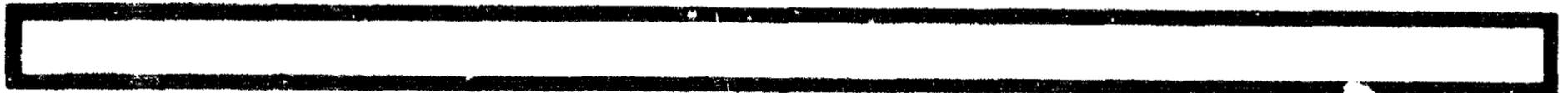
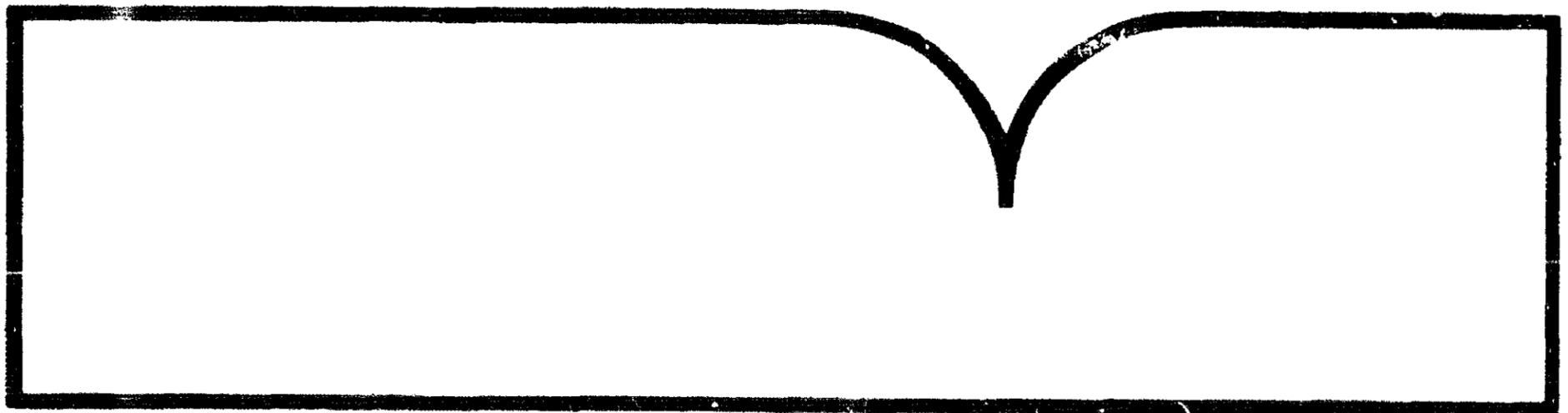


PB85-916202

HIGHWAY ACCIDENT REPORT - COLLISION OF ISLE OF WIGHT COUNTY,  
VIRGINIA SCHOOLBUS WITH CHESAPEAKE AND OHIO RAILWAY COMPANY  
FREIGHT TRAIN, STATE ROUTE 615, NEAR CARRSVILLE, VIRGINIA,  
APRIL 12, 1984

National Transportation Safety Board  
Washington, DC

Jan 85



U.S. Department of Commerce  
National Technical Information Service  
**NTIS**

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. NTSB/HAR-85/02	2. Government Accession No. PB85-916202	3. Recipient's Catalog No.	
4. Title and Subtitle Highway Accident Report— Collision of Isle of Wight County, Virginia, Schoolbus with Chesapeake and Ohio Railway Company Freight Train, State Route 615, Near Carrsville, Virginia, April 12, 1984		5. Report Date January 25, 1985	
		6. Performing Organization Code	
7. Author(s)		8. Performing Organization Report No.	
9. Performing Organization Name and Address  National Transportation Safety Board Bureau of Accident Investigation Washington, D.C. 20594		10. Work Unit No. 3956A	
		11. Contract or Grant No.	
12. Sponsoring Agency Name and Address  NATIONAL TRANSPORTATION SAFETY BOARD Washington, D. C. 20594		13. Type of Report and Period Covered Highway Accident Report April 12, 1984	
		14. Sponsoring Agency Code	
15. Supplementary Notes			
16. Abstract <p>About 3:25 p.m. on April 12, 1984, a westbound Chesapeake and Ohio Railway Company freight train traveling about 49 mph struck the front right side of a northbound 1980 Isle of Wight County schoolbus stopped at a railroad grade crossing on State Route 615 near Carrsville, Virginia. The weather was clear, the sun was to the schoolbus driver's left, and the train's whistle and bell were sounding before the collision. There were crossbucks on both sides of the single track crossing. The driver's sight distance in the direction of the approaching train was about 1/3 of a mile. The 64-passenger schoolbus body separated from the chassis at impact, rotated counterclockwise 180 degrees, rolled over 270 degrees to the right, and came to rest on its left side about 80 feet southwest of the crossing. Of the 26 school-aged bus passengers, two were injured seriously, one had moderate injuries, and the other 23 sustained minor injuries. The busdriver was seriously injured and died five days after the accident. The train crew was not injured.</p> <p>The National Transportation Safety Board determines that the probable cause of this accident was the schoolbus driver's failure to stop before driving onto the railroad crossing to determine that it was safe to proceed.</p>			
17. Key Words  Schoolbus; train; railroad grade crossing; pupil transportation safety; schoolbus crashworthiness; Operation Lifesaver; schoolbus occupant protection; stress; driver physical examination.		18. Distribution Statement  This document is available to the public through the National Technical Informa- tion Service, Springfield, Virginia 22161	
19. Security Classification (of this report) UNCLASSIFIED	20. Security Classification (of this page) UNCLASSIFIED	21. No. of Pages 51	22. Price

**CONTENTS**

**SYNOPSIS** ..... 1

**INVESTIGATION** ..... 1

- The Accident ..... 1
- Emergency Response ..... 5
- Injuries to Schoolbus Occupants ..... 6
- Schoolbus Driver Information ..... 6
- Traincrew Information ..... 9
- Schoolbus Information and Damage ..... 9
- Train Information and Damage .....12
- Roadway Information .....12
- Track Information .....13
- Medical and Pathological Information .....14
- Other Information .....14
  - Schoolbus Driver Licensing and Physical Requirements .....14
  - Discipline on the Bus .....16
  - Schoolbus Routing .....17
  - Schoolbus Driver Compliance with Railroad Crossing Requirements .....17
  - Crossing Improvements .....18
  - Schoolbus Safety Standards .....18
  - Operation Lifesaver .....18
- Tests and Research .....21

**ANALYSIS** .....22

- The Accident .....22
- Stress and Driver Performance .....23
- Schoolbus Driver Compliance with Routing Requirements .....26
- Schoolbus Driver Compliance with Railroad Crossing Requirements .....26
- Operator Qualifications and Experience .....27
- Survival Aspects .....27
- Schoolbus Body Rollover Protection .....28
- Schoolbus Body Joint Strength .....29
- Schoolbus Passenger Seating and Crash Protection .....29
- The Schoolbus Fuel Tank .....30
- Separation of Schoolbus Body from Chassis .....30
- Emergency Equipment .....31
- The Benefits of Seatbelts and Federal Motor Vehicle Safety Standards 220, 221, and 222. ....32
- Operation Lifesaver .....34

**CONCLUSIONS** .....34

- Findings .....34
- Probable Cause .....36

**RECOMMENDATIONS** .....36

<b>APPENDIXES</b> .....	<b>39</b>
Appendix A—Investigation and Hearing .....	39
Appendix B--Isle of Wight County Public Schools Personnel Evaluation .....	40
Appendix C--Medical Certificate for Virginia Schoolbus Drivers .....	41
Appendix D--Virginia Physical Requirements for Schoolbus Drivers after 1979 .....	42
Appendix E--Virginia Physical Requirements for Schoolbus Drivers before 1979 .....	43
Appendix F--Dashboard Sticker .....	44
Appendix G--Self-Evaluation: Compute Your Life Change Risk .....	45
Appendix H--Stress Warning Signs .....	47

**NATIONAL TRANSPORTATION SAFETY BOARD  
WASHINGTON, D.C. 20594**

**HIGHWAY ACCIDENT REPORT**

**Adopted: January 25, 1985**

---

**COLLISION OF ISLE OF WIGHT COUNTY, VIRGINIA,  
SCHOOLBUS WITH CHESAPEAKE AND OHIO RAILWAY COMPANY  
FREIGHT TRAIN, STATE ROUTE 615,  
NEAR CARRSVILLE, VIRGINIA,  
APRIL 12, 1984**

**SYNOPSIS**

About 3:25 p.m. on April 12, 1984, a westbound Chesapeake and Ohio Railway Company freight train traveling about 49 mph struck the front right side of a northbound 1980 Isle of Wight County schoolbus stopped at a railroad grade crossing on State Route 615 near Carrsville, Virginia. The weather was clear, the sun was to the schoolbus driver's left, and the train's whistle and bell were sounding before the collision. There were crossbucks on both sides of the single track crossing. The driver's sight distance in the direction of the approaching train was about 1/3 of a mile. The 64-passenger schoolbus body separated from the chassis at impact, rotated counterclockwise 180 degrees, rolled over 270 degrees to the right, and came to rest on its left side about 80 feet southwest of the crossing. Of the 26 school-aged bus passengers, two were injured seriously, one had moderate injuries, and the other 23 sustained minor injuries. The busdriver was seriously injured and died five days after the accident. The train crew was not injured.

The National Transportation Safety Board determines that the probable cause of this accident was the schoolbus driver's failure to stop before driving onto the railroad crossing to determine that it was safe to proceed.

**INVESTIGATION**

**The Accident**

About 3:20 p.m. on April 12, 1984, a 1980 Isle of Wight County schoolbus carrying 31 students ranging in age from 5 to 14 years was traveling south on the 2-lane gravel roadway of State Route (SR) 615 toward a single track grade crossing of the Seaboard System Railroad near Carrsville, Virginia. According to the students in the bus, the busdriver discharged two students in front of their home at a private driveway on the north side of the crossing, drove across the crossing, discharged another two students opposite a side road called Duke's Lane, drove south about 900 feet, and discharged a fifth student at a private driveway. She then shifted into reverse gear and backed the bus about 900 feet northbound on SR 615 and into Duke's Lane, turned right from Duke's Lane onto northbound SR 615, and drove onto the crossing where she stopped the bus with the steering axle between the rails. (See figure 1.) The weather was clear and the afternoon sun was to the busdriver's left.

While the schoolbus driver performed these maneuvers, a Chesapeake and Ohio Railway Company (C&O) freight train was approaching the crossing from the east. When the train was about 1 to 1 1/2 mile east of the crossing, the three crewmembers in the lead locomotive stated that they observed a cloud of dust at the crossing. When the train

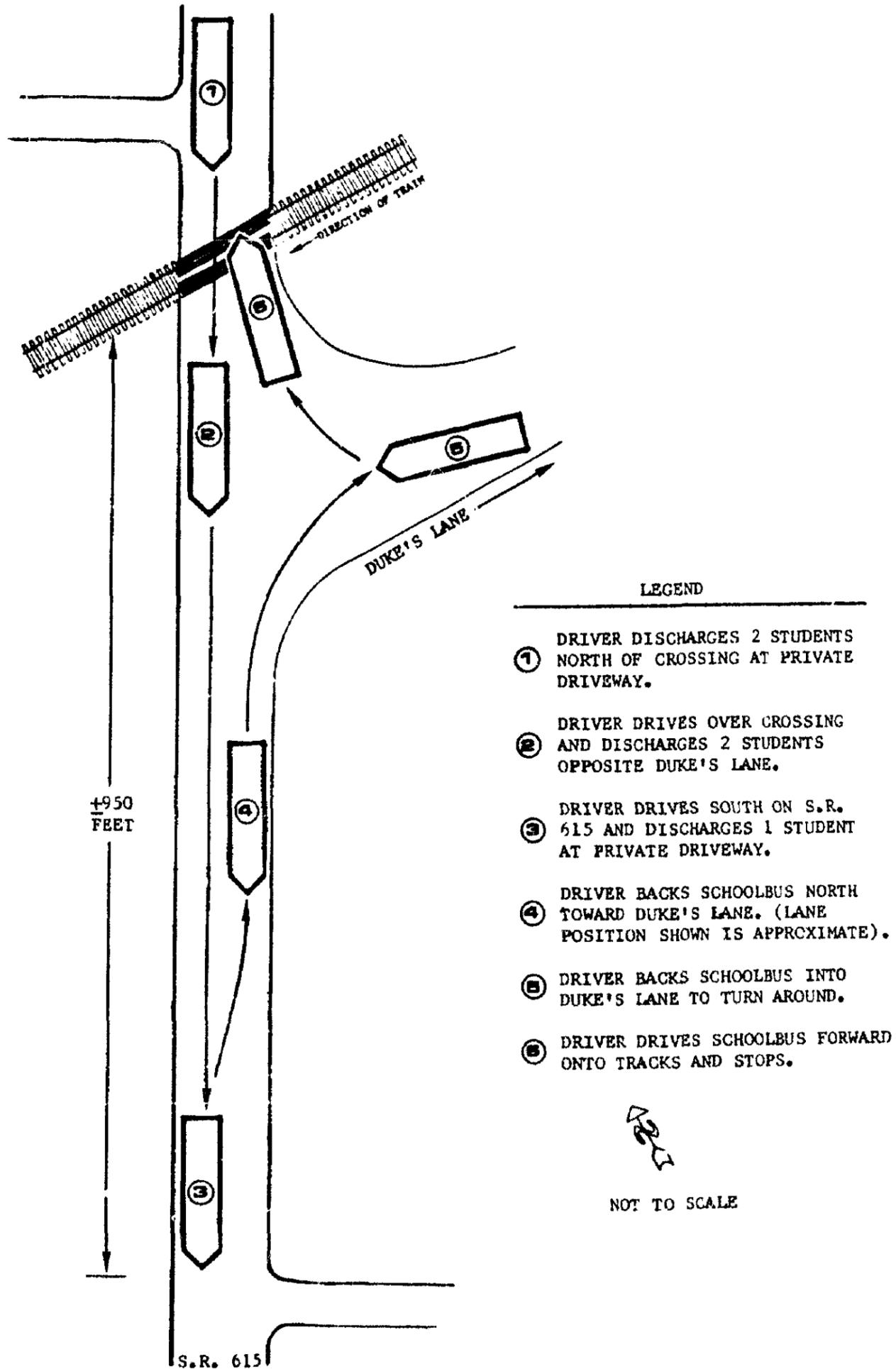


Figure 1.--Movements of schoolbus before the collision.

was about 1/2 mile east of the crossing, the traincrew stated that the schoolbus was stopped and facing south on SR 615 about 200 feet south of the tracks, and that it then backed into a dirt road (Duke's Lane) which ran parallel to the track. The engineer who was operating the train reported that he began to sound the whistle and bell as a precaution when the lead unit of the train was about 1/10 of a mile east of the whistle board. The whistle board was located 1,563 feet east of the center of the crossing. He continued to sound the whistle and bell as the train crew observed the schoolbus turn right from Duke's Lane onto northbound SR 615, drive onto the crossing, and stop with the steering axle between the rails. (See figure 2.) The fireman reported that the side door of the bus was closed when the bus pulled onto the tracks. When the train was about 500 feet east of the crossing and the bus was stopped on the tracks, the engineer stated that he placed the locomotive brake valve into emergency braking. About 3:25 p.m. and before the brakes could stop the train, the lead locomotive struck the right side of the schoolbus in front of the right side door. The train traveled an estimated 1,980 feet west of the crossing before it stopped. It did not derail.

The schoolbus body and the steering axle separated from the chassis at impact. The bus body rotated 180° counterclockwise, rolled over 270° to the right, and came to rest on its left side about 80 feet southwest of the crossing. The chassis, with the engine still mounted to it, came to rest upside down between the bus body and the crossing. A fire started in the engine area after the chassis came to rest. The steering axle of the schoolbus came to rest west of the schoolbus body. (See figure 3.)

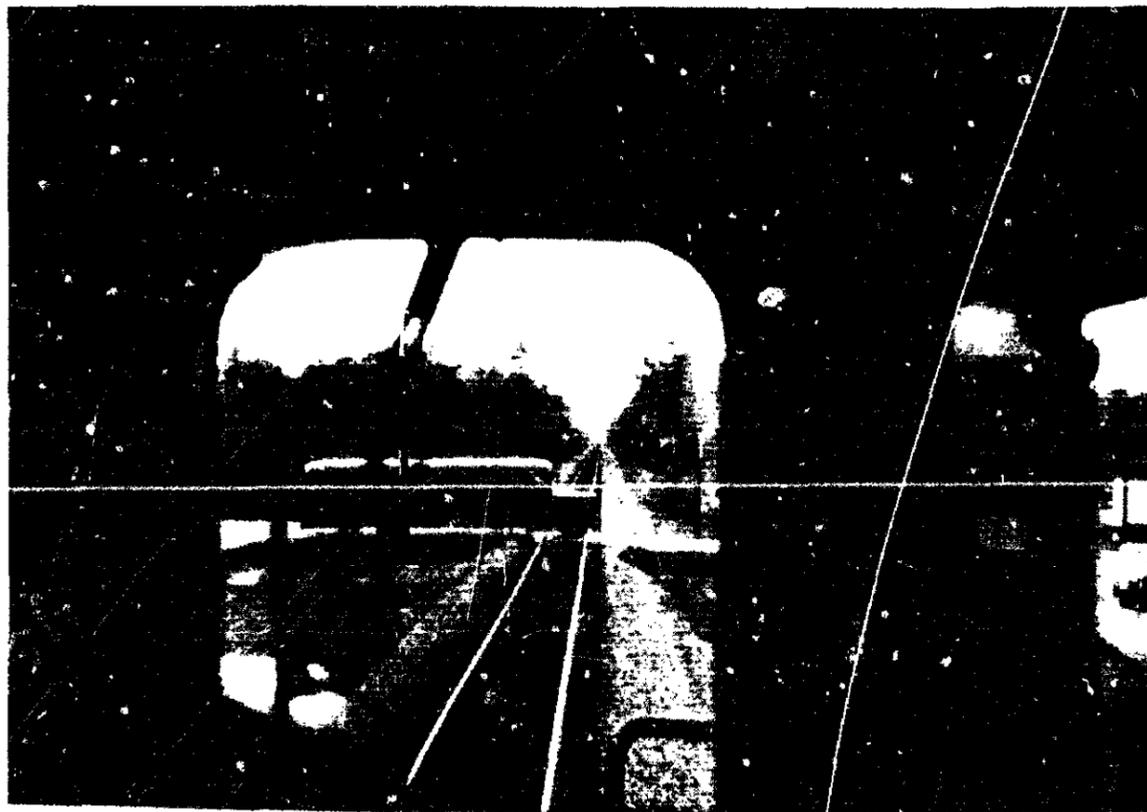


Figure 2.--Re-enactment-view of schoolbus from cab of engine before the collision.

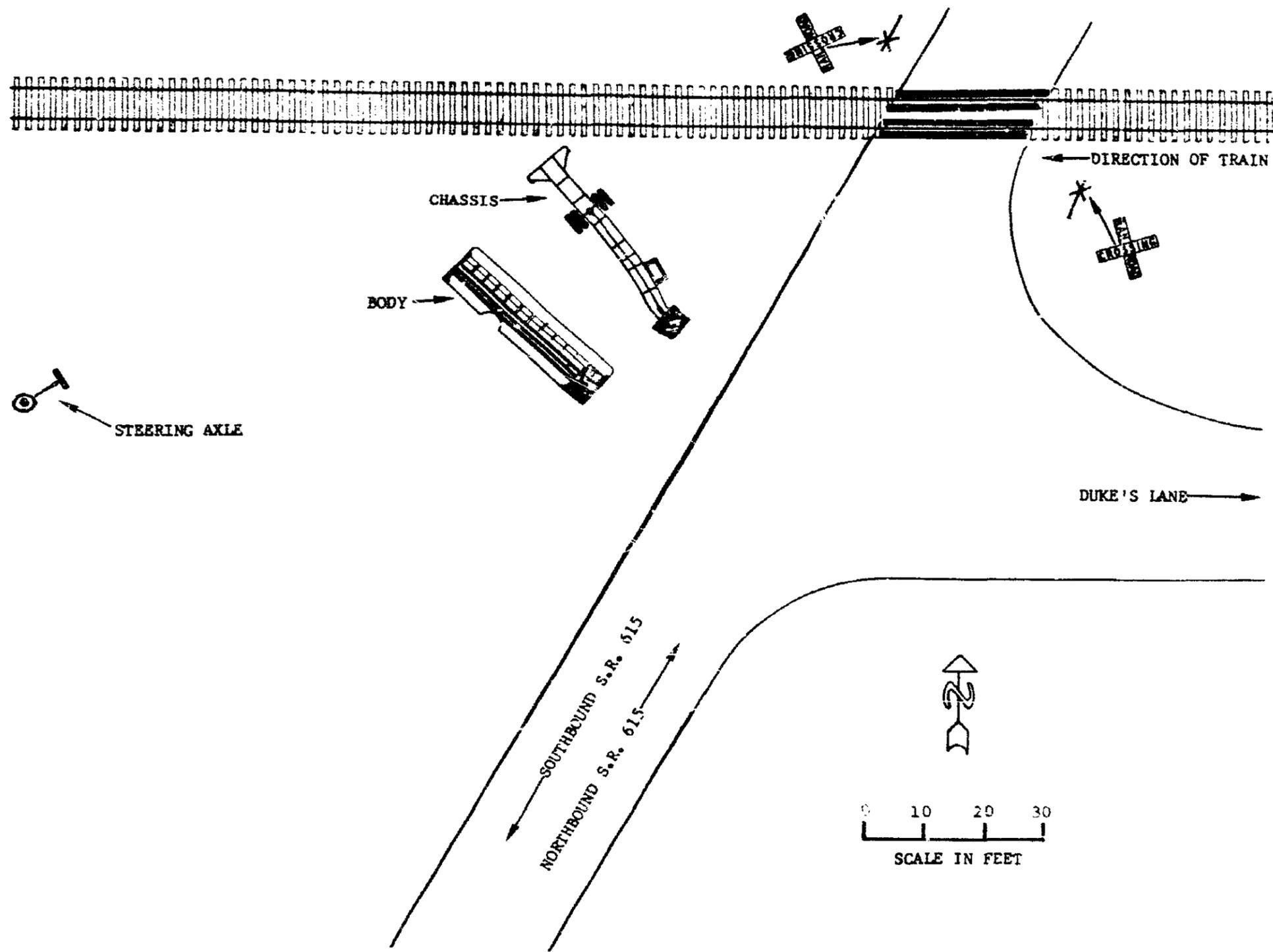


Figure 3.--Accident site.

Several passengers stated that the engine was running while the bus was stopped on the track and that the busdriver was grinding the gears as she attempted to shift the bus into reverse. One reported that the busdriver was trying to start the engine, a second reported that the driver had both of her hands on the steering wheel after she restarted the engine, and a third reported that the busdriver was just sitting there and was not trying to back the bus. Several of the students reported that the busdriver said "be quiet, I got to concentrate," "be calm," and "I can't make it" just before the collision.

One passenger seated in the fifth row window seat on the right side of the bus reported, and two others confirmed, that he told the busdriver that a train was coming just before the collision. Several passengers reported that it got "very quiet" on the schoolbus just before the collision. One passenger seated on the second row aisle seat on the left reported, and another confirmed, that when he saw the train coming he got out of his seat and ran toward the back of the bus. He stated that he got as far as the middle of the bus when the collision occurred.

Several passengers reported that they saw and/or heard the approaching train when the bus was backing on SR 615 and as the bus was being driven forward onto the track from its turnaround point on Duke's Lane. Local residents north and south of the crossing reported that they heard the train whistle before the collision.

Of the 26 school-aged bus passengers, two were injured seriously, one had moderate injuries, and the other 23 sustained minor injuries. The busdriver was seriously injured and died five days after the accident; none of the schoolbus occupants was ejected. The traincrew was not injured.

#### Emergency Response

Immediately after the collision, the train engineer contacted the Franklin, Virginia, freight station via radio and requested medical aid. The fireman and the brakeman of the train ran back to the crossing after the train stopped. One crewman cut the train to open the crossing for rescue personnel who were arriving at the scene from the north, and the other crewman assisted in the evacuation of the schoolbus.

A resident who lives about 400 feet north of the crossing stated that he heard the train whistle and the collision, and that he saw yellow debris flying from the crossing area. He called to his wife to contact the rescue squad. He then went to the crossing, crawled under the train which was blocking the roadway, and entered the front of the schoolbus body. He reported that the busdriver was conscious and bleeding badly, that she was wearing her seat belt, and that her left arm appeared to be pinned under the bus body. After he placed a cushion under her head and told her that help was on the way, he went around to the rear of the bus, opened the emergency door, and evacuated some of the passengers before the first emergency response personnel arrived at the scene. Several passengers reported they exited without assistance through the opening in the front of the schoolbus body created by the crash.

The Franklin, Virginia, Fire and Rescue Department reported that they were notified of the accident at 3:27 p.m., and that one fire truck, one crash-rescue unit, and four ambulances arrived at the scene at 3:34 p.m. The train was cut and the crossing opened to vehicular traffic within 3 minutes after the emergency response personnel arrived at the scene.

The commander in charge of the rescue operations notified Southampton Memorial Hospital in Franklin, Virginia, of the accident at 3:36 p.m., and the hospital activated its external disaster response plan. The engine fire was extinguished by the Carrsville Volunteer Fire Department.

A triage was established in the field south of Duke's Lane to identify the passengers and assess their injuries. While the injured passengers were being transported 7 miles to the hospital, other rescue personnel extricated the two remaining occupants of the bus--the driver and an 11-year-old male located behind the driver. The boy was extricated first. The Hurst "Jaws of Life" tool was used to free the busdriver's arm from under the left side of the bus. The busdriver was conscious during the 6-minute trip to the hospital, and she asked if any of the children had been killed.

Twelve ambulances were used to transport the busdriver and 20 passengers to the hospital. Another six passengers were transported in private automobiles. The last victim was transported by ambulance at 4:45 p.m. The commander in charge estimated that 100 fire/rescue personnel responded to the scene from five local jurisdictions. All fire/rescue personnel departed the scene by 7:00 p.m.

Five passengers and the busdriver, diagnosed as having potential neurological or other life-threatening injuries, were transferred from Southampton Memorial Hospital to Norfolk General Hospital in Norfolk, Virginia, using two helicopters and three ambulances. The first victim departed Southampton Memorial Hospital at 4:51 p.m. and the last victim arrived at Norfolk General Hospital at 6:07 p.m.

None of the remaining 21 victims was admitted to Southampton Memorial Hospital on the day of the accident. They were treated and released to their parents or guardians. However, two passengers returned to the hospital the next day, were admitted for followup examinations and treatment, and were released after an overnight stay.

#### Injuries to Schoolbus Occupants

<u>Injuries</u>	<u>Driver</u>	<u>Passengers</u>	<u>Total</u>
Fatal	1*	0	1
Serious	0	2	2
Moderate	0	1	1
Minor	0	23	23
Total	1	26	27

\*The busdriver was seriously injured and died 5 days after the accident.

#### Schoolbus Driver Information

The 44-year-old schoolbus driver had driven schoolbuses for 8 years and had a valid Virginia license with an "S" endorsement which permitted the operation of schoolbuses with no restrictions. She had no traffic violations on her record other than a conviction for driving an unregistered vehicle; this violation occurred before she became a schoolbus driver.

She had driven a schoolbus route for Windsor High School in Windsor, Virginia, for 7 1/2 years before she was transferred to drive another route for the Carrsville Elementary School 4 1/2 months before the accident. It was reported that she resisted the transfer to the Carrsville school and was unhappy with her new work assignment. She enjoyed working with the friends she had made on her former route, and she liked the high school students she drove. In addition, the Windsor schoolbus route was closer to her home.

The driver had driven the accident bus since it was delivered new to Isle of Wight County in 1980. The driver's husband, several friends, and a coworker stated that she had told them on several occasions that she sometimes experienced difficulty shifting the manual transmission into reverse and that on occasion she had children on the bus assist her. A close friend of the driver who was with her in the hospital after the accident and before her death reported that the driver called out, "It won't go into reverse, Oh my God," a few times while in a semiconscious state.

Most of the driver's friends, her husband, and work associates reported that the driver was experiencing difficulty in keeping order among the elementary-school-aged children on her current route. The school principal reported that the driver had come to him at least once a week with disciplinary problems, and that in some cases, the driver had gone directly to the parents of some of the children on her route. Several passengers on the driver's route reported that she stopped the bus almost daily to discipline the children.

The principal reported that although the driver was reporting disciplinary problems, she had not expressed any dissatisfaction with her present route assignment to him, and had not requested a route change.

Schoolbus drivers in Isle of Wight County receive a personnel evaluation annually during the second semester of the school year. The form used to record the results contains information concerning the evaluation of the driver's personal, professional, job relations, and performance responsibilities. (See appendix B.) The form does not contain information concerning the evaluation of the driver's satisfaction with the present route assignment. At the time of the accident, the driver involved in the accident had not received her annual evaluation from her immediate supervisor, the principal of the Carrsville school.

The driver's typical work day included the morning schoolbus run between 7:40 a.m. and 8:25 a.m., a 1- or 2-hour visit with a close friend on her way home, household activities, and occasionally a nap before the afternoon schoolbus run which began about 3 p.m. She typically returned home about 4:30 p.m. and began to prepare dinner for her family. According to her husband, her evenings usually were spent on home or church activities.

The driver's husband could not recall any specific changes in his wife's attitude or behavior several days before the accident. According to him, she had been experiencing some problems sleeping lately, but not necessarily on the two or three nights immediately before the accident. He said that the driver was always speaking of some physical ailment, that he did not pay close attention to her statements after awhile, and that her close friend who she visited daily probably would know more about his wife's recent health and mood. The driver's close friend stated that the driver "seemed normal" during their last visit 2 days before the accident, but that the driver had been under substantial

emotional strain for the last few weeks due to marital discord. She also reported that the driver had been wearing dark glasses for several weeks before the accident to hide her eyes, which were swollen from crying and sleeplessness.

On the morning of the accident, the driver had a telephone conversation with her daughter who was living temporarily in Nevada. Although the driver had been very worried about her daughter recently, the conversation was said to have been "warm and friendly." Later in the day, however, while she was making preparations for a trip her husband was taking the following day, she became upset at her step-son who came home from school early not feeling well. She was said to have been upset with him because he had missed the previous week of school due to some minor surgery and she feared he would fall far behind in his studies, and because his presence was delaying her efforts to complete her preparations for her husband's trip. Just before the accident run, the driver told one of the drivers that she had more to do that night to prepare for her husband's week-long business trip, including packing her husband's suitcase and preparing a casserole, as well as preparing the family's dinner.

Medical records indicated that the schoolbus driver was treated for a bleeding ulcer in April 1983. However, the attending physician stated that, in fact, she was treated for salmonella (food poisoning). These records also showed that the driver was hospitalized between May 11, 1983, and June 1, 1983, after taking an overdose of drugs in what she stated was a suicide attempt she attributed to marital discord. The driver was diagnosed as suffering from major depression with an underlying dysthmic disorder. She undertook outpatient psychiatric treatment but discontinued it in August 1983. It was reported that this treatment was discontinued because the driver and her husband had determined that it was no longer needed.

The driver's most recent annual physical examination required by Virginia for schoolbus drivers was performed on August 22, 1983. The text of the medical certificate prescribed by the Board of Education, according to Section 22.1-178 of the Code of Virginia, declared that the schoolbus driver has been examined and was found to be physically and mentally capable of operating a schoolbus safely. (See appendix C.) The examining physician, who also had treated the driver for food poisoning in April 1983, stated that he was not aware of the driver's suicide attempt and subsequent hospitalization in May 1983.

The 1983-1984 annual contract between the driver and the Isle of Wight County School Board required that the bus driver: stop at railroad grade crossings in compliance with Section 46.1-245 of the Code of Virginia, open the side entrance door and determine when it was safe to cross the railroad tracks, keep the side entrance door closed when the bus was in motion, and attend annual training where railroad grade crossing procedures were reviewed in detail. The driver involved in the accident attended annual training in August 1983.

Twenty-three of the 26 children who were on the bus at the time of the accident were interviewed by investigators for the Virginia State Police, the Federal Railroad Administration, and/or the National Transportation Safety Board during the 4 days immediately after the accident. Eight of the children stated that the driver did not stop before driving over one or both of the two grade crossings on the accident route; 5 stated that the driver did stop at the grade crossings; and 10 either did not remember or did not respond to questions concerning whether the driver did or did not stop.

### Traincrew Information

A 35-year-old engineer, a 29-year-old fireman, and a 42-year-old head brakeman were in the lead locomotive of the C&O train FPOR-12. A conductor and a rear brakeman were in the caboose at the rear of the train and did not see the schoolbus until after the accident.

The engineer began his career on the C&O as a brakeman in 1967 and was promoted to engineer in 1979. His last C&O-required physical examination was in March 1983; he is not required to wear glasses. His last instruction on C&O operating rules was in 1982, and his last instruction on Seaboard System Railroad operating rules was on April 6, 1984.

On the day of the accident he was called for duty at 2:00 p.m. to the Portsmouth Yard in Virginia after 15 hours of off-duty time. He worked off the extra list, but was qualified on the Portsmouth Subdivision where the crossing was located and had made three trips on the route since March 1984.

### Schoolbus Information and Damage

The 64-passenger schoolbus was owned and operated by the Isle of Wight County Public School System. It had a 1980 Ford chassis, a 1980 Blue Bird schoolbus body, an 8-cylinder gasoline engine, a five-speed manual transmission, a padded barrier in front of each of the two first-row passenger seats, 20 3-passenger bench seats, and two 2-passenger bench seats. (See figure 8.) The passenger seats did not have, nor were they required by Federal regulation to have, lapbelts. The driver's seat was equipped with a lapbelt. There was a door on the right side at the front and a center rear emergency exit door.

The major damage to the bus extended across the front and around the right side to the rear of the right side door. The impact tore away the entire front of the bus body at a point immediately in front of the driver's seat, separated the bus body and the front steering axle from the chassis, deformed the right longitudinal frame member 34 inches to the left at the point of maximum displacement immediately behind the engine firewall, and deflated the right front tire. (See figures 4 and 5.) The ignition key was found in the ignition switch in the "engine run" position. The ignition switch was damaged and could be rotated easily 360° to the right and the left with the key in or out of the switch.

The fire extinguisher mounted under the dash next to the driver was carried away with the chassis and was not used to attempt to extinguish the engine fire. The gasoline tank which was mounted on the outboard side of the right longitudinal frame rail of the chassis was not damaged during the collision and overturn, and no leakage of gasoline was reported.

The collision tore out the floor-mounted gearshift lever, part of the top housing of the transmission, and the four shifting forks inside the transmission. Although the gearshift lever and the shifting forks were recovered and the transmission was re-assembled, it could not be determined what position the transmission was in at the time of the collision.

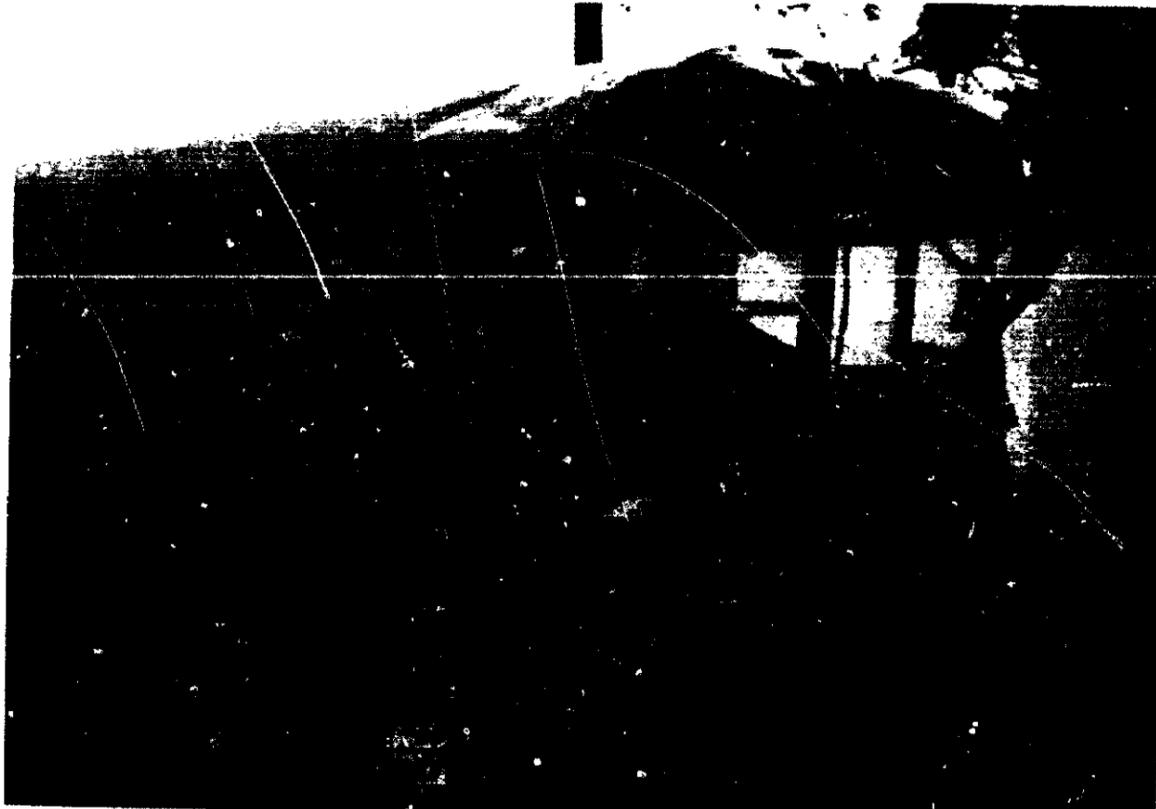


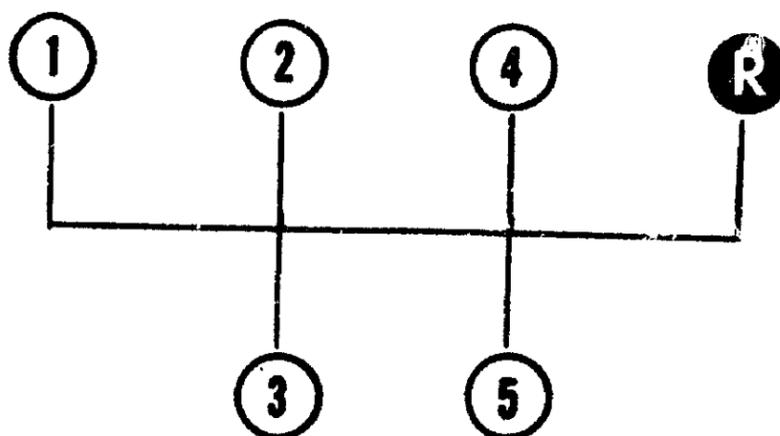
Figure 4.--Collision with train tore away the front of the bus body with the chassis.



Figure 5.--Driver's seat in bus.

According to the records of Isle of Wight County, the clutch and transmission were inspected 10 days before the accident, on April 2, 1984. No defects were disclosed. The inspection was conducted as part of the monthly inspection required for schoolbuses by the Virginia Department of Education.

According to the shift pattern embossed on the gearshift lever, the transmission was shifted into reverse by shifting the gear selector lever to the far right and then up. The shift pattern is shown below:



In its preaccident condition, the bus body was secured to each of the two longitudinal frame members by an outrigger bracket at the front, 9 tie-down clips along each side, and a shear bolt at the rear. Each tie-down clip was bolted to transverse body frame members and clipped under the top flange of each longitudinal frame member. After the accident, the tie-down clips on the left frame member were found intact. All tie-down clips on the right frame member, except the rearmost clip, were torn away from the transverse body frame members. The rearmost tie-down clip for the right frame member was bent down and away from its normal installed position. The outrigger brackets and shear bolts on each frame member were torn loose from where they were bolted to the frame member.

In its preaccident condition, the rear bumper was mounted directly below the rear of the bus body. The exterior body panel on the rear on the right side immediately above where the bumper was installed was penetrated about 8 inches and the external roof panel at the right rear corner of the roof had minor deformations. (See figure 6.) Otherwise, the exterior and interior body panels forming the right and left sides of the bus and the roof did not separate nor were they penetrated or deformed in the collision and subsequent rollover. Holes were punched in the roof and floor adjacent to the driver's position, and several windows were broken to facilitate removal of the bus from the scene. It could not be determined which windows were broken in the accident and which windows were broken by responding personnel.

The padded barriers in front of the first-row passenger seats were intact after the accident. The floor of the bus was buckled at the last row of seats. Although the buckling induced cracks in the rear seat legs of the seats in the last row at their point of attachment to the schoolbus floor, the seat legs did not separate from the schoolbus floor. The frame of the driver's seat remained attached to the floor, the seat cushion was missing, and the seatbelt was found stowed in its retractors. The floor under the driver's seat was displaced 12 inches upward.

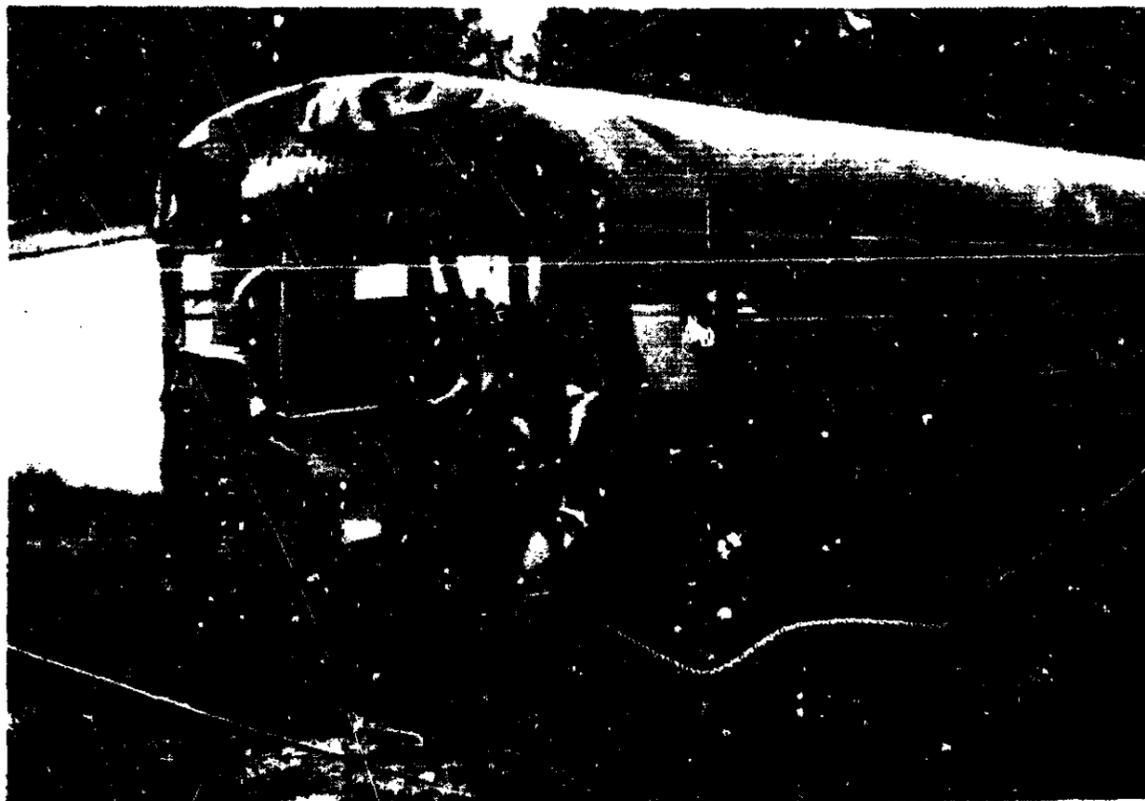


Figure 6.--Rear of Schoolbus Body.

#### Train Information and Damage

At 2:30 p.m. on April 12, 1984, Chesapeake and Ohio Railway Company (C&O) Train FPOK-12 departed Portsmouth, Virginia, for Richmond, Virginia, with three locomotive units, 108 cars (26 loaded, 82 empty), and a caboose. The trailing gross tonnage of the 6,685 foot-long train was 5,232 tons. There were no exceptions to the predeparture brake test. The train does not run according to a set schedule.

The event recorders in the 3 locomotive units were calibrated by the railroad after the accident and indicated that the speed of the train at the time of the emergency brake application was 49 mph. Post-accident inspection of the lead locomotive by the railroad disclosed that the safety appliances, piston travel, brake shoes, running gear, airbrakes, horn, bell, gauge lights, sanders, and windshield wipers were in good working order, except for a bent hand rail and a bent uncoupling lever. This damage was attributed to the accident.

#### Roadway Information

At the accident scene, SR 615 is a straight, 2-lane, 23-foot-wide, north-south, gravel roadway with no shoulders. The unposted speed limit for this roadway is 55 mph. By Virginia statute, the speed limit for schoolbuses on runs where they are stopping to pick up or discharge students is 35 mph. The angle between SR 615 and the single track of the Seaboard System Railroad is 60° for northbound vehicles. The crossing is constructed of timber headers adjacent to the rails and a bituminous surface between the headers. For about 100 feet north and south of the crossing, the roadway is level with the track. The average daily traffic volume is 55 vehicles. There had been no train/motor vehicle collisions reported at this crossing before this accident.

On each side of the crossing, there is a railroad grade crossing sign (crossbuck) located about 15 feet from the nearest rail and an advance warning sign located about 300 feet from the nearest rail. At a point 15 feet from the nearest rail on both sides of the crossing, the driver had a virtually unlimited sight distance to the east and west along the railroad right-of-way. (See figure 7.)



Figure 7.--View of train approaching accident crossing from the east.  
Tree line is 1/3 of a mile away from camera.

Duke's Lane is a 1-mile-long, 23-foot-wide private gravel road which is parallel to and the center of which is 60 feet south of the railroad track. It connects SR 615 at its west end with a mobile home park at its east end. At its intersection with SR 615, Duke's Lane has a 2.3 percent downgrade to the east for about 200 feet.

#### Track Information

The accident occurred on the single main track of the Seaboard System Railroad, Raleigh Division, Portsmouth Subdivision at railroad milepost 33+320 near Carrsville, Virginia. C&O trains regularly operate over this section of Seaboard System Railroad right-of-way. The maximum authorized speed on the Portsmouth Subdivision is 49 mph, unless restricted by engine, equipment in train, rules, special instruction, or train orders. There were no such restrictions in effect for the train involved in the accident. There were 38 train movements on the Portsmouth Subdivision during the seven days before the accident.

The east-west tangent track at the accident site had a .18-percent descending grade approaching the crossing from the east. A whistle board is located 1,563 feet east of the center of SR 615 on the right side of the track and is used to show a westbound locomotive operator when to start sounding the whistle for the upcoming crossing.

#### Medical and Pathological Information

The members of the train crew were not injured in the accident. The driver of the bus, who was seated closest to the first major impact area, sustained serious (AIS 3) injuries including fractures of the right forearm, pelvis, and right femur as well as a severed left leg below the knee, and a severed right foot. The driver refused blood transfusions or blood products for religious reasons. Five days after the accident she died as a result of her injuries. Toxicological samples to determine the presence of alcohol or other drugs were not taken from either the traincrew or the busdriver.

Two of the 26 schoolbus passengers were seriously injured (AIS 3 injuries). (See figure 8.) A 10-year-old occupant sitting in the window seat behind the driver next to the window sustained head trauma and a depressed skull fracture on the left side of the head. A 14-year-old occupant sitting in the last aisle seat on the right sustained a fracture at the base of the skull with mild brain injury as well as severe left facial abrasions. A 6-year-old child occupying this same seat was lying prone with her head on the 14-year-old's lap. The 6-year-old child suffered minor AIS 1 injuries including cuts to the left side of the head requiring stitches with scratches and bruises on her back, arms, and legs.

The schoolbus passenger in the third row window seat on the right had moderate AIS 2 injuries including bruising and abrasions across the zygomata (the bony arch below the eyes) and bruising on the lower extremities.

Twenty three of the 26 schoolbus passengers suffered minor AIS 1 injuries which included multiple lacerations, cuts/abrasions, bruises, and contusions. The head and the face were the predominant body parts injured in all categories. Eleven children had extensive head lacerations; five of these children required stitches. Another six children had numerous head cuts, abrasions, bruises, and contusions. Three children suffered facial lacerations; another seven children had facial cuts, abrasions, bruises and contusions. Four children had eye injuries.

#### Other Information

Schoolbus Driver Licensing and Physical Requirements.--To operate a schoolbus in the Commonwealth of Virginia, a driver must obtain a valid operator's or chauffeur's license with an "S" (schoolbus) endorsement from the Virginia Division of Motor Vehicles (DMV). To obtain an operator's or chauffeur's license with no restrictions as to the time of day driving is permitted, an applicant must pass a vision test requiring at least 20/40 (Snellen) corrected vision in one or both eyes and 100° of horizontal vision in one or both eyes. In addition, an applicant must pass a written test of the rules of the road, have no medical condition likely to interfere with safe driving, and not be currently adjudged to be legally incompetent or mentally ill.

To obtain an "S" endorsement on the operator's or chauffeur's license, the applicant must pass a written test on schoolbus operation, as well as a road test in a schoolbus provided by the applicant on a route at least 1/4-mile long in street traffic conditions.

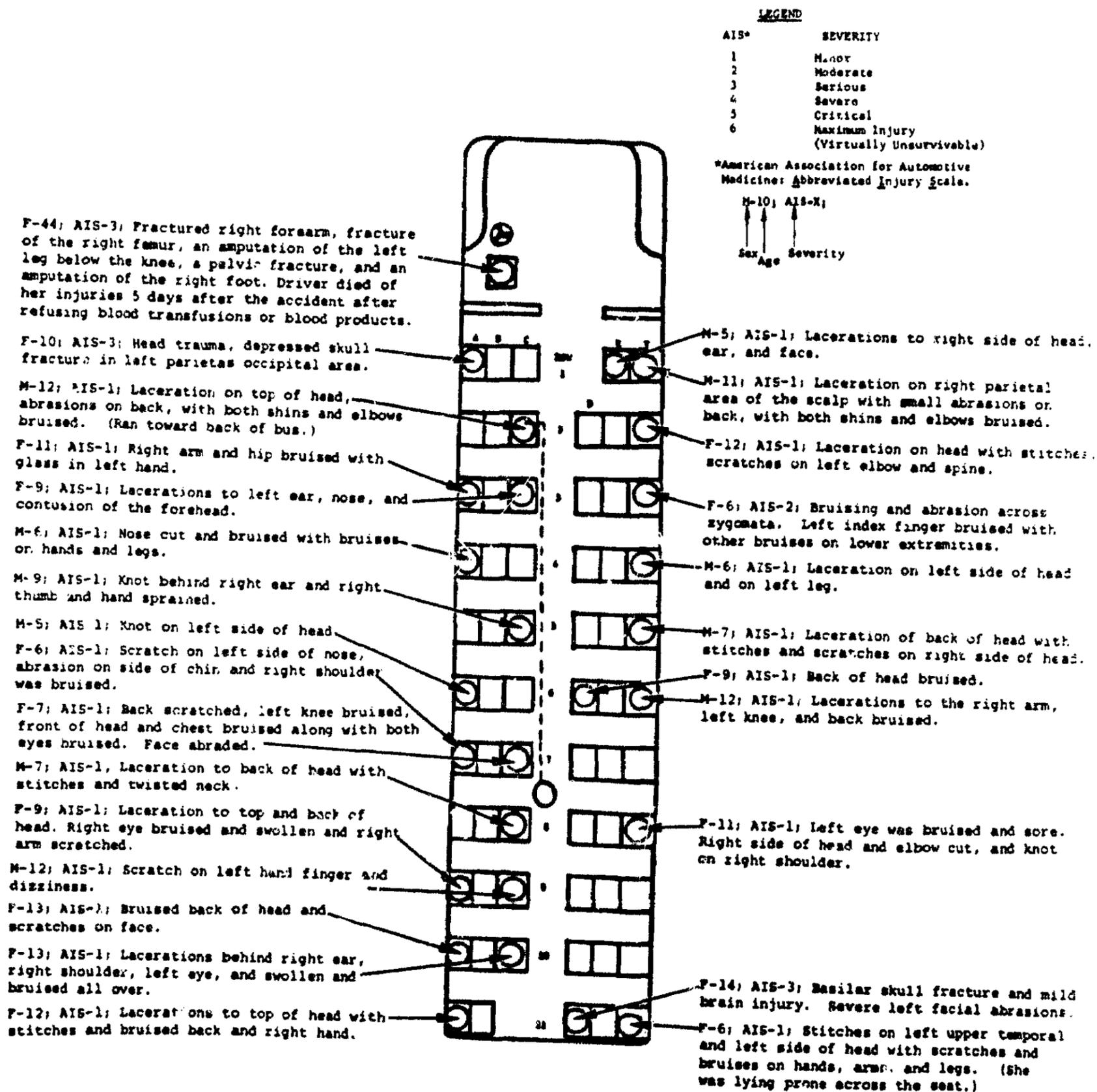


Figure 8.--Schoolbus Occupant Seating and Injury Chart.

During the road test, the applicant must demonstrate proper stopping techniques at a railroad grade crossing. If the road test is administered in a schoolbus with a seating capacity of less than 32 persons, the endorsement is restricted to the operation of schoolbuses with a seating capacity of less than 32 persons.

In addition to obtaining the "S" endorsement on the operator's or chauffeur's license, a schoolbus driver applicant must take the annual physical examination required by Section 22.1-178 of the Code of Virginia, as amended. According to a representative of the Virginia Board of Education, the Code was amended in 1979 to provide for a physical examination of a "scope prescribed by the Virginia Board of Education with the advice of the Medical Society of Virginia." (See appendix D.) This 1979 amendment to the Virginia Code deleted certain specific minimum physical requirements, relating to such items as eyesight and hearing, for schoolbus drivers which this section formerly contained. (See appendix E.) The Virginia Board of Education advised that as yet it has not consulted with the Virginia Medical Society to develop minimum physical standards for schoolbus drivers, and that there are no minimum physical requirements beyond those necessary to obtain an operator's or chauffeur's license.

Discipline on the Bus.--The principal of Carrsville Elementary School informed Safety Board investigators that his policy was that disciplinary problems with children riding the schoolbuses are to be brought to him for resolution. Generally, the first time there is a disciplinary problem, the principal will warn the child. If the problem continues, he sends a warning letter to the child's parents advising them of the problem. If the child continues to misbehave, the child is suspended from riding the schoolbus for a period of time appropriate to the offense. This policy is flexible and varies with the severity of the problem.

During the 4 1/2 months the driver was driving the route, there were 20 warning letters sent to parents of students who rode on this schoolbus route regarding schoolbus misbehavior. Seven of these letters were sent to parents of students occupying the bus at the time of the accident. Four of these seven letters suspended the students from riding the bus on the accident route for varying periods of time.

The driver who drove the route before it was assigned to the accident driver reported that she retired in November 1983 after 22 years of schoolbus driving because of an incident involving a disciplinary problem with one of the students. The driver characterized the children on the accident route as being very loud and reported that they would jump around on the bus. She believed that it was possible not to hear an approaching train because of the noise level in the bus. One of the other bus drivers at the Carrsville Elementary School reported that the driver involved in the accident had spoken to her on the day before the accident about organizing the drivers in taking their complaints concerning disciplinary problems to the school supervisors. This driver stated that she personally believed that the school did a good job in dealing with disciplinary problems. The substitute driver who took over the route after the accident and who had been a substitute driver for 5 years reported that the children on this route were "louder and worse" than any others she has ever driven.

Several of the children reported that on the accident run the children were noisy, but that the driver did not, as she usually did almost every other day, pull the bus over to the side of the road to restore order.

Schoolbus Routing.--Article 2 of the annual Contract for Pupil Transportation between the busdriver and the Isle of Wight County School Board states that the driver shall operate the bus over the assigned route and make no change unless duly authorized. According to a map and instructions covering the driver's route supplied by the Isle of Wight County Coordinator of Pupil Transportation, the established turnaround point on SR 615 was a "double-wide trailer in swamp." Safety Board investigators determined that this turnaround point was a wide driveway 9/10 of a mile south of the crossing.

The driver's husband reported that his wife had previously stated to him that a turnaround point on her designated route was unsafe, but that she did not specify the location. The map of her route shows three turnaround points, including the one on SR 615. Two of the children on the bus reported that the driver formerly used a driveway "down the road" as a turnaround point on SR 615, but had recently been backing up and using Duke's Lane to turn around. One of these children reported that the driver had told her before the accident that she could not continue to turn around in the driveway because of "a government policy or law."

The Isle of Wight County Coordinator for Pupil Transportation stated that he was unaware that the driver had altered the method in which she turned around on SR 615, and that there was no established program to systematically monitor the compliance of all schoolbus drivers with their established routes. He further stated that he monitors drivers while driving to and from work and on other occasions as he drives in the county. The Assistant Superintendent of Schools for Isle of Wight County also reported that he monitors school-bus operations when he is driving in the area.

There is no route available which would avoid either this crossing or another railroad crossing farther south on SR 615. The only alternative would be to let the students out of the bus and have them walk across the tracks to their homes.

Schoolbus Driver Compliance with Railroad Crossing Requirements.--The previous driver assigned to this route reported that she encountered trains at the accident crossing at least once a week while driving on the schoolbus route. One of the children reported that she saw trains while riding on the schoolbus "lots of times."

The resident whose two children were dropped off north of the crossing just before the accident reported that eight days before the accident, on April 4, 1984, she mentioned during a visit with the secretary of the principal of the Carrsville Elementary School that the driver involved in the accident was not stopping the bus at the crossing. Both the principal and his secretary denied ever having received such a report about any Carrsville schoolbus driver.

Another resident of the area who lives on Duke's Lane about 2/10 of a mile east of the accident site reported that his wife, who died on March 10, 1984, had called the "school board" on three separate occasions during the 1982-83 school year to report that one or more bus drivers were not stopping at the crossing. The last call reportedly was made in the spring of 1983. He could not identify which school official was contacted, or whether it was a Carrsville or some other school's bus which his wife observed failing to stop for this crossing. Buses for the Windsor High School in Windsor, Virginia, also use this crossing. This resident reported that schoolbuses would never stop at the crossing and that the first time he ever saw a schoolbus stop and open the entrance door at the crossing was on May 24, 1984, the day he was interviewed by a Safety Board investigator. (The busdriver involved in this accident did not use this crossing on the route she drove for Windsor High School.)

On the day after the accident, a resident who lives two houses north of the crossing was in his yard being interviewed by a Seaboard Coast Line Railroad official concerning the accident. Both men reported that they observed the substitute schoolbus driver fail to stop at the accident crossing. Officials for Isle of Wight County reported that they do not systematically monitor the compliance of schoolbus drivers with grade crossing requirements.

Crossing Improvements.--When Safety Board investigators revisited the scene of the accident in September 1984, SR 615 had been resurfaced. The approaches to the crossing had been marked with "no passing" double yellow centerlines extending from the rails to the advance railroad crossing warning signs located about 300 feet from both sides of the track. Stop lines had been painted on the roadway adjacent to the rails and crossbucks (railroad advance warning markings) had been painted on the roadway about midway between the advance warning signs and the nearest rail. (See figures 9 and 10.)

Schoolbus Safety Standards.--Schoolbuses manufactured after April 1, 1977, are required to meet Federal Motor Vehicle Safety Standard (FMVSS) 220, Schoolbus Rollover Protection. Two requirements of the standard are that: (1) when a force equal to 1 1/2 times the unloaded vehicle weight is applied to the roof of the vehicle's body structure through a force application plate, the downward vertical movement at any point on the plate shall not exceed 5 1/8 inches, and (b) that each emergency exit shall be capable of opening after the test loading has been applied.

In addition to FMVSS 220, schoolbuses manufactured after April 1, 1977, must comply with FMVSS 221, 222, and 301.

FMVSS 221, Schoolbus Body Joint Strength, requires that both inside and outside panels of schoolbuses be fastened to other parts and to each other by joints which have at least 60 percent of the strength of the metal of the thinner panel which is joined. The purpose of this standard is to prevent separation of the exterior and interior panels that form part of the schoolbus body.

FMVSS 222, School Bus Passenger Seating and Crash Protection, established occupant protection requirements for schoolbuses, including the installation of restraining barriers. The purpose of this standard is to reduce the number of deaths and injuries resulting from the impact of schoolbus occupants against seats and other interior bus structures during crashes and sudden driving maneuvers.

FMVSS 301, Fuel System Integrity, established fuel system integrity requirements for large schoolbuses. The purpose of this standard is to reduce deaths and injuries occurring from fires that result from fuel spillage during and after crashes.

Operation Lifesaver.--"Operation Lifesaver" is a nationwide, cooperative effort of many organizations, coordinated by the National Safety Council, to increase public awareness of the hazards at railroad crossings and to develop proper driver behavioral patterns for approaching and moving over crossings. About 40 States, including Virginia, have adopted this coordinated program which involves State and local governing bodies (especially public service commissions and transportation, education, enforcement, and motor vehicle administrators) as well as civic groups, safety organizations, railroads



Figure 9.--April 1984 view of northbound SR 615 at accident grade crossing.



Figure 10.--September 1984 view of northbound SR 615 at accident grade crossing.

operating in the State, labor groups, public information media, and citizens. In locations where this type of program has been implemented, the results have been impressive and encouraging in terms of reduced accidents, fatalities, and injuries at crossings. <sup>1/</sup>

The three aspects of Operation Lifesaver (engineering, enforcement, and education) draw on the techniques available to reduce the number of collisions between trains and motor vehicles at railroad crossings. The engineering aspect of Operation Lifesaver promotes the permanent installation of and improvements to existing traffic control devices at crossings. The enforcement aspect is an ongoing program aimed at specific locations that can be identified by analyzing accident rates and observing driver actions at the site. The education aspect involves a highly visible and concentrated public relations program aimed at reaching a significant portion of the target population.

Although the State of Virginia has had an active program in effect in the State since 1980, there had been no "Operation Lifesaver" educational activities before this accident aimed directly at schoolbus drivers in the State. On April 19, 1984, a week after the accident, the Virginia Operation Lifesaver Council sent a letter to all of the 139 public school superintendents in the State informing them of this accident, as well as a college bus/train collision which occurred in the State in November 1983, and a near-miss which occurred in January 1984. The letter also advised of the availability, free-of-charge, of a sticker which could be applied to the dashboard of schoolbuses. This sticker reminds the driver to stop at all railroad crossings. (See appendix F.) About 80 of the public school districts in Virginia responded to this letter and requested stickers, and more than 10,000 of the stickers were distributed and applied to schoolbuses in the respective jurisdictions.

One county in southern Virginia requested the stickers even though there are no railroad crossings in the county because, as school officials advised the Operation Lifesaver Council, their schoolbus drivers are likely to encounter railroad crossings outside the county during student activity trips.

The Chairman of the Virginia Operation Lifesaver Council reported that, although he was pleased by the initial response by the public school superintendents, he was concerned that not all jurisdictions requested the stickers. The Chairman also expressed concern that stickers may not be requested for new buses being placed in service or for in-service buses which had the stickers removed or defaced.

In addition, the Virginia Operation Lifesaver Council conducted three presentations on schoolbus railroad crossing safety to about 300 State schoolbus safety officials at the Virginia Pupil Transportation Conference in June 1984, and at the request of local officials, conducted presentations in 15 political subdivisions throughout the State on schoolbus railroad crossing safety during annual in-service schoolbus driver training sessions conducted before the start of the 1984-85 school year. The Virginia Operation Lifesaver Council also has an on-going program to identify private schools which operate schoolbuses in Virginia and advise these organizations of the availability of Operation Lifesaver safety presentations and materials.

<sup>1/</sup> Railroad/Highway Accident Report—"Collision of Chicago, Rock Island and Pacific Railroad Company Freight Train with an Automobile, Des Moines, Iowa, July 1, 1975" (NTSB-RHR-77-2); and "Operation Lifesaver—a Program to Reduce Accidents and Deaths at Railroad-Highway Crossings," Traffic Safety, Vol. 79, No. 8, August 1979.

### Tests and Research

Sight and time-distance tests were conducted at the scene after the accident using a similar locomotive and a similar schoolbus. Based on these tests, the busdriver could have first seen the train to her left 1,800 feet east of the crossing, or about 25 seconds before the collision, as she backed northward on SR 615. There was only one period during that 25 seconds when the train was not visible to the driver when because of the 2.3 percent downgrade to the east on Duke's Lane, the rear portion of the schoolbus roof obscured the train as the driver completed her backing maneuver about 40 feet into Duke's Lane. However, as soon as the driver started to pull forward for the right turn, the approaching train was again visible. Tests indicated that it took 9 seconds to pull from the stopped position on Duke's Lane onto the track. During the time the bus was pulling forward onto the track the train could be observed at any time by a person seated at the controls of the bus, either by looking through the window on the right side directly behind the side door, through the glass panels in the door when the door was closed, through the door opening when the door was opened, or through the right corner of the windshield. (See figure 11).

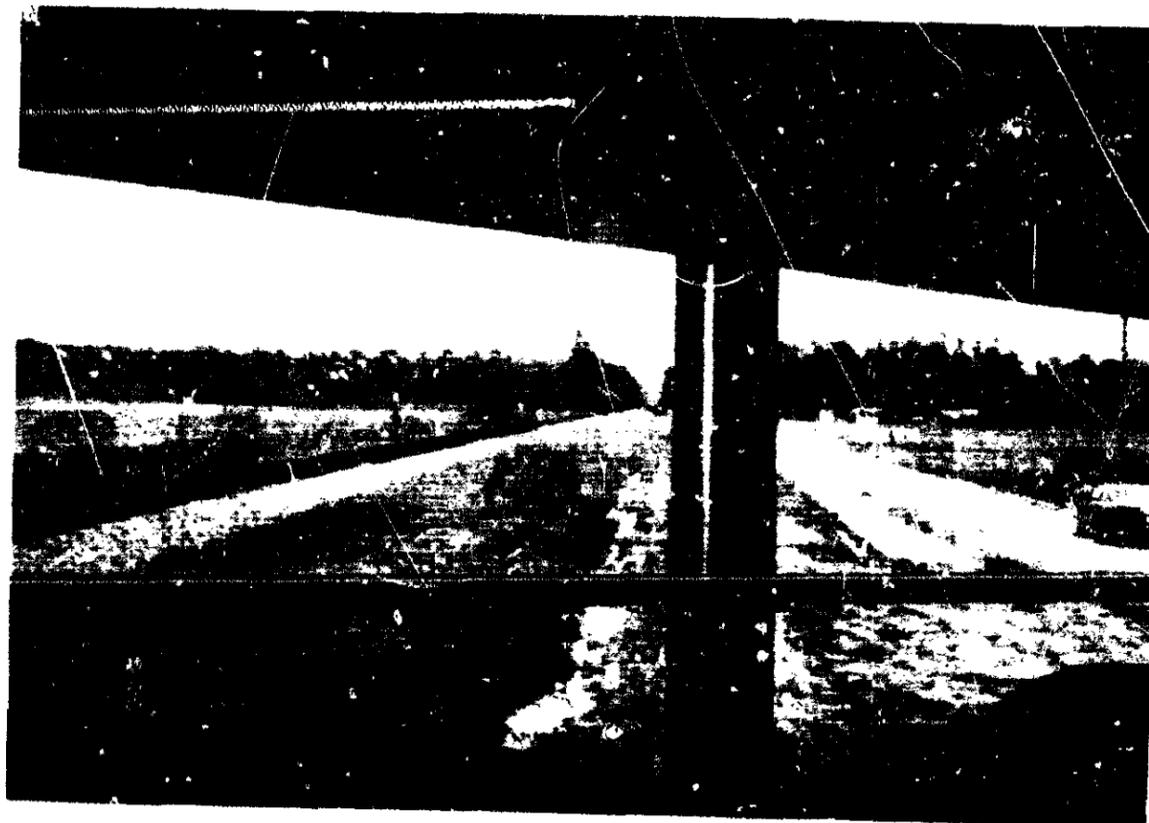


Figure 11.--View of track east of crossing through schoolbus window. Photo taken from driver's seat of similar bus. Tree line is about 1/3 of a mile from crossing.

## ANALYSIS

### The Accident

The weather, the roadway, and the mechanical condition of the schoolbus and the train were not factors in this accident. Although it was reported that the driver had occasionally experienced difficulty shifting the bus into reverse gear, the Safety Board found no defects in the transmission, the clutch linkage, or the clutch. The driver successfully shifted the bus into reverse for her backing maneuver northbound on SR 615 immediately before the collision without any reported problem. Moreover, no defects were found in the clutch and transmission in the monthly inspection conducted 10 days before the accident.

There were no obstructions at the scene which would have obscured the approaching train from the busdriver's view except at the point where she completed the backing maneuver into Duke's Lane. She could have seen the train to her left while backing on SR 615, or to her right while driving toward the track after executing the turnaround maneuver in Duke's Lane.

According to the traincrew in the lead locomotive, the bus stopped with its steering axle between the rails. Collision damage and paint transfers indicated that the schoolbus body rotated 180° counterclockwise during the collision and that the schoolbus body contacted the train at the right front, the right rear, and the left rear before it rotated away from the train, overturned 270° to the right, and came to rest on its left side.

The lack of collision damage on the right side of the rear bumper indicated that the chassis, with the rear bumper attached, had already separated from the bus body when the right rear of the bus body contacted the train. The deformation on the right rear exterior roof panel of the schoolbus body occurred after the third contact with the train at the left rear when the body was rolling over to the right and the right rear corner of the roof contacted the ground.

The fireman of the train stated that the right side door of the bus was closed when it stopped on the track. Tests indicated that although the door was closed, a person seated at the controls of the bus could see the approaching train after starting to pull up to the track after completing the backing maneuver into Duke's Lane. The statements of the traincrew and the students on board the bus verified that the schoolbus driver neither stopped before proceeding onto the crossing nor opened the side entrance door to determine that it was safe to cross the track.

The traincrew stated, and event recorders on board the three locomotives confirmed, that the train was traveling about 49 mph before the emergency brake application. The engineer in the lead locomotive stated that the emergency brake application was made about 500 feet before the crossing, and it was reported that the train stopped about 1,980 feet past the crossing after the collision. Based upon these data, it was calculated that about 7 seconds elapsed between the time the schoolbus driver pulled onto the track and the collision, that the initial collision occurred when the train's speed was about 44 mph, and that it took about 69 seconds for the train to come to a complete stop after the emergency brake application.

Tests indicated that it took the driver about 9 seconds to drive the bus from its stopped position in Duke's Lane onto the track. Therefore, about 16 seconds elapsed from the time the driver started out of Duke's Lane to the time of the collision. For the train

to stop and avoid the collision, the train's emergency brakes would have had to have been applied about 53 seconds before the busdriver started driving forward from her stopped position in Duke's Lane.

The evidence indicates that the train was being operated at the speed specified by the railroad's operating rules, that the engineer was sounding the train whistle before the collision, and that the whistle was audible to local residents to the north and south of the crossing and to some of the children on the bus before the collision. The Safety Board concludes that the train engineer acted reasonably during the events preceding the collision.

### Stress and Driver Performance

The investigation disclosed that the schoolbus driver had been under a great deal of both continuing and immediate stress during the months before, and the day of, the accident. It was reported that this driver had been involved in marital discord during the weeks before the accident and had been wearing dark glasses to hide her eyes which were swollen from crying and sleeplessness.

Marital discord may or may not be, in itself, the source of substantial stress, depending upon a person's ability to cope with it. In this driver's case, it is reasonable to assume that her ability to cope was not good since medical records indicated that marital discord was the precipitating event leading to her reported suicide attempt 1 year before the accident. It is reasonable to conclude that the driver was reacting to the stress created by her marital situation, and from a clinical stance her response to the presence of this stress indicated emotional instability.

Evidence also indicates that the driver's new schoolbus route caused her stress. All her friends who were interviewed recalled her talking about her dislike for the new schoolbus route and the disciplinary problems she was having with the children on the route. This kind of dissatisfaction and lack of control of the work environment is rated highly on stress-evaluation scales such as the Holmes-Rahe test and can, in itself, cause many stress-related symptoms. 2/ (See appendix G.)

During the weeks before the accident, the schoolbus driver was manifesting symptoms of stress such as fatigue, sleeplessness, chronic complaints of minor illnesses, and deterioration of morale and appearance according to her husband and her close friend. Other symptoms of stress, which are typical but which the driver did not exhibit according to the interviews, include performance deficiencies, needless risk taking, carelessness, and high accident rate. 3/ (See appendix H.) These symptoms are consistent with her apparent failure to perceive the danger of not stopping at railroad crossings as was reported by several of the students on the schoolbus route, and why she altered the turnaround point on SR 615. This alteration included a backing maneuver about 900-foot long and which blocked the approaching train from her view at its point of termination in Duke's Lane.

2/ Rahe, R.H. "Life Crisis and Health Change," Report No. 67-4, Naval Medical Neuropsychiatric Research Unit, San Diego, California, 1967.

3/ Reighard, H.L., MD., Federal Air Surgeon, "Warning Signs of Employee Distress," Memorandum to Federal Aviation Administration Regional Flight Surgeons, dated February 29, 1984.

In addition to the continuing stress in her life, the events of the day just before the accident were conducive to immediate stress. The driver was busy at midday preparing for her husband's business trip and was upset when her stepson came home sick from school. She told another driver just minutes before the accident run that she had to finish preparations for her husband's business trip, which included packing her husband's suitcase. This would require some preparation since the trip was going to last for a week. She also had to finish making the casserole for her husband to take with him and prepare the family dinner. It is likely she was preoccupied and in a hurry to complete her afternoon schoolbus run and return home which may have made her inattentive.

The children on the bus were characterized by the driver and others as being very loud, and according to the children on the bus at the time of the accident, their behavior on the accident run apparently was typical. Several children commented that on the accident run the driver did not pull over to the side of the road to restore order as she had almost every day before the accident. Due to her possible preoccupation with other matters the day of the accident, the driver may have blocked out the noise on the bus intentionally, which also would have the effect of blocking out other audible stimuli, including the whistle of an approaching train.

Several of the students on the bus reported that the driver was attempting to get the bus off the crossing before the collision. It also was reported that the busdriver cried out in the hospital before her death that she could not shift the bus transmission into reverse. Although the Safety Board cannot rule out the possibility of suicide, based upon the available evidence, the Safety Board believes that when the busdriver stopped on the track, it was not a suicide gesture.

Given the circumstances of the accident, the Safety Board concludes either that the busdriver failed to see or hear the approaching train until about 7 seconds before the collision when she executed a sudden stop on the track, or that she attempted to beat the train over the crossing, panicked and then braked when the speed of the approaching train was noted.

This driver had been experiencing both continuing and immediate stress both on and off the job, which may have affected her perception, her judgment, and her ability to react appropriately to the approaching train. While some level of stress can enhance performance, excess stress can lead to substandard performance. Initially as stress increases, performance improves until some optimal relationship occurs. Any further increase in stress will result in performance degradation. When a person becomes overloaded because of any stress, there is a narrowing of his/her attention. Any central task will be focused upon while quality of the performance of any peripheral tasks will deteriorate. <sup>4/</sup> (See figure 12.)

The change in the driver's route assignment 4 1/2 months before the accident probably exacerbated her problem with coping with the stress she was experiencing due to marital discord. Because of the unique physical and mental demands placed upon schoolbus drivers, and because these demands may induce stress which adversely affects job performance, the Safety Board believes that persons responsible for schoolbus driver selection and supervision should: discuss the physical and mental demands placed upon schoolbus drivers with driver applicants during the selection process, encourage drivers to

<sup>4/</sup> Yerkes, R.M., and Dodson, J.D., "The Relations of Strength of Stimulus to Rapidity of Habit Formation," *Journal of Comparative Neurology & Psychology* 18" (1908); 459-82.

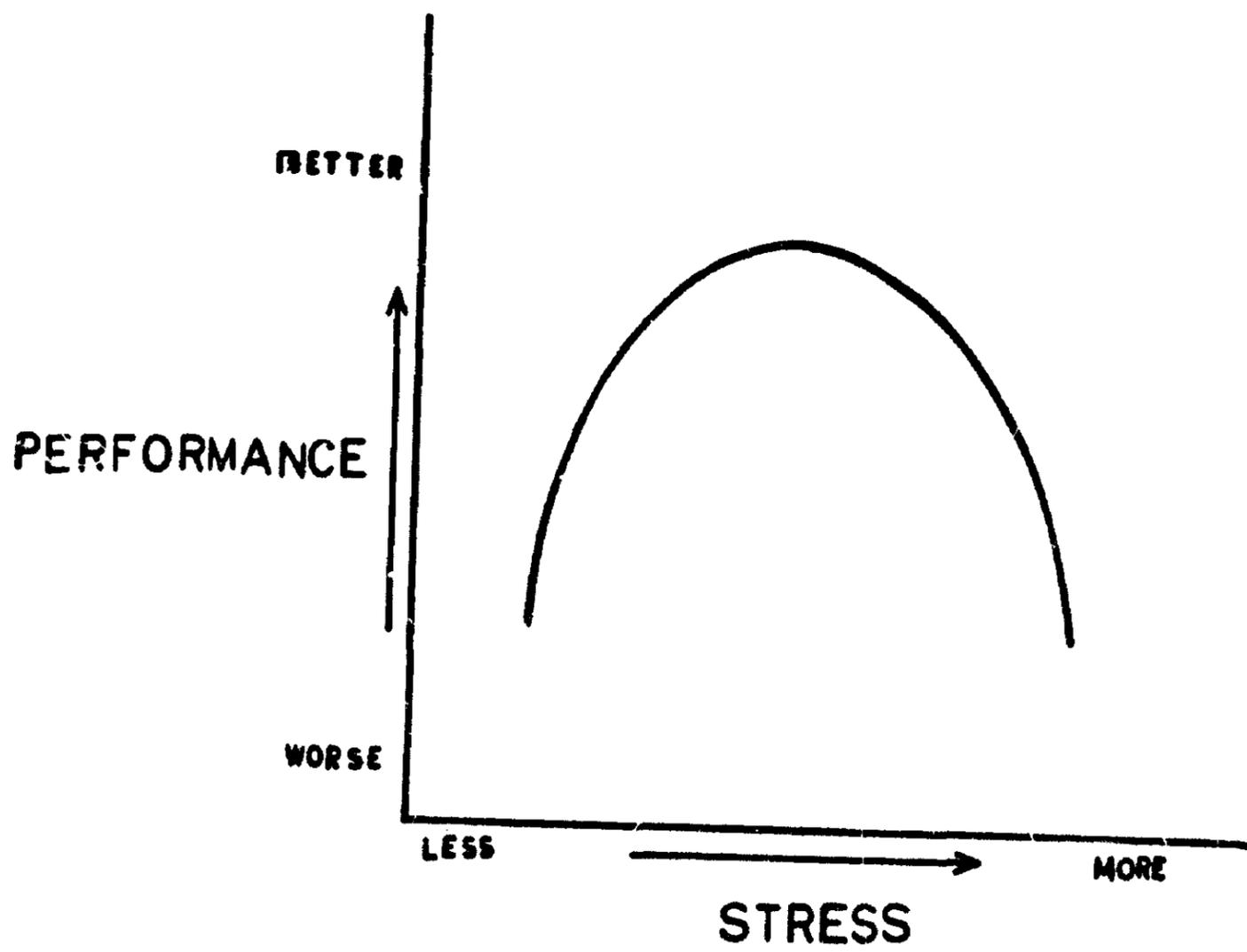


Figure 12.--The relationship between stress and performance.

discuss their problems and their satisfaction with the present job assignment during routine contacts and during performance evaluations, and encourage supervisors to have frequent contact with their schoolbus drivers to discuss and resolve behavior problems concerning schoolbus passengers. Persons responsible for schoolbus driver selection and training may also consider developing and incorporating a stress recognition and management program into the initial and in-service training for schoolbus drivers and their immediate supervisors. 5/

#### Schoolbus Driver Compliance with Routing Requirements

It was reported that the driver had considered one of her specified turnaround points on her route to be unsafe. Since there is no evidence to indicate that the driver changed either of the other two specified turnaround points on her route, it is reasonable to assume that the turnaround point on SR 615 is the one to which she was referring. If the driver had been approaching the crossing driving forward for a greater distance without the distraction of backing the bus, she would have had more time to see and gauge the speed of the approaching train, and the train would not have been blocked from her view for a period of time while she was turning around in Duke's Lane.

The annual contract between the driver and the Isle of Wight County School Board specified that the driver was to make no unauthorized changes to the assigned route. The County Coordinator for Pupil Transportation stated that the county had no program to systematically monitor schoolbus driver compliance with established routes, that he was unaware of the change in the turnaround made by this driver, but that he did observe schoolbus driver actions on his way to and from work and while driving in the area. The Safety Board believes that school officials should periodically monitor the compliance of all schoolbus drivers with established route requirements.

#### Schoolbus Driver Compliance with Railroad Crossing Requirements

Based on an interview with a former driver on the accident route, the Safety Board believes that the driver was aware that trains were likely to be encountered at this crossing. However, several persons reported that they had observed schoolbuses fail to stop at the accident crossing, both before and after the accident. There was no program in effect in Isle of Wight County to systematically monitor the compliance of schoolbus drivers with railroad crossing stop requirements. Reports that schoolbus drivers were not stopping at the crossing either were not made or effective action was not taken by school officials.

The Safety Board believes that school officials should stress, during initial and in-service training of schoolbus drivers, the necessity for complying with statutory and contractual requirements that schoolbuses stop at crossings and that school officials should monitor systematically driver compliance with these requirements by on-scene observations. Also, at or near the start of each school year, school officials should issue an announcement to parents and students which contains the railroad crossing stop requirements for schoolbuses in effect in that jurisdiction and which requests that schoolbus drivers who fail to comply be reported to a designated school official.

5/ Murphy, Lawrence R., Ph.D, "Worksite Stress Management Programs," 1981-1982 Employee Assistance Program (EAP) Digest Annual, pp. 81-84, published by Performance Resource Press, Inc., 2145 Crooks Road, Suite 103, Troy, Michigan 48084.

The Safety Board also believes that the National Highway Traffic Safety Administration should include in the next revision of Highway Safety Program Standard (HSPS) 17--Pupil Transportation Safety and the "Program Manual" for implementing HSPS-17: guidelines for systematically monitoring schoolbus driver compliance with railroad crossing requirements, and guidelines for the development of an annual notification to parents and students at or near the start of each school year of the railroad crossing stop requirements in effect for schoolbuses in that jurisdiction, and that schoolbus drivers who fail to stop at crossings should be reported to a named school official whose telephone number is included with the notification.

#### Operator Qualifications and Experience

The qualifications and experience of the train engineer were not factors in this accident. The driver of the schoolbus was experienced in schoolbus operations and met Virginia's requirements for the operation of schoolbuses, including the requirement for an annual physical examination. There is no indication that the schoolbus driver did not have the skills required to operate a schoolbus safely.

The value of the current Virginia busdriver physical examination, over and above the examination required to obtain an ordinary operator's or chauffeur's license, is questionable. Objective requirements to be used by an examining physician to evaluate an applicant's physical and mental fitness to operate a schoolbus were deleted from the Code of Virginia in 1979 and have not been replaced as mandated by the Virginia General Assembly. The Safety Board believes that the lack of objective physical standards for schoolbus drivers can result in drivers with serious physical impairments being permitted to operate schoolbuses. For example, since Virginia permits the licensing of drivers who are deaf, a deaf driver with an "S" endorsement on his or her license can pass the annual schoolbus physical examination based solely on the opinion of the examining physician.

The physician who examined the driver on August 22, 1983, for her physical and mental fitness to operate a schoolbus was not aware of her suicide attempt four months before that examination and was not aware that the driver had received psychiatric treatment from June to August 1983.

The Safety Board believes that the Virginia Board of Education, with the advice of the Virginia Medical Society, should promulgate without delay objective minimum physical standards for schoolbus drivers. Since examining physicians may or may not be aware of the demands made upon schoolbus drivers, the minimum standards should be preprinted on any form approved by the Board of Education so that these standards are readily available to the examining physician. The Safety Board also believes that examining physicians should obtain a health history from a schoolbus driver applicant to make more informed judgements of the medical and psychological condition of a prospective schoolbus driver.

#### Survival Aspects

As the train struck the front right side of the bus, the entire front of the bus body forward of the driver's seat was torn away when the schoolbus body separated from the chassis. If the driver had not been wearing her seat belt, she probably would have been ejected through the opening in the right front of the bus created by the collision and possibly crushed between the schoolbus body and the train during the collision or subsequent rotation. Similar kinematics were experienced by the student sitting in the first seat behind the driver and the two students occupying the first seat on the right. The barriers installed in front of the first seat on the left and right of the bus probably prevented these children from being ejected and crushed.

The 10-year-old child sitting in the first seat behind the driver and the 14-year-old child sitting in the rear aisle seat on the right were the most seriously injured. The child sitting behind the driver was close to the area of the first impact with the train and probably was thrown head-first toward the right side of the bus when the train struck the front right side. This child sustained head trauma, including a depressed skull fracture. The installation and use of a seat belt by this child probably would have prevented or mitigated this injury.

The 14-year-old child sitting in the rear aisle seat on the right, and a 6-year-old child lying prone on the same seat with her head in her 14-year-old sister's lap, were seated immediately in front of the second impact area at the right rear of the bus. The force of the second impact initially would have propelled both of these children to the right rear. Because of her size and initial seating position, the 14-year-old child sustained her basilar skull fracture when her head, which was above the padded seat back, probably contacted the frame of the emergency door at the right rear of the bus. Because of her prone position in the seat, the 6-year-old was propelled into the padded seat back instead of the hard interior surfaces above the back of the right rear seat.

The 14-year-old also sustained facial abrasions to the left side of her face, and the 6-year-old sustained cuts on the upper left side of the head and scratches and bruises on her hands, arms, and legs. It is believed that these less-serious injuries were sustained when the bus rolled over. Although installation and use of seatbelts by these two children may have prevented or mitigated their abrasions, scratches, and bruises, use of a seat belt would not have prevented the 14-year-old's basilar skull fracture.

Most of the children who were seated next to the side wall on the right side of the bus at the time of the collision sustained lacerations, bruises, or abrasions to the right sides of their heads or upper torsos. Although it is possible that some of these injuries may have been sustained when the bus rolled over, the Safety Board believes that the majority of these injuries were sustained when the train initially struck the bus and these children were propelled to the right and contacted the right side wall, windows, and window frames on the right side of the bus. The installation and use of seatbelts by the children seated by the sidewall on the right side would not have prevented or mitigated most of these minor to moderate injuries.

The children who were seated away from the major impact areas sustained minor injuries. It is believed that these injuries occurred when these children contacted the side walls, the windows and frames, and the roof when they were thrown about the interior of the bus during the initial impact and the subsequent rotation and rollover. Installation and use of seatbelts by these children may have prevented or mitigated some of these minor injuries.

If the train had struck the right side of the schoolbus in the passenger seating area rather than in front of the firewall, the accident would have been much more severe. There would have been more penetration into the occupant space and probably a higher number of serious to fatal injuries in or near the area of impact.

#### Schoolbus Body Rollover Protection

The minor deformation of the exterior roof panel at the right rear of the schoolbus body occurred when this portion of the roof contacted the ground during the rollover. After this contact and as the bus continued to roll over 270 degrees to the right, the roof was subjected to vertical loading, and it performed in a crashworthy manner with respect to the requirements of FMVSS 220. The roof reacted to the crash forces as a unit, and the schoolbus body retained its basic shape which provided survivable occupant space.

The damage sustained at the right rear during the secondary impact of the bus with the train and the crash forces experienced during the subsequent rollover did not prevent the rear emergency exit from being operable. Several children were evacuated through this door. The Safety Board believes that the schoolbus body met the rollover protection requirements of FMVSS 220.

#### Schoolbus Body Joint Strength

In its 1970 Special Study on deficiencies in the structural assembly of schoolbus bodies, 6/ the Safety Board pointed out to schoolbus manufacturers and the National Highway Safety Bureau (predecessor to the National Highway Traffic Safety Administration (NHSTA)) injuries attributed to panel separation in several schoolbus accidents. Based on the crash performance of the schoolbus body in this accident, it appears that post-1977 construction methods are substantially better than construction methods in use before the promulgation of FMVSS 221. Many accidents involving pre-1977 schoolbuses resulted in exterior and interior body panel separations which resulted in exposed sharp edges and which caused occupant injuries and a general collapse of the schoolbus body. In this accident there was no interior body panel separation, and the only exterior body panel penetration noted was at the lower right rear of the bus where it collided with the train. This point of impact could not be expected to withstand the crash forces applied. The Safety Board concludes that the schoolbus body met the requirements of FMVSS 221 and that schoolbus body crashworthiness has been improved because of this standard.

#### Schoolbus Passenger Seating and Crash Protection

FMVSS 222 provides for schoolbus occupant crash protection, primarily from frontal and rear-end collisions, through the use of strengthened, properly spaced, padded seat backs and padded restraining barriers. Although the collision of the right rear of the bus with the train induced cracks in the rear seat legs in the last row of seats, there were no seat leg separations, and all the passenger seats retained their original spacing and provided for survivable occupant space.

In its report of the January 10, 1984, near-head-on collision of a tractor-semitrailer and a 1979 schoolbus which occurred in Rehoboth, Massachusetts, 7/ the Safety Board concluded:

During the collision with the truck the passengers were contained in their respective seating areas and the padding on the seats and barriers provided for a less hostile environment than pre-1977 buses which generally had exposed metal seat frames. . . . The injuries to passengers seated on the right side of the bus probably occurred while the bus was rolling over when they contacted the right side windows, the sidewall, and the roof of the bus.

6/ For more detailed information read Special Study—"Inadequate Structural Assembly of Schoolbus Bodies." The accident at Decatur and Huntsville, Alabama, July 29, 1970. (NTSB-HSS-70-2)

7/ Highway Accident Report—"Collision of G&D Auto Sales, Inc. Towtruck Towing Automobile, Branch Motor Express Company Tractor-Semitrailer, Town of Rehoboth Schoolbus, Rehoboth, Massachusetts, January 10, 1984." (NTSB-HAR-84-05)

The occupants of the Carrsville schoolbus were subjected to the initial collision kinematics of a side impact while the occupants of the Rehoboth schoolbus were subjected to the initial collision kinematics of a near-head-on impact. Both accidents involved rollovers. The Carrsville schoolbus rolled 270° and the Rehoboth schoolbus rolled 180°. While padded seatbacks and barriers protect schoolbus occupants in front and rear collisions such as the Rehoboth accident, there is no protection for schoolbus occupants who strike and are injured by unyielding interior walls, windows, window frames, and roof surfaces in side impacts and rollovers. In both the Carrsville and Rehoboth schoolbus accidents, the majority of the injuries were sustained when the occupants struck interior surfaces other than seats and barriers. Although these injuries were minor, the numerous lacerations (some requiring stitches) and abrasions of the head, face, and body that the Carrsville schoolbus occupants sustained could have been disfiguring. These injuries could result in needless emotional trauma for the victims.

Based on the results of the Rehoboth and Carrsville schoolbus accidents, the Safety Board concludes that the matter of additional injury protection for schoolbus occupants involved in side collisions and rollovers should be explored by schoolbus manufacturers and NHSTA and that additional accident investigation data should be collected in this area. Examples of potential injury reducing alternatives might include padding interior wall and roof surfaces and utilizing more forgiving window structures. A discussion concerning the potential benefits of seatbelts for the schoolbus passengers is contained in a subsequent section of this report.

#### The Schoolbus Fuel Tank

The fuel tank was not damaged during the accident, and there was no leakage of fuel reported after the chassis overturned and came to rest upside down. The fuel tank met the performance requirements of FMVSS 301.

#### Separation of Schoolbus Body from Chassis

In the Rehoboth, Massachusetts, schoolbus crash on January, 1984, a 65-passenger post-1977 schoolbus was struck nearly head-on by a tractor-semitrailer. The body of the schoolbus partially separated from the schoolbus chassis and the schoolbus body overturned. The drivers of the tractor-semitrailer and the schoolbus, and one child who was sitting directly behind the driver, were killed. The most seriously injured child who survived was sitting in the same seat directly behind the driver. The rest of the children in the bus sustained minor or no injuries. In its investigation of the accident, the Safety Board determined that the energy expended in forcing the schoolbus body from the chassis mounting brackets and clips and off the chassis served to dissipate crash energy which otherwise would have been absorbed by the schoolbus body, and which would have reduced the occupant's survivable space.

The body of the Carrsville bus was mounted to its chassis in a manner similar to the Rehoboth schoolbus. During the initial collision with the train, the chassis of the Carrsville schoolbus absorbed much of the initial crash forces as the body was forced off the chassis. As was the case with the Rehoboth accident, the Safety Board concludes that the separation of the chassis from the schoolbus body had positive safety results in that the crash forces which otherwise would have been transmitted to the schoolbus body were expended when the body was forced off the chassis. This may not be true of other accidents.

### Emergency Equipment

Because of the body-chassis separation, the entire dash and the dash-mounted fire extinguisher were carried away with the chassis. At the final rest position of the chassis, the fire extinguisher was underneath the overturned chassis and adjacent to the area involved in the engine fire. Therefore the fire extinguisher could not be easily reached and used to extinguish the fire.

On March 25, 1983, an accident occurred near Newport, Arkansas, involving a Jonesboro, Arkansas, School District schoolbus. 8/ The Safety Board's investigation of that accident resulted in the issuance of Safety Recommendations H-83-45 and H-83-48 to NHTSA and the Governors of the 50 States and the Mayor of the District of Columbia to place fire extinguishers at the front and rear of schoolbuses, post signs in schoolbuses on the location and use of emergency equipment, and brief passengers on the location and use of emergency equipment, both periodically and before beginning activity trips.

Seventeen States have responded to Safety Recommendation H-83-48 with varying degrees of acceptance. Ten States have placed the matter under study but have expressed skepticism as to the need for the second extinguisher. Five States have expressed concern for the economic impact of such a step citing also the high probability of misuse of the fire extinguishers, the high capital outlay for initial installation, as well as intentional vandalism and large maintenance or replacement costs. One State, in disagreeing with the recommendation, has strongly endorsed the drilling of students in escape and evacuation procedures after an accident as better insuring safety than providing students with the equipment to fight a fire. One State has agreed to present the idea to an advisory committee on schoolbus safety for consideration, and two States have taken action to implement the two fire extinguisher policy through instructions to local school superintendents from the Governor's office. One of the States made a commitment to introduce and support the two fire extinguisher concept at the National Schoolbus Minimum Standards Conference to be held in Warrensburg, Missouri, on May 19-24, 1985.

The Safety Board's investigation of the schoolbus accident in Rehoboth, Massachusetts in January 1984, determined that an engine compartment fire in the schoolbus was extinguished using fire extinguishers obtained from another involved vehicle and from a nearby residence. Due to extensive collision damage and the collapse of the front of the roof of the Rehoboth schoolbus, the single fire extinguisher mounted in the front could have been reached only by entering the rear emergency exit door of the bus and crawling to the front of the bus. As a result of its investigation of the Rehoboth schoolbus accident, the Safety Board reiterated recommendation H-83-48 to the National Highway Traffic Safety Administration.

The evidence obtained during the Safety Board's investigation of the Carrsville schoolbus accident confirms the Safety Board's findings in the Jonesboro and Rehoboth accident investigations, relating to the desirability of installing fire extinguishers at both the front and rear of schoolbuses. All three accidents involved rollovers in which an engine fire developed. Each of these fires had to be extinguished by means other than the vehicle's own fire extinguisher because it was not easily accessible as a result of the accident.

8/ Jonesboro School District Schoolbus Run-off Road and Overturn State Route 214 at State Highway 18 Near Newport, Arkansas, March 25, 1983, (NTSB/HAR-83/03).

**The Benefits of Seatbelts and Federal Motor Vehicle Safety Standards 220, 221, and 222.**

The installation of seatbelts in schoolbuses is a controversial issue. Proponents of installation of seatbelts argue that seatbelts help to attenuate some of the crash forces experienced, keep occupants in their seats, and that occupants are less likely to be ejected when wearing a seatbelt.

Opponents of Federal regulations requiring seat belt installation on large schoolbuses argue that additional safety benefits to be derived from the installation and use of seatbelts on conventional size schoolbuses built to post-1977 standards have not been demonstrated; that the passive crash protection provided by the seat design (compartmentalization) is superior to reliance on seatbelts since seatbelts may be unused; and that seatbelts may not function safely in combination with the seats designed for compartmentalization since lap-belted passengers are likely to jackknife at impact, hitting their heads on the seats in front, causing head and facial injuries.

Other arguments against seatbelts in schoolbuses include the assertion that monitors would be needed to ensure that students properly wear and use their seatbelts; that the pelvises of very young children are not fully developed and cannot withstand lap belt crash loads; that belts and buckles could be used as "weapons" by unruly students; and that scarce school funds could be used more effectively to improve busdriver visibility, since schoolbus riders are more likely to be killed or injured while boarding or leaving a schoolbus rather than while riding in them. 9/

Since 1977, when new schoolbus safety standards relating to occupant protection were promulgated, the NHTSA has required schoolbus manufacturers to use a compartmentalization approach to occupant protection rather than the installation and use of passenger seatbelts in schoolbuses. The compartmentalization concept is essentially passive in that the occupant contactable impact zones are defined and an occupant is protected against injury by interior seat and barrier padding and by controlled bending of the seat back or barriers in front of the occupant.

As a result of its investigation of a 1977 schoolbus accident at Rustburg, Virginia, 10/ the Safety Board saw a need to gather crash performance data on schoolbuses manufactured under the new standards. The Safety Board recommended that NHTSA:

Review available accident statistics involving 1975 and later model schoolbuses equipped with seating arrangements that comply with Federal Motor Vehicle Safety Standard No. 222 to determine if the specific seating, restraining barrier, and impact zone requirements for schoolbuses have reduced the injuries sustained by occupants on these schoolbuses when involved in collisions and rollovers. A report of the findings should be submitted to the National Transportation Safety Board at the earliest opportunity.

9/ "Accident Facts," National Safety Council, 1983 Edition, Page 83.

10/ Tractor-Semitrailer/Schoolbus Collision and Overturn, U.S. Route 29 near Rustburg, Virginia, March 8, 1977, (NTSB/HAR/78-1).

In its June 1978 response to this recommendation, the NHTSA stated that "Vehicles built according to the latest rule. . .are just reaching the operators, and considering the safety performance of the national school fleet, it may be several years before a sufficient quantity of data is accumulated." NHTSA said it would "continue to evaluate the effect of the compartmentalization concept as data are received."

In 1980, the NHTSA published a statistical evaluation of the effectiveness of the occupant restraint requirements (for small schoolbuses) and the seatback height and padded seat requirements (for all schoolbuses) of FMVSS 222. <sup>11/</sup> However, the analysis was based on inferences drawn from an examination of the injuries sustained in accidents involving schoolbuses built before the effective date of FMVSS 222. To date no NHTSA analysis has been performed of the actual accident performance of buses designed to meet the post-1977 schoolbus protection standards (primarily FMVSS 220, 221, and 222).

The National Coalition for Seat Belts on School Buses, an organization that promotes installation of seatbelts on schoolbuses, reports that approximately 16 school districts nationwide now have included in their schoolbus fleets some conventional size schoolbuses with lapbelts for all occupants. In statements made to the New York Legislative Commission on critical transportation issues in December 1983, two New York School districts, Greensburgh and Ardsley, reported that their schoolbus "Buckle Up" rate for students in the elementary grades was about 90 percent, with a lower, but improving percentage for senior high school students. The Safety Board has not investigated any crashes involving large schoolbuses equipped with seatbelts for the passengers; as far as the Board can determine, data documenting the effect of lapbelts in real world crashes of large schoolbuses are not yet available.

In its report of the Rehoboth, Massachusetts, schoolbus accident, the Safety Board concluded:

The use of seatbelts by both drivers and passengers in window seats of rows one and three on the left of the schoolbus would not have benefited them because of the degree of crush at their occupant spaces in the major impact area. The use of seatbelts by all other occupants would have prevented them from being thrown out of their seats and onto the ceiling as the bus collided with the truck and rolled over. However, if the children seated away from the major impact area had been wearing lap belts, their injuries may have been different, but not necessarily less severe because passengers sitting in the outboard seats still would have contacted the seatbacks, the sidewalls, windows, and the roof either during the initial collision with the truck, during the rollover, or both.

As in the Rehoboth accident, the use of seatbelts by all the passengers in the Carrsville bus would have prevented them from being thrown out of their seats as the bus rotated and rolled over and might have prevented or mitigated some of the minor injuries sustained. The use of seat belts probably would not have prevented or mitigated the injuries sustained by the occupants seated next to the windows on the right side of the bus during the initial impact. Although the use of a seatbelt probably would have mitigated

<sup>11/</sup> "Statistical Evaluation of the Effectiveness of FMVSS 222: Schoolbus Seating and Crash Protection" (DOT HS-8-02014, October 1980).

the skull fracture sustained by the child occupying the first seat behind the driver, the use of a seatbelt by the 14-year-old passenger who was seated in the right rear seat would not have prevented her basilar skull fracture sustained during the second impact at the right rear of the bus.

In September 1983, the Safety Board transmitted to the States the results of the Board's interim findings on the issue of occupant crash protection in both large (conventional) schoolbuses and small buses and vans. The Board stated that it did not "believe there is sufficient justification at this time to recommend extending the mandatory passenger restraint system requirements to large schoolbuses." However, the Board recommended that States take steps to ensure that children be required to use the available seatbelts on small schoolbuses or vans because of the lesser degree of crash protection afforded by these vehicles' smaller bodies compared to conventional schoolbuses and that schoolbus drivers be required to use the seatbelts provided on all school vehicles.

At the same time, the Safety Board began a series of special investigations of schoolbus accidents to look more closely at the issue of the real-world performance of schoolbuses in crashes, particularly the adequacy of the occupant crash protection afforded by schoolbuses built to meet the current Federal Motor Vehicle Safety Standards. This study is ongoing; the findings of the Carrsville accident and a number of others involving post-1977 schoolbuses will be used in considering the necessity of further recommendations concerning schoolbus occupant crash protection requirements.

#### Operation Lifesaver

The Safety Board commends the Virginia Operation Lifesaver Council for its efforts to improve schoolbus grade crossing safety in the State. The Safety Board believes that the installation of dashboard stickers advising schoolbus drivers of the necessity for stopping at railroad grade crossings may be an inexpensive method for improving compliance with schoolbus grade crossing stop requirements, but that without a continuing effort to ensure that stickers are replaced when needed on in-service buses and installed on buses being placed in service, any such program may lose its effectiveness over time.

### CONCLUSIONS

#### Findings

1. The weather, the condition of the highway, the visibility at the scene, and the pre-accident condition of the schoolbus and the train were not factors in the accident.
2. The qualifications and experience of the engineer of the lead engine of the train were not factors in the accident.
3. The schoolbus driver was experienced in the operation of schoolbuses and met the requirements of the Commonwealth of Virginia for the operation of schoolbuses.
4. The schoolbus driver did not stop, as required by State law, before proceeding onto the railroad crossing.

5. The engineer of the train acted reasonably in his attempts to avoid the collision. The train's whistle and bell were being sounded before the collision, and the brakes were applied promptly in emergency when the bus was observed stopped on the track.
6. The schoolbus driver had been experiencing both continuing and immediate stress before the accident. This stress may have affected her judgement and ability to properly react to the presence of the approaching train. The driver's pulling onto the tracks was not a suicide gesture.
7. The lack of student discipline on the bus was a problem and the noise level in the bus may have interfered with the driver's ability to hear the whistle of the approaching train.
8. Schoolbus drivers in Isle of Wight County were not systematically monitored to determine their compliance with grade crossing stopping or routing requirements.
9. Several persons observed schoolbus drivers fail to stop for the accident crossing both before and immediately after this accident. Reports to school officials of these failures to stop either were not made, or effective action was not taken to correct the problem.
10. The value of the annual physical examination required by Virginia for schoolbus drivers is questionable since there have been no objective physical standards for schoolbus drivers in existence since 1979 other than those required to obtain or renew an ordinary operator's or chauffeur's license.
11. The schoolbus met the requirements of FMVSS 220, 221, 222, and 301 relating to rollover protection, joint strength, passenger seating and crash protection and fuel system integrity.
12. The use of the available seatbelt prevented the schoolbus driver from being ejected and possibly crushed between the schoolbus body and the train. The barriers installed in front of the first row of seats probably prevented the occupants of this row of seats from being ejected and crushed.
13. The installation and use of a seatbelt probably would have prevented or mitigated the skull fracture sustained by the occupant of the first seat behind the driver.
14. The installation and use of a seatbelt probably would not have prevented or mitigated the basilar skull fracture sustained by the 14-year-old occupant of the right rear seat. Use of a seatbelt probably would have mitigated the minor injuries sustained by this child and the 6-year-old occupying the seat with her when the bus rolled over.
15. The majority of the minor injuries and the one moderate injury to the occupants seated next to the right side wall probably were sustained when these children struck the right side wall. The installation and use of seatbelts would not have prevented or mitigated these injuries.

16. The majority of occupants sustained minor injuries when they contacted the interior surfaces of the bus other than seats and barriers during the collision, rotation, and rollover. Installation and use of seatbelts may have prevented or mitigated some of these minor injuries.
17. The only fire extinguisher, which was installed at the front of the bus, was not easily accessible after the accident.
18. The separation of the schoolbus body from the chassis allowed much of the crash energy to be absorbed by the chassis rather than be transmitted to the schoolbus body and the occupants.
19. The installation and maintenance of dashboard stickers advising schoolbus drivers of railroad grade crossing stop requirements may be an effective and inexpensive method of improving compliance with these requirements.

#### Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the schoolbus driver's failure to stop before driving onto the railroad crossing to determine that it was safe to proceed.

#### RECOMMENDATIONS

As a result of its investigation of this accident, the National Transportation Safety Board made the following recommendations:

--to the State Directors of Pupil Transportation of the 50 States and the District of Columbia:

Encourage local school jurisdictions to establish and enforce procedures to systematically monitor schoolbus driver compliance with railroad crossing stop requirements and routing requirements which include on-scene observations of driver performance. (Class II, Priority Action) (H-85-4)

Encourage local school jurisdictions to issue an announcement to parents and students at or near the start of each school year which (1) states the jurisdiction's rules regarding schoolbuses stopping at railroad crossings, (2) requests that schoolbus drivers who fail to comply be reported to a designated school official, and (3) provides the name and telephone number of the official. (Class II, Priority Action) (H-85-5)

Encourage local school jurisdictions to: discuss with driver applicants during the selection process the physical and mental demands placed upon schoolbus drivers, encourage in-service drivers to discuss their problems and their satisfaction with the present job assignment with their supervisors during routine contacts and during performance evaluations, and encourage supervisors to have frequent contact with their schoolbus drivers to discuss and resolve behavior problems concerning schoolbus passengers. (Class II, Priority Action) (H-85-6)

--to the Virginia Department of Education:

Consult without delay with the Virginia Medical Society to promulgate objective minimum physical standards for schoolbus drivers as specified by Section 22.1-178 of the Code of Virginia, as amended in 1979. Incorporate the standards in the prescribed physical examination forms and specify the health history that medical examiners shall obtain when examining schoolbus driver applicants. (Class II, Priority Action) (H-85-7)

**BY THE NATIONAL TRANSPORTATION SAFETY BOARD**

/s/ JIM BURNETT  
Chairman

/s/ PATRICIA A. GOLDMAN  
Vice Chairman

/s/ G. H. PATRICK BURSLEY  
Member

January 25, 1985

Preceding page blank

- 39 -

APPENDIXES

APPENDIX A

INVESTIGATION AND HEARING

Investigation

The National Transportation Safety Board was notified of this accident at 6:00 p.m. on April 12, 1984, by the news media.

Highway Accident investigators were dispatched from the National Transportation Safety Board Headquarters Office in Washington, D.C. and arrived onscene at 6:30 a.m. on April 13, 1984. Participating in the investigation were representatives of the Virginia Department of State Police, the Virginia Division of Motor Vehicles, the Virginia Department of Education, the offices of the Isle of Wight County Superintendent of Schools, the Virginia Railway Association, the Seaboard Coast Line Railroad Company, the Chesapeake and Ohio Railroad Company, the Blue Bird Body Company, and the Federal Railroad Administration of the United States Department of Transportation.

Deposition

There were no depositions taken or public hearings held in conjunction with this investigation.

APPENDIX B

ISLE OF WIGHT COUNTY PUBLIC SCHOOLS PERSONNEL EVALUATION

Evaluatee: \_\_\_\_\_ Evaluator: \_\_\_\_\_ Date: \_\_\_\_\_  
School: \_\_\_\_\_ Assignment: \_\_\_\_\_ Bus Drivers

	G	F	P	N	S
<b>I. PERSONAL</b>					
a. Demonstrates tact, kindness, courtesy					
b. Adjusts to changes in procedures					
c. Accepts responsibility					
d. Is dependable					
e. Exhibits emotional maturity					
<b>II. PROFESSIONAL</b>					
a. Uses discretion in speaking of division and colleagues					
b. Cooperates with division personnel					
c. Cooperates with school personnel					
d. Displays interest in and concern for school					
<b>III. RELATIONS</b>					
a. Works understandingly and cooperatively with principal					
b. Works understandingly and cooperatively with parents					
c. Keeps principal informed of pupil behavior					
d. Keeps parents informed of pupil behavior					
e. Has a knowledge of the community in which school is located					
<b>IV. PERFORMANCE RESPONSIBILITIES</b>					
a. Operates bus on schedule					
b. Submits required reports					
c. Operates the bus in a safe manner					
d. Obeys all traffic laws and regulations					
e. Reports any defect in the bus to the garage					
f. Makes a safety check of the bus before all runs					
g. Is knowledgeable of the bus drivers manual					
h. Other duties as designated by the Superintendent					

G - good - Almost always meets or exceeds the standard for the division. F - fair - Normally meets the standard for the division, however improvement is needed. P - poor - Frequently fails to meet the standard for the division. N - not applicable - Not applicable or insufficient knowledge on which to evaluate. Self-Evaluation - S - The number one (1) means that this is an area needing considerable improvement. The number two (2) means that this is an area needing some improvement. The number three (3) means that this is an area of strength.

COMMENTS:

Evaluator: \_\_\_\_\_  
\*Evaluatee: \_\_\_\_\_

\* I certify that this evaluation has been discussed with me. I understand that my signature does not necessarily indicate agreement.

APPENDIX C

MEDICAL CERTIFICATE FOR VIRGINIA SCHOOLBUS DRIVERS

VIRGINIA DEPARTMENT OF EDUCATION  
RICHMOND, VIRGINIA 23216

The use of this form is required under the provision of Section 22.1-178 of the Code of Virginia.

PHYSICIAN'S CERTIFICATE

APPLICANT NAME \_\_\_\_\_ SEX \_\_\_\_\_ AGE \_\_\_\_\_  
ADDRESS \_\_\_\_\_ BIRTH DATE \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

I am a duly licensed physician in the State of Virginia.

I certify that I personally examined the above-named applicant. The results of that examination do not indicate that the applicant has a condition that could impair his or her ability to drive a school bus safely and indicate that the applicant is otherwise, from my observation, physically and mentally capable of operating a school bus safely as provided for by Section 22.1-178 (a) of the Code of Virginia.

\_\_\_\_\_  
Physician Signature

\_\_\_\_\_  
Address

\_\_\_\_\_  
Date of Examination

\_\_\_\_\_  
Telephone

NOTE: This report must be signed personally by physician.

APPENDIX D

VIRGINIA PHYSICAL REQUIREMENTS FOR SCHOOLBUS DRIVERS AFTER 1979

**§ 22.1-178. Requirements for persons employed to drive school bus.**

— A. No school board shall hire, employ, or enter into any agreement with any person for the purposes of operating a school bus transporting pupils unless the person proposed to so operate such school bus shall:

1. Have a physical examination of a scope prescribed by the Board of Education with the advice of the Medical Society of Virginia and furnish a form prescribed by the Board of Education showing the results of such examination.

2. Furnish a statement or copy of records from the Division of Motor Vehicles showing that the records of such Division do not disclose that the person, within the preceding five years, has been convicted upon a charge of driving under the influence of intoxicating liquors or drugs, convicted of a felony or assigned to any alcohol safety action program or driver alcohol rehabilitation program pursuant to § 18.2-271.1 of the Code or, within the preceding twelve months, has been convicted of two or more moving traffic violations or required to attend a driver improvement clinic by the Commissioner of the Division of Motor Vehicles pursuant to § 46.1-514.11 of the Code.

3. Furnish a statement signed by two reputable residents of the school division that the person is of good moral character.

4. Exhibit a license showing the person has successfully undertaken the examination prescribed by § 46.1-370.

✓ 5. Have reached the age of sixteen and not have reached the age of seventy or the first day of the school year.

B. Any school board may require successful completion of the American National Red Cross first-aid course as a condition to employment to operate a school bus transporting pupils. -

C. The documents required pursuant to paragraphs A 1 and A 2 shall be furnished annually within thirty days prior to the anniversary date of the employment agreement as a condition to continuing employment to operate a school bus. A school board may require the statement set forth in paragraph A 3 to be furnished periodically.

D. The documents required pursuant to this section shall be filed with, and made a part of, the records of the school board employing such person as a school bus operator.

E. The State Department of Education shall furnish to the several division superintendents the necessary forms to be used by applicants in furnishing the information required by this section. Insofar as practicable, such forms shall be designed to limit paperwork, avoid the possibility of mistake, and furnish all parties involved with a complete and accurate record of the information required. (Code 1950, § 22-276.1; 1962, c. 544; 1966, c. 604; 1970, c. 696; 1972, c. 359; 1973, c. 170; 1976, cc. 116, 123; 1977, c. 393; 1978, c. 322; 1979, c. 126; 1980, c. 559.)

APPENDIX B

VIRGINIA PHYSICAL REQUIREMENTS FOR SCHOOLBUS DRIVERS BEFORE 1979

§ 22-276.1. Requirements for persons employed to drive school bus. — No school board or superintendent of schools of any county or city shall hire, employ, or enter into any agreement with any person for the purposes of operating a school bus transporting pupils on and after April fourth, nineteen hundred seventy-two, unless the person proposed to so operate such school bus shall:

(a) Furnish a certificate signed by a physician licensed by this State attesting that such physician has examined the applicant within the thirty days preceding the date of the application for such employment and showing results which do not indicate that the applicant has a condition that could impair his ability to drive a school bus safely and which indicate that the applicant is otherwise, from the observation of such physician, physically and mentally capable of operating a school bus safely and agree to furnish such certificate annually thereafter within thirty days prior to the anniversary date of the agreement of employment. As used in this paragraph "physically capable" means having two hands, two feet, two eyes, the normal use of the foregoing, normal hearing, to wit, the ability to hear the spoken voice from a distance of fifteen feet with each ear separately, with or without the use of hearing aids or devices, vision, to wit, visual acuity of at least 20/40 in each eye without or with corrective lenses and at least a field of one hundred forty degrees of horizontal vision and normal color perception. Whenever an applicant shall use a hearing aid or device in order to obtain such certificate, the certifying physician shall specify the type, design and manufacture of such hearing aid or device, and such applicant's employment shall be conditioned upon his use of a hearing aid or device of such type, design and manufacture at all times while operating a school bus transporting pupils.

**APPENDIX F**  
**DASHBOARD STICKER**



**STOP AT ALL**  
**RAILROAD CROSSINGS**

APPENDIX G

SELF-EVALUATION: COMPUTE YOUR LIFE CHANGE RISK

(Holmes-Rahe Test)

Dr. Thomas Holmes and Dr. Richard Rahe have studied the clinical effects of major life changes over the past 20 years. Change puts distinct strain on stress-coping mechanisms. When such events accumulate, the chances for stress-linked disorders tend to increase. The Life Change Units (LCU) below suggest the relative impact of various common life change events. Which of all these changes occurred in your life during the past 24 months? Add up the point values of each event to obtain your total. If an event occurred more than once, count that point value more than once.

WORK EVENTS

LIFE CHANGE UNITS (LCU)

Being fired from work	47
Retirement from work	45
Major business adjustment	39
Changing to different line of work	36
Major change in work responsibilities	29
Trouble with boss	23
Major change in working conditions	20

PERSONAL

Major personal injury or illness	53
Outstanding personal achievement	26
Major change in recreation	19
Major revision of personal habits	24
Major change in church activities	19
Major change in sleeping habits	16
Major change in eating habits	15
Vacation	13

FINANCIAL

Major change in financial state	38
Mortgage or loan over \$10,000	32
Mortgage foreclosure	30
Mortgage or loan less than \$10,000	17

SOCIAL

Detention in jail	63
Sexual difficulties	39
Death of a close friend	37
Start or end of formal schooling	26
Major change in living conditions	25
Changing to a new school	20
Change in residence	20
Change in social activities	18
Minor violations of the law	11

FAMILY

Death of a spouse	.	.	.	.	.	.	.	100
Divorce	.	.	.	.	.	.	.	73
Marital separation	.	.	.	.	.	.	.	65
Death of a close family member	.	.	.	.	.	.	.	63
Marriage	.	.	.	.	.	.	.	50
Marital reconciliation	.	.	.	.	.	.	.	45
Major change in health of family	.	.	.	.	.	.	.	44
Pregnancy	.	.	.	.	.	.	.	39
Addition to family of new family member	.	.	.	.	.	.	.	39
Major change in arguments with spouse	.	.	.	.	.	.	.	35
Son or daughter leaving home	.	.	.	.	.	.	.	29
In-law troubles	.	.	.	.	.	.	.	29
Wife starting or ending work	.	.	.	.	.	.	.	26
Major change in family get-togethers	.	.	.	.	.	.	.	15

YOUR TOTAL SCORE . . . . . \_\_\_\_\_

150-199 LCUs: Small chance of incurring some form of illness in the next year.

200-299 LCUs: Moderate risk.

Over 300 LCUs: Very likely to suffer serious physical or emotional illness (high-risk group).

Name \_\_\_\_\_ Date \_\_\_\_\_

APPENDIX H  
STRESS WARNING SIGNS



U.S. Department  
of Transportation  
Federal Aviation  
Administration

# Memorandum

Subject: INFORMATION: Warning Signs of Employee  
Distress

Date FEB 29 1984

From: *H. L. Reighard*  
H. L. Reighard, M.D.  
Federal Air Surgeon, AAM-1

Reply to  
Attn of

To: All Regional Flight Surgeons

I have attached a checklist of warning signs of employee distress. It is requested that you send a copy to the manager of each facility in your region. I have also attached a suggested transmittal memorandum to be used in forwarding the checklist.

The checklist is a slightly modified version of a checklist that has been used by supervisors of Bell Laboratories in Murray Hill, New Jersey. The medical director of Bell Laboratories has indicated that the use of this checklist has improved supervisors' abilities to identify cases of employee "stress," especially those resulting from or due to alcohol abuse/alcoholism, drug use, work pressures, domestic strife, and emotional illness. Bell uses the checklist as an adjunct to an inhouse employee assistance program and constitutes the prime case finding instrument for that program.

We would hope that you will devise some means of assessing the extent to which the checklist is used and the results of its use. Whether or not you set up such an assessment device we ask that the checklist be distributed promptly.

Attachments

Subj: Warning Signs of Employee Distress  
From: (Regional Flight Surgeon)  
To: (Facility Manager)

The attached checklist has been provided to me by the Office of Aviation Medicine. It is a modification of a checklist issued by the medical department of a major corporation to company supervisory personnel. It has been shown to be helpful in identifying cases of employee "stress." Employees identified have then been offered assistance, usually by counselors working within the employee assistance program.

The list is neither exhaustive nor revolutionary. It consists of items which are observable by a supervisor and most certainly are already used by supervisors in assessing the well-being of members of their work force. Of course the mere presence of an item or items on this list, particularly as an isolated or transient event, may have absolutely no significance. Recurring or persistent such indicators, however, should serve to alert supervisors to the possible need to offer assistance to an employee. This would best be done by referral to the person performing employee assistance services for the facility.

It is requested that you give a copy of this checklist to each supervisor in your facility. I am available to answer any questions you may have at (telephone number).

Warning Signs of Employee Distress

Deterioration of Personal Appearance  
Isolation  
Mood Swings  
Borrowing Money from Friends/Peers  
Radical Loss or Gain of Weight  
Deterioration of Morale  
Complaints of Fatigue  
Lowered Productivity  
Loss of Interest in Promotions  
Performance Deficiencies  
Apathy  
Poor Concentration  
Irritability  
Needless Risks Taken  
Vague Complaints of Illness  
    . Stomach/Intestinal Distress  
    . Flu  
    . Headaches  
    . Sore Throat  
    . Sweating  
Carelessness  
Extended Lunch Periods  
High Accident Rate  
Complaints of Personal and Family Problems  
Unexplained Disappearances from the Work Place  
Sporadic Work Pace  
Inconsistent Work Quality  
Increased Lateness  
Increased Absenteeism  
Loss of Driving License