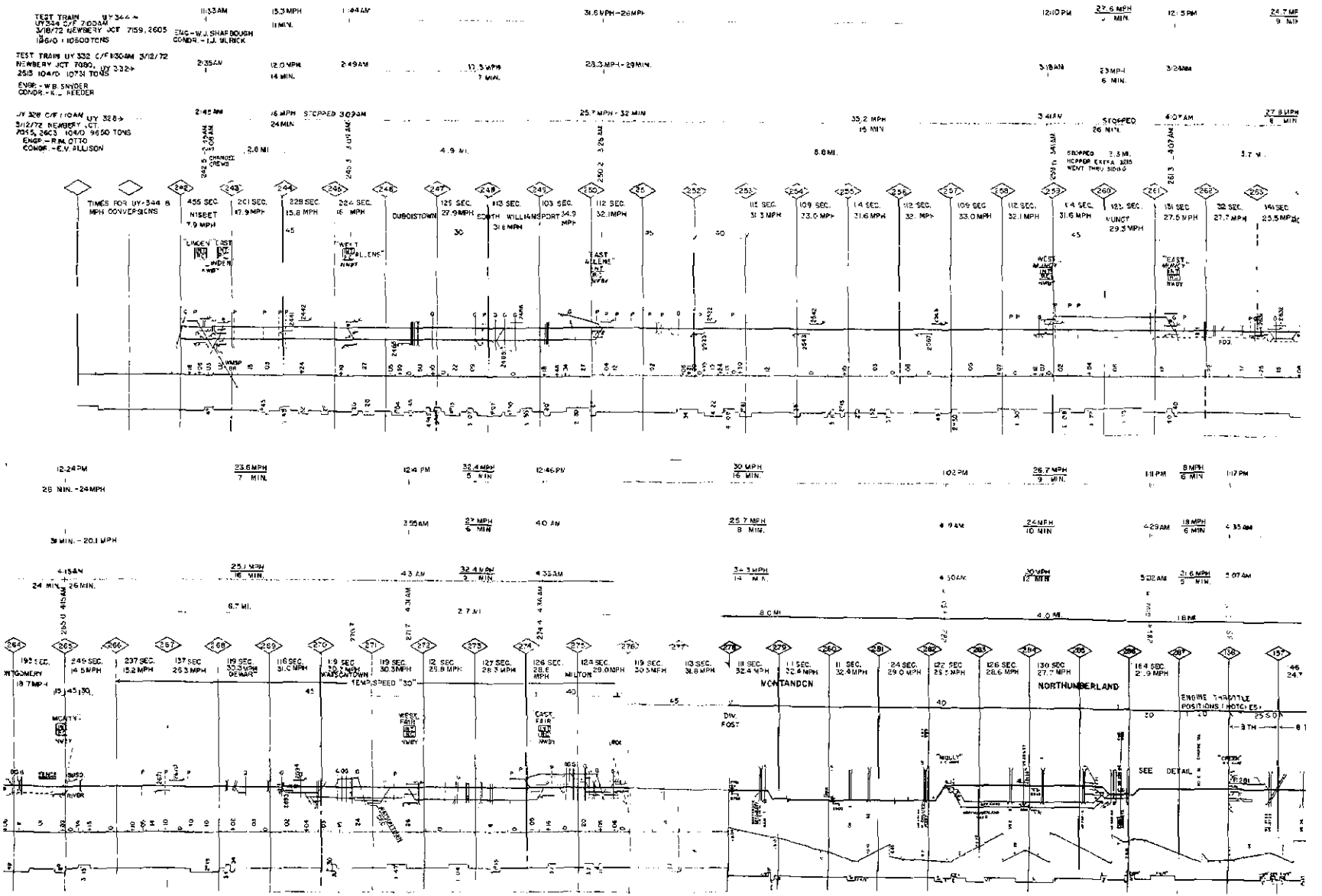
They must not allow any member of the crew to operate the engine except under their personal supervision. They will be responsible for the proper operation of the engine and must not leave it while on duty except in case of necessity in which case the engine must be secured.

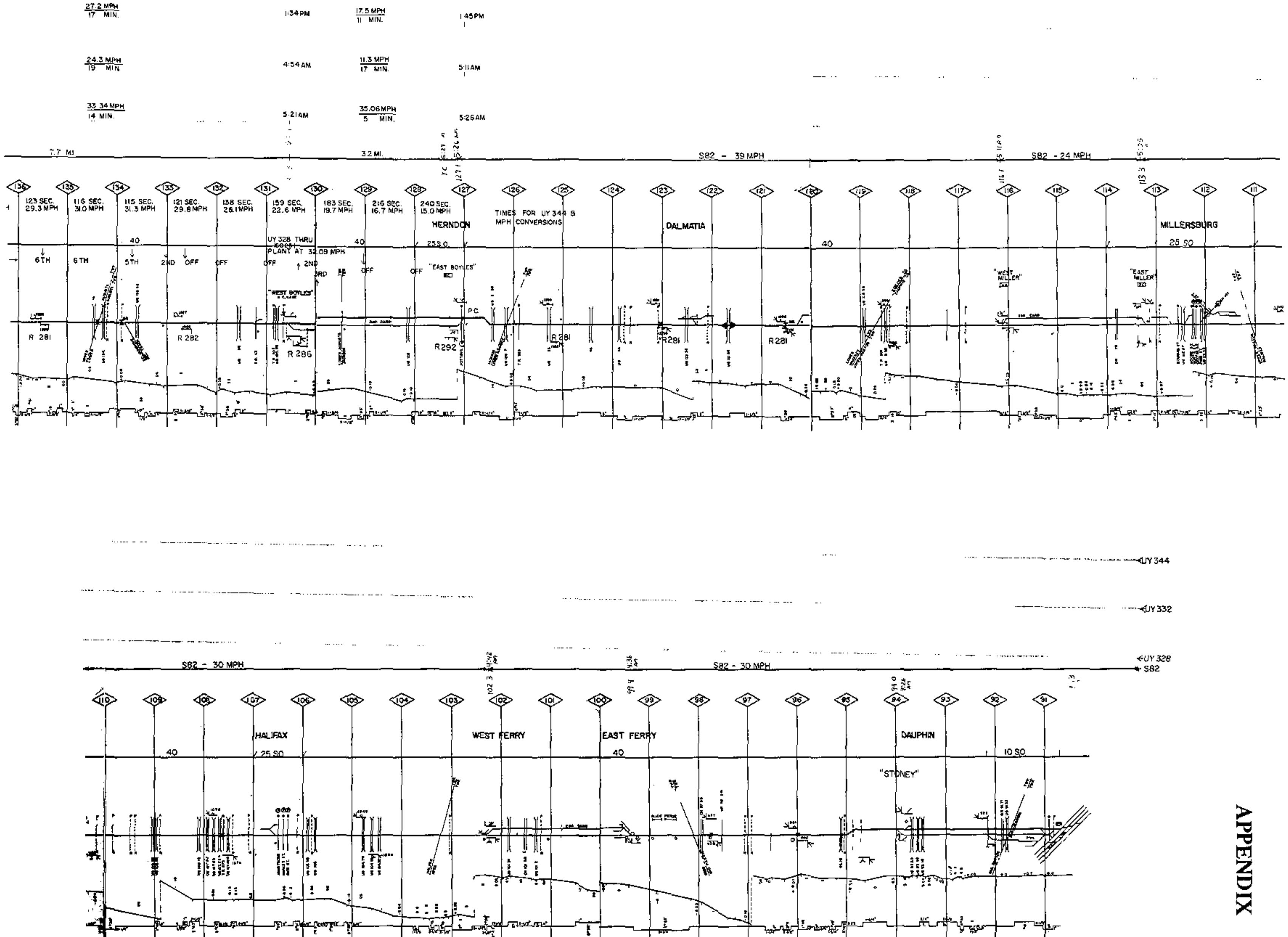
They must, if anything withdraws attention from constant lookout ahead, or weather conditions make observation of signals or warnings in any way doubtful, at once so regulate speed as to make train progress entirely safe.

When a train has more than one engine the rules apply alike to the engineman of each engine, but the use of the engine bell, whistle and air brake except in emergency must be limited to the leading engine.

The engineman is responsible for the vigilance and conduct of other employes on the engine. He will see that they are familiar with their duties and instruct them if necessary.

APPENDIX B
CHARTS WHICH COMPARE THE OPERATION OF TWO TRAINS WITH THE OPERATION OF UY-328




27.2 MPH / 17 MIN.
1:34 PM
17.5 MPH / 11 MIN.
1:45 PM
24.3 MPH / 19 MIN.
4:54 AM
11.3 MPH / 17 MIN.
5:11 AM
33.34 MPH / 14 MIN.
5:21 AM
35.06 MPH / 5 MIN.
5:26 AM
7.7 MI
3.2 MI.
S82 - 39 MPH
S82 - 24 MPH
123 SEC. 29.3 MPH
116 SEC. 31.0 MPH
115 SEC. 31.3 MPH
121 SEC. 29.8 MPH
138 SEC. 26.1 MPH
159 SEC. 22.6 MPH
183 SEC. 19.7 MPH
216 SEC. 16.7 MPH
240 SEC. 15.0 MPH
HERNDON
TIMES FOR UY 344 & MPH CONVERSIONS
DALMATIA
MILLERSBURG
UY 328 THRU PLANT AT 32.09 MPH
"WEST BOYLES"
"EAST BOYLES"
"WEST MILLER"
"EAST MILLER"
R 281
R 282
R 286
R292
R281
HALIFAX
WEST FERRY
EAST FERRY
DAUPHIN
"STONEY"
S82 - 30 MPH
UY 344
UY 332
UY 328
S82

APPENDIX B

APPENDIX C

EXCERPTS FROM A R.E A. MANUAL FOR RAILWAY ENGINEERING

SPEEDS OF TRAINS THROUGH LEVEL TURNOUTS

Turnouts with Straight Switch Points (AREA)

Turnout Number	*Length of Switch Points*	*Speed in Miles Per Hour*	
		Lateral Turnouts	*Equilateral Turnouts*
5	11′-0″	12	16
6	11′-0″	13	19
7	16′-6″	17	23
8	16′-6″	19	27
9	16′-6″	20	28
10	16′-6″	20	28
11	22′-0″	26	37
12	22′-0″	27	38
14	22′-0″	27	38
15	30′-0″	36	51
16	30′-0″	36	52
18	30′-0″	36	52
20	30′-0″	36	52

Turnouts with Curved Switch Points (AREA)

Turnout Number	*Length of Switch Points*	*Speed in Miles Per Hour*	
		Lateral Turnouts	*Equilateral Turnouts*
5	13′-0″	12	17
6	13′-0″	15	21
7	13′-0″	18	25
8	13′-0″	20	28
9	19′-6″	22	30
10	19′-6″	25	35
11	19′-6″	28	39
12	19′-6″	29	40
14	26′-0″	34	49
15	26′-0″	38	53
16	26′-0″	40	57
18	39′-0″	44	63
20	39′-0″	50	70

For passenger trains completely equipped with cars in which the lean tests show a roll angle of less than 1° 30′, trains may operate comfortably through turnouts at 12 percent higher speeds than those indicated in the foregoing