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Highway Accident Report - Academy Lines, Inc.
Intercity Bus Run-Off-Roadway and Overturn
Middletown, New Jersey, September 6, 1987

(U.S.) National Transportation Safety Board
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16. Abstract

On September 6, 1987, at 5:00 a.m. an intercity bus operated by Academy Lines, Inc., ran off the northbound local lane of the New Jersey Garden State Parkway at milepost 111, struck a guardrail and bridge rail, and overturned onto its right side. The busdriver and one passenger, the busdriver's 13-year-old son, sustained fatal injuries, and 32 of the remaining 33 bus passengers sustained minor to moderate injuries.

The National Transportation Safety Board determines that the probable cause of this accident was the busdriver's lack of vigilance which resulted in his failure to perceive that his vehicle was leaving the roadway. The busdriver's lack of vigilance resulted from the combined adverse effects of sleep deprivation, illness due to a cold or influenza, and a high dosage of medication probably ingested to treat the symptoms of that illness and to control his weight.

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CONTENTS

EXECUTIVE SUMMARY

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This report discusses several safety issues including the lack of a Federal rule which requires an employing motor carrier to verify the authenticity of a medical examiner's certificate presented to it by a driver applicant; the present lack of a Federal rule requiring that commercial vehicle drivers forward a record of duty status to the employing motor carrier when the record is completed; and the adequacy of the bridge rail at the accident site.

The report concludes that the Federal Highway Administration should promulgate a rule which requires the prospective employer of a commercial vehicle driver applicant to verify the authenticity of any medical examiner's certificate presented to it by a driver applicant if the examining physician was not selected by the motor carrier; that the Federal Highway Administration should reinstitute a rule, eliminated in 1983 in the interest of reducing the paperwork burden on motor carriers, which requires that a duty status record be forwarded to the employing motor carrier upon completion of the record; and that the New Jersey Highway Authority replace the bridge rail at the accident site with 42-inch-high extended New Jersey Safety Shape bridge rail. The report contains two new safety improvement recommendations and reiterates a 1985 safety improvement recommendation that address these issues.

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

HIGHWAY ACCIDENT REPORT

ACADEMY LINES, INC., INTERCITY BUS RUN-OFF-ROADWAY AND OVERTURN MIDDLETOWN, NEW JERSEY, SEPTEMBER 6, 1987

INVESTIGATION

The Accident

At 5 a.m. eastern daylight time on September 6, 1987, an intercity chartered bus operated by Academy Lines Inc., (ALI) of Leonardo, New Jersey, was traveling northbound in the right "local" lane of the New Jersey Garden State Parkway en route from Atlantic City, New Jersey, to Brooklyn, New York. At milepost 111.0, the bus ran off the traveled portion of the roadway to the left, struck the median guardrail, a bridge rail and chainlink fence attached to the bridge rail, and overturned onto its right side The bus came to rest 145 feet from the point of initial impact. Parts of the bridge rail and chainlink fence were imbedded in the forward end of the bus to about the second row of seats. (See figures 1 and 2.) At the time of the accident it was dark, and although it had been raining in the area, the pavement was dry. There was no fire.

A witness reported to the New Jersey State Police (NJSP) that immediately before the accident, the bus passed him on the right at a speed he estimated to be about 70 mph. The bus then started to "drift" to the left without signaling, left the roadway, and struck the guardrail. This witness reported he did not see any brake lights activate on the bus before the collision. Another witness who was passed by the bus also estimated the speed of the bus to be about 70 mph. This witness reported that as he was assisting passengers off the bus after the accident, a woman passenger remarked to him that immediately before the collision she heard a change in the engine noise of the bus which indicated to her that the busdriver's foot had slipped off the accelerator pedal. Several witnesses and passengers reported that the bus struck the guardrail twice before it overturned.

The busdriver and his 13-year-old son, who was seated in the right front seat, were killed. Thirty-two of the remaining 33 passengers were transported to nearby hospitals where they were treated for minor to moderate injuries and released. One passenger was not injured, and the extent of the injuries sustained by four of the passengers could not be determined.

Emergency Response

Surviving passengers reported to police investigators that they exited the bus through the left-side emergency windows and the emergency roof hatches. Police interviews revealed that most passengers did not report any unusual difficulties exiting the bus. Safety Board investigators sent questionnaires to all survivors for whom addresses were available requesting information about the accident including where they were seated, how they exited the bus, and the extent of their injuries. Only two of these questionnaires were returned.

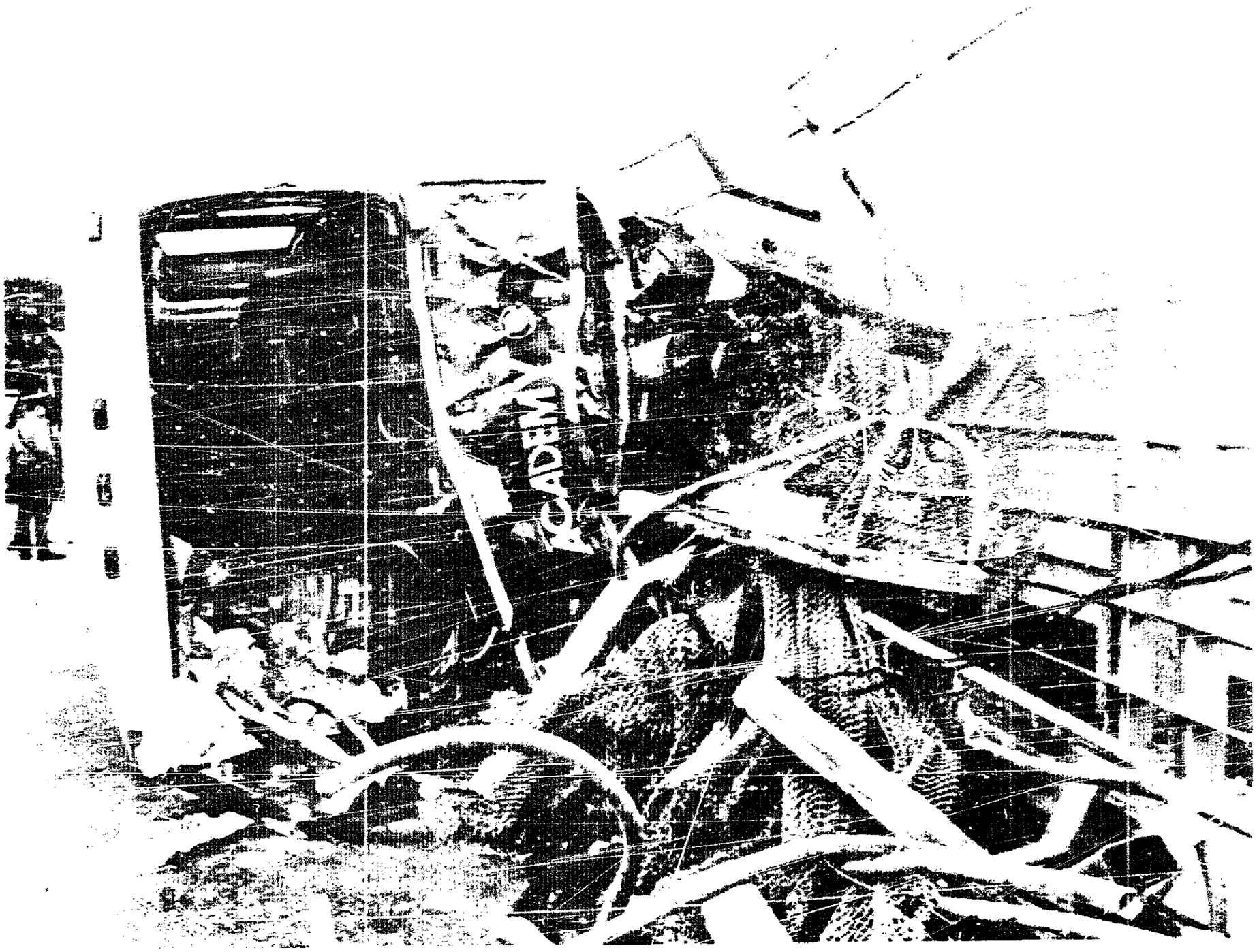

Figure 1.--View of bus facing south.

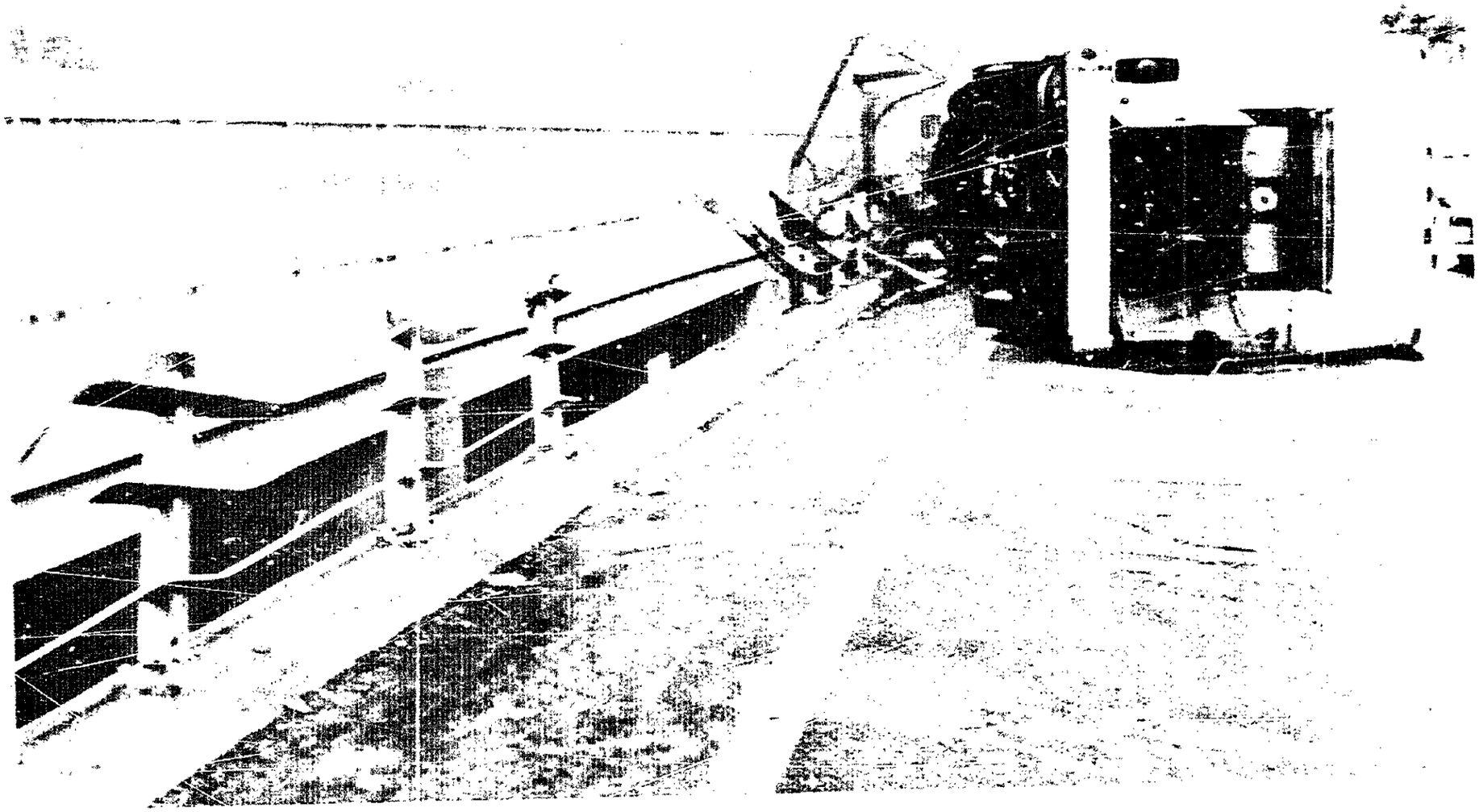

Figure 2.--View of bus facing north.

A captain with the Lincroft (New Jersey) Fire Company (LFC) was the first rescuer on the scene. He arrived in his private vehicle. On his arrival, he noted that all survivors had exited the bus. A passerby, who was an emergency medical technician, told the captain that there were two fatalities in the bus. However, because of the fence and debris inside, the captain could not see them.

Both Middletown Township and Monmouth County, New Jersey, have a disaster plan. These plans were not needed and were not activated. The first rescue units on the scene, an ambulance and a crash truck from the Lincroft First Aid and Rescue Squad (LFARS), and a pumper from the LFC, arrived at 5:15 a.m. A first lieutenant from the LFARS was the incident commander.

Five first-aid squads and three paramedic units were initially dispatched. An additional three ambulances were alerted and the NJSP helicopter was placed on stand-by. All survivors were triaged and transported to either Bayshore Community Hospital in Holmdel, New Jersey, or Riverview Medical Center in Red Bank, New Jersey. A log was kept on-scene, noting the patients' names, injuries, and the hospital to which they were taken.

After a tow truck pulled the fence from the front of the bus, rescuers cut into the bus with rescue tools and removed the fatally injured occupants. Rescuers reported that the busdriver's body was found in the stepwell which was located below his seat in the overturned bus.

Rescuers stated that there were no response or communication problems. Every fire and rescue unit had an eight-channel radio and one channel was devoted to this response. All units, including the county units, could communicate directly with each other. The last unit left the scene at 9:45 a.m.

Busdriver Information

Employment History.--The 42-year-old busdriver had been employed by ALI since July 11, 1987. He had previously worked as a part-time busdriver for ALI from May 1982 until he moved with his family to Florida in November 1984.

The busdriver was described by ALI officials as being an experienced truckdriver and busdriver and a good, reliable employee who consistently arrived at the ALI terminal well in advance of his scheduled departure time. The general manager for ALI indicated that he had received no complaints regarding the busdriver's performance since he returned to work for the company.

According to family, friends, and available records, the busdriver had owned and operated his own tractor semi-trailer and had worked as an over-the-road driver for two trucking firms before and during his original part-time employment with ALI. The Safety Board could not identify the name of the first company, and the second company was no longer in business. Therefore, no records concerning the busdriver's employment with these companies could be obtained.

On the busdriver's most recent application to ALI, he stated that he had been self-employed during the previous 3 years. An investigation revealed that he had attended plumber's school and had been a plumber while residing in Florida.

A boat transportation company located in Clearwater, Florida, reported that the busdriver had been employed as a truckdriver for the company from December 1, 1984, through January 25, 1985. The position required him to drive vehicles carrying wide cargos throughout the United States. He was described as a "decent" driver who created no problems. He voluntarily left the job with no reason given for his leaving. An official for this trucking company reported that the busdriver had telephoned him within the past year inquiring about re-employment, and that the busdriver had been informed that he was eligible to be rehired.

The investigation also disclosed that he had worked for another trucking company from June 1982 through November 1984 when he quit because he was moving to Florida. While employed with this company, the busdriver had operated tractor-semitrailers in 48 States and was "highly recommended" by an official of this company.

The busdriver was familiar with the accident bus and had driven that particular vehicle several times during the preceding weeks as well as other buses in ALI's fleet. Friends reported that the busdriver did not use the available lapbelts in the buses he was assigned to drive. The busdriver was familiar with the accident route, having driven the route at least 10 times since he was re-employed by ALI in July 1987.

Training.--Although ALI had recently established a training program for new drivers, the busdriver was not required to attend this course since he was an experienced truck and bus operator. The Safety Board was unable to locate any record of his attending any formal bus or truck operator training program.

Written Examinations.--According to records obtained from ALI and one other of his previous employers, the busdriver had been administered written tests concerning his knowledge of the Federal Motor Carrier Safety Regulations (FMCSR) in January 1982, December 1984, and July 1987. He had correctly answered questions on these examinations concerning disqualifying medical conditions for interstate commercial vehicle drivers.

Driving License/Driving Violation Conviction Record.--Before he moved to Florida in 1984, the busdriver possessed a New Jersey driver's license. According to New Jersey records, the busdriver's record included seven moving violations which occurred between July 1963 and May 1983. Four of these violations were for speeding, one was for failing to observe a traffic control device, one was for improper leaving or entering a highway, and one was for driving with a suspended license. In addition, the record indicated that he had been involved in four accidents between February 1966 and May 1975. The May 1975 accident resulted in a fatality.

Between July 1963 and May 1985, his New Jersey license had been suspended seven times, one time for his involvement in the fatal accident (the specific basis for this suspension is unknown), four times for failure to appear in court in response to traffic violation charges, once for being a persistent violator, and once for failing to verify insurance.

A check with the other 50 licensing jurisdictions in the United States disclosed that the busdriver had received two other speeding citations that were not listed on the New Jersey records. The first was in Saratoga County, New York, on March 26, 1983.

The second speeding citation was on October 3, 1984, in Jackson County, Georgia. The busdriver failed to pay the fine levied as a result of this speeding violation. Georgia contacted New Jersey concerning this delinquency, and New Jersey responded by suspending the busdriver's license in May 1985. However, the notification of the suspension of his New Jersey driving privileges, which was sent by the New Jersey Division of Motor Vehicles (NJDMV) to the busdriver's last known New Jersey address, was returned to the NJDMV unopened because the busdriver had moved to Florida by the time the notification was sent.

When he was rehired by ALI in July 1987, the busdriver possessed a valid Florida chauffeur's license which had been issued on December 20, 1984. When he applied for his Florida license, the busdriver responded "no" to the question that asked if his privilege to operate a motor vehicle had

ever been denied, revoked, or suspended in any other State. The busdriver's Florida driving record was clear of any violations.

When he returned to New Jersey, ALI officials informed the busdriver that he would have to renew his New Jersey driver's license within 6 months to comply with New Jersey licensing requirements.

On August 26, 1987, the busdriver was involved in a fatal accident while driving an ALI bus in Aberdeen Township, New Jersey. The busdriver displayed his Florida license to the police officer investigating the accident. Although the investigating officer deemed the busdriver not to be at fault in the accident, the officer learned that the busdriver's New Jersey driving privileges had been suspended, and he cited the busdriver for driving with a suspended license.

The busdriver later indicated to friends that he was not aware that his New Jersey license had been suspended and that he had turned in his New Jersey license when he applied for his Florida license. On September 2, 1987, the busdriver went to the NJDMV office in Trenton, provided officials with documentation that he had recently satisfied the fine associated with the outstanding Georgia citation, and paid a $30.00 license restoration fee. On September 4, 1987, his basic and bus driving privileges were restored by New Jersey.

Daily Work Activities.--After he returned to work for ALI in July 1987, the busdriver was assigned to drive morning and evening commuter runs to and from New York City each business day. The busdriver would report for duty between 5:15 a.m. and 5:30 a.m. at ALI's Leonardo, New Jersey, terminal. Sometimes he would dispatch or count buses, and then he would drive a morning commuter run into New York City. He usually then would go off duty around 8 a.m.

Each afternoon the busdriver would report for duty in New York City about 4 p.m. and drive a commuter run from New York City to points in northern New Jersey. He then would return to the Leonardo terminal, arriving there about 7 p.m. The busdriver then would go off duty until 5:15 a.m. or 5:30 a.m. the next business day if he did not drive a scheduled line run to a casino in Atlantic City.

On the weekend before his death, the busdriver drove charter trips to Agawam, Massachusetts, on Saturday, August 29, arriving back at ALI's Leonardo terminal at 10:45 p.m., and to Vernon Valley, New York, on Sunday, August 30, arriving back at ALI's terminal at 8:45 p.m. On Monday, August 31, he resumed driving his usual morning and evening commuter runs until Friday evening, September 4.

On the evenings of September 4 and 5, he drove the late evening/early morning runs to and from Atlantic City. The accident occurred on the return trip from Atlantic City he began on the evening of September 5. (See appendix B.)

Compensation.--The busdriver was paid $35.00 for each commuter run he drove, usually originating at Union Hill, New Jersey. He was paid an additional $10.00 on days he dispatched or counted buses before he left on the morning commuter run into New York City. He was paid $70.00 for each round trip he drove to Atlantic City.

According to records supplied by ALI, the busdriver averaged about $506.00 a week gross pay during the approximately 2 months he was employed by ALI immediately before the accident.

Behavioral Profile/Life Habits.--The busdriver was described by some of his friends and work associates as a "jolly-go-lucky guy," who had a "big heart" and who was always smiling. He never complained and exhibited a willingness to work at any time.

Although he had previously worked as a plumber, there is no evidence available to the Safety Board that he continued to practice this profession, or any other, on a part-time basis after he returned to New Jersey in July 1987. Several of his friends reported that he did not have the time to hold a second job.

When he was driving on the Atlantic City or other charter trips the busdriver took along an ice chest containing food and soft drinks. Friends and work associates reported that he continually snacked and that his usual diet included 1/4 sandwich, 1/2 bowl of soup, chocolate milk or diet soda, ice cream, cookies, and candy bars.

His wife said his usual breakfast consisted of 1 cup of tea and 2 tablespoons of oatmeal; for lunch he had 1/2 of a sandwich, 1/2 cup of soup, and a glass of milk; and for dinner the busdriver ate salad, a small portion of the main course (for example, one slice of London broil), a few spoonfuls of potatoes, and vegetables.

Interviewees stated that he consumed alcohol in small quantities on rare occasions. He did not use illicit drugs and did not like to take medications, only occasionally using aspirin. He did not drink coffee, nor did he use tobacco products.

The busdriver had been married for 17 years and had two sons, aged 7 and 13. Friends reported that he had been having marital problems over the past few years and that his wife had recently filed for divorce.

It was reported that these marital problems in conjunction with the lack of steady plumbing work had persuaded him to move back to New Jersey and live with some friends for at least the remainder of the summer of 1987. Friends and family stated that he was trying to reconcile with his wife and that he wanted his wife to move back to New Jersey. They added that the discord in his marriage caused him to continually change his plans regarding where he was going to reside and work.

Interviewees indicated that he loved his children very much and that when he returned to New Jersey he received a telephone call from his older son in Florida who wanted to come live with him. On August 28, 1987, the older son told his mother he was going to the movies and instead he took a taxi to the airport and flew to meet his father in New Jersey using a prepaid airline ticket purchased by his father.

According to friends, the busdriver spent a great deal of time with his older son, and the two could be found together most of the time. There was no room for the son at the busdriver's residence, so arrangements were made for the son to live nearby at a relative's home. The busdriver had been saving money to rent an apartment so the two could live together. He had enrolled his son in the local school system and had purchased a considerable amount of clothing for his son who had not brought his personal belongings with him from Florida.

Friends reported that although the busdriver had been experiencing financial difficulties, his financial situation was improving and his attitude had become more positive. His other than routine expenditures included clothing for his son, his son's airline ticket, automobile payments, and support payments to his wife. He did not gamble.

During the weeks before the accident, associates indicated that he was "not his usual jolly self," he appeared to be "on-edge," and was depressed and under stress. They attributed this change to several causes including fatigue, marital problems, and not having a home for his son. In addition, he became distraught following the August 26 fatal accident; he had stated to friends that he did

not feel right and did not want to drive his bus the next day. After being encouraged by friends, he resumed driving the following day.

Sleeping Habits.--The busdriver routinely slept 6 to 7 hours per day. His brother reported that he always got at least 6 hours sleep as he "was built that way." Friends indicated that he was a sound sleeper who experienced uninterrupted sleep. However, his wife indicated that it was not unusual for him to wake up during the night and watch television or play backgammon.

He was not known to "doze" or become sleepy while driving. His wife stated that if he became drowsy he would pull to the side of the road or get a motel room.

A friend and work associate reported that when the busdriver drove to Atlantic City, he would drop his passengers off at the casinos and park his bus at Hansen's Bus World (HBW) as required by ALI policy. He then would eat something from his cooler chest, set the alarm of his wristwatch to the desired wake-up time, and go to sleep on a homemade bed that he placed in the aisle of his bus.

Activities Before the Accident.--On September 2, the busdriver and a friend traveled to Trenton, New Jersey, to resolve the problem with his suspended New Jersey driver's license. He did not work for ALI that day, and slept for an estimated 6 hours until about 4 a.m. on September 3.

On September 3, he drove his normal morning and afternoon commuter runs to and from New York City for ALI, visited his son in the evening, and slept for an estimated 6 hours until 4 a.m. on September 4.

On September 4, he drove morning and afternoon commuter runs to and from New York City for ALI, and then drove a run to Atlantic City where he dropped off his passengers at a gambling casino and then arrived at HBW about 11:05 p.m. Presumably, he then slept in the bus for about 3 1/2 hours as was his usual custom. He left the bus parking lot at 2:52 a.m. on September 5, picked up his passengers for the return trip, and arrived back at the ALI terminal in Leonardo at about 6 a.m.

He was observed with his son at several locations in New Jersey during the afternoon of September 5, and he reported to the ALI terminal in Leonardo to pick up his bus for the Atlantic City run at 5:30 p.m. He left the ALI terminal at 6:15 p.m., picked up his passengers in New York City, and drove them to Atlantic City, where he arrived at HBW at 9:38 p.m.

Another ALI busdriver observed the accident busdriver getting undressed in his bus and briefly spoke with him shortly after the other busdriver arrived in HBW's parking lot. The accident busdriver's son was not seen. The other busdriver later observed the accident bus parked in the same location when he left the HBW parking lot at 2:45 a.m. on September 6.

According to records maintained by the parking lot, the accident busdriver left the lot at 2:57 a.m. According to the bus schedule, he was to pick up his passengers at a gambling casino in Atlantic City at 3:30 a.m. The accident occurred 1 1/2 hours later at 5 a.m. (See appendix B for a summary of the busdriver's activities for the 96 hours before the accident.)

Medical and Pathological Information

Medical Examiner's Certificate.--Because he operated his bus across State lines, the busdriver was required by U.S. Department of Transportation (DOT) regulations to have a valid medical examiner's certificate showing that he was physically qualified to operate commercial vehicles in interstate commerce.

The busdriver's qualification file assembled by ALI in 1982 contained copies of two medical examiner's certificates indicating that he was qualified to operate commercial vehicles in interstate commerce. One certificate, a copy of a wallet-sized card, indicated that he was examined in 1981 (the day and month was obliterated) by a physician in New Jersey.

The address given for the physician's office was the same as the busdriver's home address. The New Jersey Medical Examiners (NJME) office, the physician-licensing agency for the State, reported that it had records of two physicians whose surnames resembled the name of the physician on the certificate. One physician, who was still practicing medicine in Haddonfield, New Jersey, reported he had no records pertaining to the busdriver. The other physician, who had once practiced medicine in Long Branch, New Jersey, and who is now a resident of Delray Beach, Florida, reviewed his patient files for the last 6 years and reported he had no record of the busdriver.

The second medical certificate was completed on July 30, 1982, by a physician in Atlantic Highlands, New Jersey. This physician reported he had performed the examination on the date listed on the certificate.

The busdriver's qualification file retained by the boat transportation company included a medical examiner's certificate that was signed by a physician in Keansburg, New Jersey, on August 28, 1984. The busdriver's home address appeared in the section of the certificate reserved for the physician's address. This physician advised Safety Board investigators that the signature on the certificate appeared to be his.

The most recent medical examiner's certificate for the busdriver on file with ALI was dated March 16, 1987. The certificate bore the surname of a physician at an address in Clearwater, Florida, with no first name or initial given. The Florida Bureau of Licensing advised Safety Board investigators that there was no record of any physician licensed to practice medicine in Florida with the surname as given on the certificate. A poll of all physicians living in the Tampa, Florida, area with a similar surname revealed that they had no record of the busdriver. The Clearwater Police Department reported that the physician's address given on the certificate was the address of a furniture store that had been in business at that location for several years.

Medical History.--At the time of his death, the busdriver was 6 feet tall and weighed 303 pounds. His medical records indicate that in July 1983, he was diagnosed by his physician in New Jersey as having diabetes mellitus type II and morbid obesity, and he was placed on a diabetic diet to control his blood sugar level. As a result of the diet, his blood sugar level was subsequently reduced without the introduction of insulin or hypoglycemic agents.

Medical records indicate that during the succeeding months the busdriver did not follow his diabetic diet and gained weight until he weighed 485 pounds. In January 1984, he opted to undergo vertical banded gastroplasty (stomach stapling) and cholecystectomy procedures which were performed by his New Jersey physician to limit the amount of food he could consume. On November 21, 1984, as a result of these procedures, he had reduced his weight to 262 pounds.

Since the busdriver was planning on moving to Florida, his New Jersey physician referred him to a physician in Florida. Neither the physician in Florida nor the hospital where the physician practices had a record of treating the busdriver.

Other information contained in medical notes relating to the busdriver's surgical recovery indicate that he was "cautioned" by his physician in July 1984 for consuming alcohol to excess on weekends. In addition, an August 1984 radiology report revealed that there was "no evidence of acute infiltrate or pulmonary vascular congestion."

Available medical records indicate that the busdriver was never directed to use insulin, and his wife confirmed that he was never on insulin therapy. His wife, a registered nurse, reported that she would monitor his blood sugar levels weekly, and to the best of her recollection, the readings were never above the 110 mg. level. Physicians consulted by the Safety Board reported that blood sugar levels from 88 to 110 are considered to be in the "normal" range.

The busdriver's Florida driver license was restricted in that he was required to wear corrective lenses. The only available information pertaining to his vision was the July 1982 physical examination record completed for his ALI employment. The examination indicates that he had 20/20 vision in both eyes while wearing corrective lenses.

Friends and family members stated that he always wore his glasses while operating motor vehicles. One passenger on the accident bus recalled that he was wearing glasses during the accident trip. He was reported to have had no hearing impairments.

On the day before the accident at approximately 3 p.m., the busdriver related to a friend who had inquired about his physical appearance that, "I feel tired. I don't feel too good. I think I [have] the bug."

Toxicological Information.--The NJME conducted an alcohol and drug screen analysis on blood and urine samples that had been collected from the busdriver's body at 7:32 a.m. on the day of the accident. The results of the analysis were negative for alcohol, carbon monoxide, and other volatiles. The NJME reported that chlorpheniramine and phenylpropanolamine were present in the blood at 0.04 milligrams per liter (mg/l) and 1.10 mg/l, respectively and in the urine at 0.97 mg/l and 205 mg/l, respectively.

On September 18, 1987, toxicological samples were sent to the Center for Human Toxicology (CHT) for further analysis. CHT reported phenylopropanolamine at 0.62 micrograms per milliliter (mcg/ml) in the blood, and greater than 750 mcg/ml in the urine. Toxicological samples obtained after the busdriver's death could not be used to determine the blood sugar level at the time of his death because, according to medical authorities consulted by the Safety Board, blood sugar levels are likely to change appreciably after death due to cell rupture and bacterial action.

Fatal Injuries.--An autopsy of the busdriver showed he sustained subarachnoid and intraventricular hemorrhage, multiple rib fractures, a fracture of the sternum, pulmonary edema and congestion, focal hemorrhage of the liver and right adrenal gland, fracture of the right tibia, and multiple lacerations and abrasions.

An autopsy of the fatally injured passenger, who reportedly was sitting in the first seat on the right side of the bus before the collision, showed he sustained subarachnoid and intraventricular hemorrhage, cerebral edema, pulmonary edema and congestion, multiple abrasions and contusions, and a fracture of the right elbow.

Survivor Injuries.--According to medical records, the injured passengers sustained contusions, small lacerations, abrasions, strains, sprains, and unspecified injuries. All persons were treated and released from two hospitals on the day of the accident.

Vehicle Information

The bus was manufactured in December 1982 by Motor Coach Industries, Inc., and was leased by ALI from an ALI affiliate, Academy Bus Tours, Inc., of Hoboken, New Jersey. The three-axle bus had a rear-mounted diesel engine and a four-speed automatic transmission. The bus was equipped with

air-mechanical service brakes and power steering. A postaccident examination of the bus by NJSP and the Safety Board did not reveal any preexisting mechanical defects.

After the accident, the left front of the bus was crushed rearward 10 inches. The roof line in the front was not damaged. The right corner below the bumper at the right side entrance door was pushed rearward 22 inches. Scrapes, about 50° to the right of vertical which varied between 2 and 4 feet in length, were noted along the right side of the bus.

The driver's panel/dashboard was displaced rearward about 12 inches at the steering column, which was also displaced rearward about 12 inches, measured at seat cushion height. The forward half of the steering wheel was displaced rearward, and the rear half was displaced upward about 30°.

The driver's seat was mounted on a single central pedestal that was attached to the floor with four bolts. After the accident, the floor was displaced upward about 3 inches just left of the driver's seat. The driver's seat was tilted slightly forward and to the right. The driver's seat back and the fiberglass panel and its tubular metal frame located just behind the drivers seat were bent rearward at about an 80°-angle, almost touching the first pair of passenger seats.

There were 11 rows of double-width seats on each side of a center aisle that ran the length of the bus. At the rear of the bus, there was a lavatory on the right side and a bench seat which extended from the lavatory to the left interior sidewall of the bus.

On the left side of the bus, the outboard seatback of the first row of seats was twisted to the right about 30° and the aisle seat was twisted to the right about 10°. Rows 2 through 4 on the left side were undamaged. In row 5, the armrest next to the sidewall was bent inboard about 10°, and the remainder of seat rows on the left side of the bus were undamaged.

On the right side of the bus, the right seatback of the first row of seats was twisted inboard about 40° and the left seatback was broken loose. The seats in rows 2 through 4 were undamaged. In row 5, the armrest next to the aisle was bent outboard about 10°, and the seats in rows 6 and 7 were undamaged. In row 8, the right seatback was twisted outboard about 20° and in row 9 the inboard armrest bent inboard about 10°. The seats in rows 10 and 11 and the lavatory on the right side were undamaged.

Both windshield halves were broken out in the accident. There were seven windows on each side of the bus that measured 51 1/2 inches wide by 26 1/2 inches high. Each of these windows could be used as an emergency exit. On the left side, the glass in the first passenger window was broken out, and the glass in windows 3, 4, and 5 was cracked. The glass in the first five windows on the right was broken out, and the glass in windows 6 and 7 was cracked. A window to the left of the driver's seat, which was 35 inches high and 21 inches long at the top and 28 inches long at the bottom, was broken out after the accident.

There was no emergency lighting system on the bus and none was required by local or Federal regulation. There were two emergency exit hatches in the roof, one near each end of the bus. Rescuers reported that some of the surviving passengers used these hatches to exit the bus after the accident.

The driver's seat was equipped with a lapbelt. The passenger seats were not equipped with lapbelts, nor were they required to be by local or Federal regulations. A 2 3/4-pound dry chemical fire extinguisher labeled as being a type 1-A:10-B:C. was found on the floor in the front of the bus. The safety pin was missing, the gauge read 0 PSI, and there was evidence of extinguishant in the nozzle.

A folding fabric-covered bed was found in the bus after the accident. This bed was 6 feet long and 19 inches wide, and it was constructed of 2-inch-thick foam rubber attached to a 1/2-inch-thick plywood base. The bed was hinged so that it could be folded and stored in the overhead luggage rack when it was not being used. (See figure 3.)

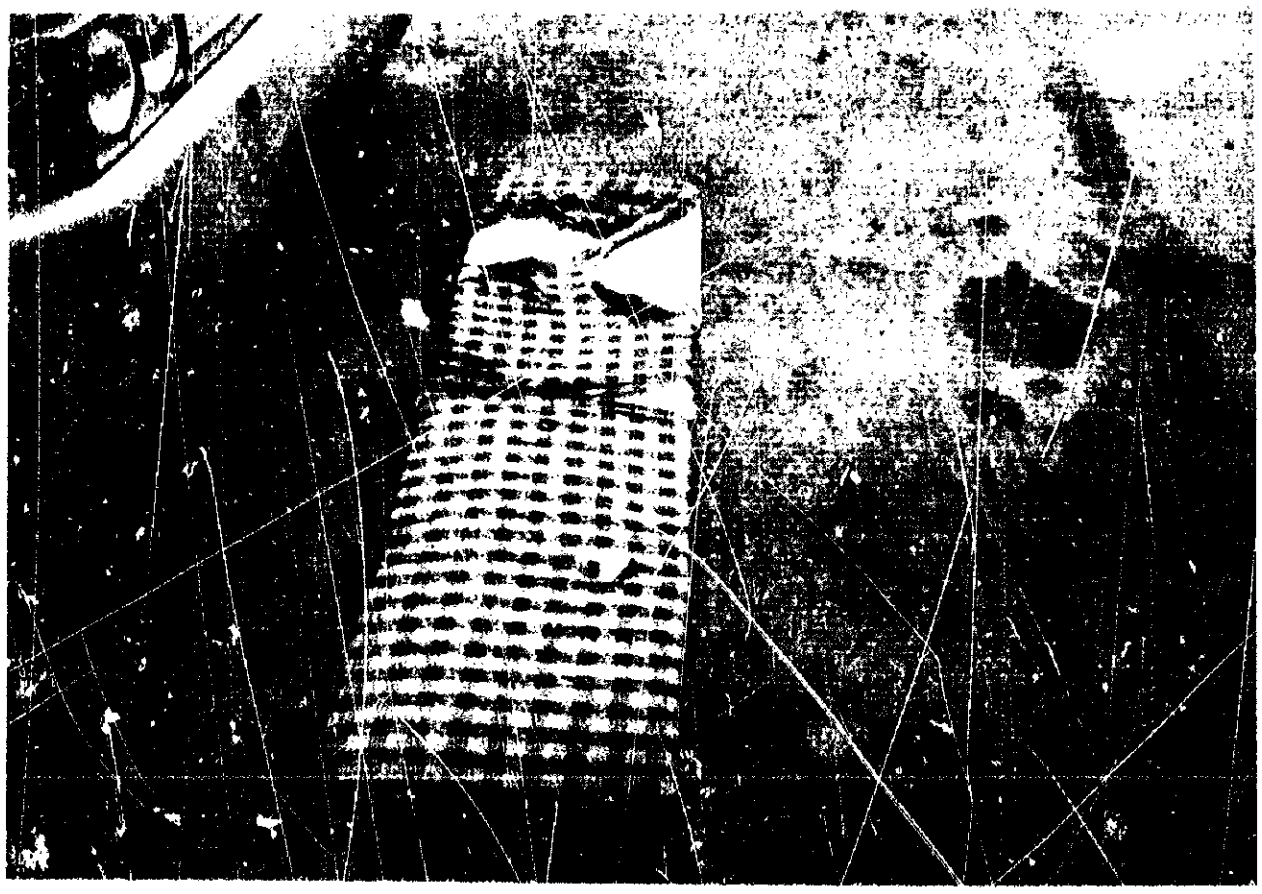

Figure 3.--Bed found in Academy Lines, Inc., vehicle.

Highway Information

General Information.--The New Jersey Garden State Parkway is a 173-mile toll facility running generally in a south-north direction through New Jersey. Its southern terminus is at Cape May, Cape May County and its northern terminus is at Montvale, in Bergen County at the New Jersey-New York border. The parkway was built and is maintained and operated without Federal aid funds by the New Jersey Highway Authority (Authority).

The parkway is primarily a limited access highway. From its southerly end (milepost 0) in Cape May to about 104 miles north to the the Asbury Toll Plaza the Parkway is four lanes wide (two lanes in each direction). Between the Asbury Toll Plaza and the Raritan Toll Plaza, which includes the accident site, the parkway is 10 lanes wide (5 lanes in each direction).

On the 10-lane section of the parkway, a grass strip separates the right three lanes known as the outer or "local" roadway from two parallel lanes carrying vehicles traveling in the same direction known as the inner or "express" roadway in both the north and south traffic directions. The Authority prohibits buses and trucks from operating in the left lane of the outer or "local" roadway.

At milepost 37, the parkway intersects with the Atlantic City Expressway, which serves as a direct connection to Atlantic City located 8 miles to the east. According to ALI officials, the busdriver probably entered the parkway at this location on the return portion of the accident trip.

There are three service areas where rest facilities are available north of the parkway's connection to the Atlantic City Expressway before the accident site. The first service area is 4 miles north of the connection at milepost 41; the second is at Forked River about 39 miles north of the connection at milepost 76; and the third is about 63 miles north of the connection at milepost 100, about 11 miles south of the accident site. A driver is not required to stop at these service areas.

In addition to the service areas, there are four toll plazas on the busdriver's probable accident route after he entered the parkway and before the accident site. The first toll plaza is at New Gretna located at milepost 54; the second is at Barnegat at milepost 69; the third is at Toms River at milepost 85; and the fourth is at Asbury at milepost 104, about 7 miles south of the accident site. The busdriver had to stop his bus and pay a toll at each of these locations.

The Accident Site.--The accident occurred on a rural section of the parkway in Middletown Township, Monmouth County, New Jersey, in the "local" lanes of the highway. The posted speed limit for all vehicles is 55 mph. There were no speed studies available, but observations made during the Safety Board investigation indicated that the average speed for all vehicles was between 65 and 70 mph. The design speed for the highway is 70 mph. There was no artificial lighting at the site.

At the accident site, the "local" roadway curves to the right with a 3,200-foot radius and is a 1.58 percent upgrade for northbound vehicles. At a point 320 feet north of the beginning of the curve is a four-span, 272-foot long steel girder bridge with a concrete deck. This bridge spans Normandy Road, a two-lane, two-way roadway, and the Earle Naval Ammunition Depot Railroad, a two-track spur serving a Navy facility. A "Speed Limit 55" sign with a supplementary "Police Use Radar" sign mounted beneath was installed 150 feet south of the beginning of the bridge. It was reflectorized and in excellent condition.

Three other parallel bridges, for the southbound local, the southbound express, and the northbound express lanes, span the road and railroad. The distance between the bridges for the northbound local and express roadways is 15 feet.

The outer roadway was originally built to carry two 12-foot wide lanes with 11-foot-wide left and right shoulders. The parkway was reconstructed in 1980, and after this reconstruction, the northbound roadway had three 11-foot-wide travel lanes. The left shoulder was 5 feet wide and the right shoulder was 8 feet wide. Broken white lines delineated the travel lanes. A solid yellow edge line was on the left and a solid white edge line was on the right. All pavement markings were in excellent condition at the time of the accident.

A W-beam steel guardrail was installed for 180 feet along both sides of the approach to the bridge at the accident site about 6 months before the accident. The standard post spacing for the

27-inch-high guardrail was 6 feet 3 inches. On the west side spacing decreased to 3 feet 1 1/2 inches starting 22 feet from the end of the bridge, and the last guardrail post was placed 4 feet 4 inches from the first bridge rail post. The guardrail sections were 12 feet 6 inches long and were blocked out from the posts. Amber delineators were mounted every 25 feet along the guardrail leading up to the bridge.

According to the NJSP, the bus first struck the guardrail 54 feet south of the bridge. There were no tire marks attributable to the bus leading up to the point of initial impact. The damaged guardrail and part of the bridge railing had been removed before the Safety Board arrived at the scene. Therefore, it was not possible to determine how the transition guardrail attachment was made to the bridge railing.

The bridge railing consisted of three 6-inch by 3/4-inch steel rails welded to vertical posts. The first section of railing used five posts, and each of the next two sections of railing used four posts. The rails were mounted at a 22.5° upward angle to the posts, and the tops of the rails were spaced 12, 24, and 36 inches, respectively, above the curb. The curb was 12 inches high with a 10-inch horizontal distance between the face of the curb and the face of the rail.

The first five sections of bridge rail were damaged in the accident. The first section of bridge rail had all the base plate filet welds sheared, and the section was knocked off the bridge. The second section remained on the bridge with most of the base plate filet welds sheared and some crimping of the rail. The third section was knocked off the bridge with the first three base welds sheared and the lower rail weld sheared on the fourth post. The fourth section remained on the bridge with the most southerly post fractured at the lower rail weld, the next two posts fractured at the middle rail weld, and the last post fractured at the butt weld for the extension post. The fifth damaged section of bridge rail had cracked butt welds and a slight westerly displacement of the extension post. (See figure 2.)

The bridge rail posts were extended to a height of 132 inches by butt welding a section of steel to the existing post to provide support for a chainlink 1-inch diamond mesh fence. The fence was installed to prevent items from being dropped to the highway and railbed below.

The Authority plans to replace the existing steel bridge rail on the local roadway with standard 32-inch-high New Jersey-type concrete barrier in the future. The express roadway bridges had the New Jersey concrete barrier installed as bridge rail at the time of the accident.

Federal Motor Carrier Safety Regulations

As a motor carrier transporting passengers for-hire in interstate commerce, ALI's motor carrier operations are subject to the requirements of the FMCSR contained in Title 49, Code of Federal Regulations, Parts 390 to 397, and administered by the DOT's Federal Highway Administration (FHWA).

Section 391.23 of the FMCSR requires that each motor carrier inquire into each driver's driving violation conviction record with State driver licensing agencies and to inquire into employment records with past employers for the last 3 years within 30 days of the date the driver's employment begins. Entries documenting when these inquiries were made, and the licensing State(s) and past employer's responses are to be included as part of the driver's qualification file.

Section 391.41(b)(3) of the FMCSR provides that a person is physically qualified to drive a motor vehicle if that person has no established medical history or clinical diagnosis of diabetes mellitus currently requiring insulin for control.

Section 391.45 of the FMCSR requires that drivers must be medically re-examined and certified as being physically qualified to operate a motor vehicle every 24 months. As stated in Section 393.41 (a), the examination must be performed by a licensed doctor of medicine or osteopathy. Any physician meeting this requirement can perform medical examinations of interstate commercial truckdrivers and busdrivers. The format of the prescribed medical examiner's certificate contained in Section 391.43(e) includes a space to enter the date of the examination, a space for the examining physician's name to be printed, a space for the physician's address, and the physician's signature.

Section 391.51 requires that each motor carrier maintain, at its principal place of business or other locations as may be approved, a driver qualification file for each driver employed.

The driver qualification file must include the medical examiner's certificate or a legible copy thereof. Unlike the requirements pertaining to verification of driving conviction record and past employment, the regulations do not require that an employing motor carrier make any attempt to verify the authenticity of a medical examiner's certificate presented to it by a driver.

Section 393.76 provides that any sleeper berth installed on any motor vehicle after September 30, 1975, shall be at least 75 inches long and 24 inches wide, and must be properly equipped for sleeping including adequate bedclothing and blankets. Any such sleeper berth must be equipped with springs and a mattress, an innerspring mattress, a cellular rubber or flexible foam mattress at least 4 inches thick, or an air mattress.

Section 395.2 defines "on-duty time" as all time from the time a driver begins to work or is required to be in readiness to work until the time he is relieved from work and all responsibility for performing work. Before November 30, 1987, time spent working for nonmotor carrier entities was not included in the FMCSR definition of on-duty time. Effective November 30, 1987, the definition of on-duty time was expanded to include performing any compensated work for any nonmotor carrier entity.

On-duty time includes all time, other than driving time, in or on any motor vehicle except time spent resting in a sleeper berth conforming to the requirements of Section 393.76.

Section 395.3 prohibits a driver from:

a) Driving any motor vehicle more than 10 hours since his last 8 or more hours off duty;

b) Driving any motor vehicle after having been on-duty more than 15 hours since his last 8 or more hours off duty; and

c) Remaining on duty more than 60 hours in any 7 consecutive days.

Section 395.8 provides that every motor carrier shall require each driver used, with certain exceptions, to record their duty status in duplicate for each 24-hour period in the manner prescribed by this section. Drivers shall submit or forward by mail the original driver's record of duty status to the motor carrier within 13 days following the completion of the form. Motor carriers must retain these records on file for 6 months.

Motor Carrier Information

General.--The bus company, formerly named the New York, Keansburg, Long Branch Bus Company, changed its name to Academy Lines, Inc., in 1984. The company, which maintains its

principal place of business in Leonardo, New Jersey, operates as an interstate common carrier of passengers under a certificate of public convenience and necessity issued by the Interstate Commerce Commission. ALI also operates buses out of a terminal in Hoboken, New Jersey.

This certificate authorizes the regular route for-hire transportation of passengers from all points in Ocean and Monmouth counties, New Jersey, to New York City, New York, and return. This certificate also authorizes the irregular route for-hire transportation of passengers and their baggage in charter operations between all points in the United States and to the Canadian and Mexican borders.

ALI also holds intrastate authority issued by the New Jersey Department of Transportation's Office of Regulatory Affairs authorizing the regular route for-hire transportation of passengers between points in Hazlet, New Jersey, on the one hand, and Atlantic City, New Jersey, on the other, making intermediate stops at Keansburg, East Keansburg, Leonardo, Long Beach, and Eatontown, via the Garden State Parkway from Exit 105 at Asbury Park to Exit 38 at the Atlantic City Expressway.

Routes.--ALI operates about 108 peak-hour regular route round-trip commuter runs Monday through Friday from points in northern New Jersey to New York City and return. The commuter operation constitutes the majority of ALI's business, about 6.5 million miles a year. The minimum commuter trip time is about 45 minutes, and the maximum commuter trip time is about 1 hour 45 minutes one way.

After the morning commuter run, most, if not all of the buses are parked in downtown lower Manhatten and the drivers, unless otherwise assigned, are released from duty until the beginning of their scheduled runs out of New York that afternoon. One or two buses sometimes return to the Hoboken and/or Leonardo terminals after completion of the morning commuter runs, and drivers of other buses may ride back to the terminals on these buses and take their off-duty time at home before riding back to New York to drive an afternoon commuter run.

ALI also performs regular route operations from points in northern New Jersey to the gambling casinos in Atlantic City, New Jersey, about 125 miles from the carrier's Leonardo terminal. One daily run is scheduled to leave Hazlet, New Jersey, at 9:30 a.m. and arrive in Atlantic City about 11:45 a.m. This bus is scheduled to leave Atlantic City on the return trip at 6 p.m. and arrive back in Hazlet about 8 p.m.

Other scheduled gambling casino runs are made every Wednesday, Friday, and Saturday evenings. All of the scheduled gambling casino runs are set so that the passengers are afforded a 6-hour stay in Atlantic City.

ALI seldom takes charters during the business week because all available buses are needed to complete the commuter and other regularly-scheduled runs.

Equipment.--ALI owns 12 buses and leases about 110 buses from an affiliate, Academy Bus Tours, Inc., 1515 Jefferson Street, Hoboken, New Jersey. Routine inspection and maintenance operations are performed at the Leonardo facility. All maintenance operations performed at the ALI terminal are done by certified mechanics in ALI's shop which is open 24 hours a day. In cases where repairs are needed while buses are away from the terminal, ALI has agreements with bus companies located in other parts of the country to perform repairs.

Drivers.--ALI employs about 80 full-time and about 50 to 70 part-time drivers in its commuter and charter operations. In some cases, part-time drivers hold full-time jobs in New York City and drive a commuter bus to and from their regular jobs.

Driver Qualification.--According to its general manager, ALI attempts to hire new driver applicants with 2 years previous intercity bus driving experience and violation-free driving records. However, applicants for part-time work on the commuter runs without prior intercity bus driving experience could be considered for employment and trained to drive a bus if their driving records were free of convictions for serious driving violations, such as operating under the influence of alcohol careless driving, or more than three speeding convictions.

Driver Compensation.--Drivers of the regularly-scheduled commuter and gambling casino runs are compensated on a "per trip" basis. The amount paid for driving a commuter trip is determined by the location of the origin point in northern New Jersey. Drivers are paid $70.00 per round trip from Leonardo to Atlantic City.

Driver Supervision.--All newly-hired drivers are placed on a 12-month probationary period. Officials for ALI reported that if a new driver receives a citation for a moving traffic violation while driving an ALI bus or is involved in an accident which is deemed to have been preventable during the probation, the driver is fired.

The accident driver had previously been employed by ALI before moving to Florida in 1984, and because of his previous satisfactory employment with ALI, the accident driver was on a 6-month probationary period. At the satisfactory completion of this period, he would have been classified as a full-time driver.

ALI Policies Concerning Duty Status Records.--ALI officials reported that it was company policy to require a duty status record (driver's daily log) from each driver for each day and that the duty status record was to be turned in each day with the driver's trip report. Drivers' duty status records are routinely filed in the dispatcher's office at ALI's terminal in Leonardo.

On September 10, 1987, a Safety Board investigator and an investigator for the FHWA sampled the first 21 drivers dispatched the morning of August 28, 1987, to determine if duty status records were on file for those drivers for that date. The investigators selected August 28 because it was the last day drivers could submit duty status records before violating a 1983 FMCSR regulation, 49 CFR 395.8(i), which permits drivers 13 days before the duty status record is required to be turned in to the employer.

No duty status records were located for the accident driver for any of the trips he drove for ALI after he was re-employed in July 1987. In addition, duty status records for 8 of the sampled 21 drivers could not be located either in the dispatcher's office or other areas at ALI's principal office in Leonardo, New Jersey.

In August 1987, ALI had employed a full-time driver safety supervisor whose duties included overseeing the day-to-day activities of the drivers and providing contact between the drivers and higher management. After the accident, when the investigation disclosed that duty status records for the accident driver and several others could not be found, the safety supervisor's duties were expanded to include oversight of ALI's dispatchers and the prompt retrieval of the drivers' required paperwork, including drivers' records of duty status. In addition, each week the safety supervisor is now provided a list of all drivers who have not submitted duty status records.

Officials for ALI also reported that as a result of the disclosure that the accident driver and others were not being required to prepare and submit the required duty status records, ALI established a policy that specifies that no trips will be processed for driver payment until all the drivers' required paperwork is turned in.

Other Paperwork Requirements.--In addition to the duty status record, ALI requires each driver to submit a daily work-day record and a posttrip vehicle inspection report. ALI also uses a written pretrip inspection report and supplies each driver with a trip envelope which must be turned back in containing the day's receipts.

Driver Activities in Atlantic City.--ALI drivers who drive passengers to the gambling casinos in Atlantic City are required to go to HBW in Atlantic City, park their buses, and go off-duty for the rest of the time, usually about 6 hours, before the passengers are scheduled to be picked up for the return trip. ALI maintains a charge account with HBW and is charged $13.00 for each ALI bus parked there. Officials for ALI reported that they made this arrangement with HBW to prevent drivers on the Atlantic City runs from drinking or gambling while they were in Atlantic City.

HBW maintains a driver's lounge that can seat 50 drivers in comfortable chairs so the drivers may watch television, sleep, or relax while they are waiting to drive their passengers back. The HBW general manager reported that the lounge area was not conducive to quality sleep due to the noise generated by the nearby cafeteria, pool tables, television, and general conversation. The available evidence indicates that the accident busdriver seldom, if ever, used the HBW lounge, but rather elected to sleep in his bus on his homemade bed.

HBW offers other services to busdrivers, including a garage, fueling facilities, a cafeteria, and private sleeping rooms. The HBW general manager stated that several bus companies contract to rent sleeping rooms monthly to ensure that their drivers receive proper rest. The managers of these companies call HBW on occasion to determine if the drivers are using the rooms. The ALI contract with HBW was for parking services only.

ALI Policies Concerning Nonpaying Passengers.--ALI officials reported that company policy concerning the transportation of nonpaying passengers was that the only persons allowed to ride free were those individuals who held signed passes or busdrivers employed by other bus companies who were in uniform and en route to or from work.

An ALI official also reported that about a week or two before the accident, he received information that the accident driver was taking his son with him on the buses he was assigned; the ALI official verbally advised the busdriver that this practice was prohibited. No supporting written documentation concerning this reprimand was found in the busdriver's personnel file. Several other ALI employees reported having seen the busdriver's son at the bus terminal and were aware that he was occasionally riding on bus trips with his father.

Federal DOT Oversight of Academy Operations

A review of the records maintained for ALI by the Trenton, New Jersey, DOT Motor Carrier Safety Office disclosed the following:

1. A safety compliance audit of Academy's operations completed on February 24, 1983, (while the company was named the New York-Keansburg-Long Branch Bus Company) disclosed violations of the FMCSR (49 CFR Parts 390-397) including 400 instances of failing to forward drivers' daily logs to the principal place of business by the 20th day of the succeeding calendar month.

2. In October 1983, the company forfeited $4,000 in settlement of a civil claim filed against the motorcarrier by the DOT for failing to maintain drivers' logs at the principal place of business. ALI officials reported that this fine was levied because they were not aware that records were no longer

permitted to be retained at the Hoboken terminal after the DOT had rescinded authority to retain divided records.

3. In 1983, the accident busdriver was the subject of a driver-equipment compliance check performed by a DOT investigator. This inspection disclosed that there was no previous vehicle condition report on the bus, the speedometer was inoperative, and there was no fire extinguisher aboard the bus. No driver-type violation (logs, medical certificate, etc.) was noted on the inspection form.

4. On June 26, 1987, a compliance review of ALI's operations was performed as a result of a complaint received from a motorist. This review disclosed 10 instances of failing to maintain inquiries into drivers' employment record in drivers' qualification files, 1 instance of requiring or permitting a driver to drive more than 10 hours, and 150 instances of failing to require drivers to prepare records of duty status in the form and manner prescribed.

5. A compliance review completed on September 16, 1987, disclosed 15 instances of failing to maintain inquiries into drivers' employment record in drivers' qualification files, and 176 instances of failing to require drivers to prepare a record of duty status.

6. In March 21, 1988, the FHWA announced that ALI had paid $2,000 in settlement of a civil claim brought against it for failing to retain driver's records of duty status at its principal place of business for 6 months.

ANALYSIS

The Accident

There is no evidence that the weather or the condition of the highway caused the accident. Although it had been raining, the roadway was dry when the accident occurred. No preexisting mechanical defects were found during the postcrash examination of the accident bus, and no defects were reported. The Safety Board concludes that the mechanical condition of the bus did not cause or contribute to the accident.

The busdriver was experienced in operating articulated heavy commercial vehicles as well as the type of bus he was operating at the time of the accident. The Safety Board concludes that the busdriver had the necessary skills to operate the bus safely.

Although the busdriver's New Jersey license had been suspended on seven previous occasions, the majority of these suspensions were for failure to pay fines associated with relatively minor traffic violations. The busdriver's driving conviction record was not sufficiently serious to cause New Jersey to deny the busdriver's request to have his license reinstated several days before the accident, and the Safety Board concludes that the busdriver's driving conviction record was not sufficiently serious to disqualify him from operating commercial vehicles in interstate commerce.

It is unlikely that the bus' transmission would have automatically shifted as the bus approached the accident location, given only a 1.58 percent upgrade and the speed at which witnesses reported the bus was being operated. Therefore, the change in the engine noise reported by one of the passengers probably was an indication that the busdriver's foot had unintentionally slipped off the accelerator pedal.

The lack of any tire marks on the roadway or shoulder attributable to the bus and leading to the point of the bus' initial contact with the guardrail, as well as the fact that a witness reported not seeing any brake lights activate on the bus, indicates that the busdriver made no attempt to slow or stop his vehicle before the collision. What this witness perceived and reported to be the bus' "drift" to the left before impact suggests to the Safety Board that the bus may in fact have been traveling straight ahead without the busdriver making any steering input to compensate for the curve his bus was negotiating.

The Safety Board concludes that the busdriver did not perceive that his vehicle was leaving the roadway and was not actively operating the driving controls of the bus at the time of the collision.

Driver Alertness, Medical, and Pathological Factors

Because the busdriver had been diagnosed in 1983 as having diabetes mellitus type II, the Safety Board considered the possibility that this condition may have adversely affected his performance on the morning of the accident. Although his New Jersey physician referred him to a Florida physician, there is no evidence that he continued to have his diabetic condition treated or monitored under a physician's supervision after he moved to Florida in 1984.

Literature indicates that although moderately elevated blood sugar levels of diabetics may produce long-term medical problems such as vision and kidney damage, diabetes generally will not produce acute symptoms such as a loss of consciousness in a noninsulin dependent patient. 1/ Due to the absence of information concerning the type(s) and amounts of food that the busdriver had or

1/ Krolewski, A.S., Warram, J.H., and Ghristieb, A.R., "Onset, Course, Complications, and Prognosis of Diabetes Mellitus," in Joslin's "Diabetes Mellitus," 12th Ed., Lea and Febeger, Philadelphia, Pennsylvania, 1985.

the time the busdriver last ate, and the inability to obtain data concerning the blood sugar level present at the time of his death, the Safety Board is unable to determine if diabetes was a factor in the accident. However, the Safety Board cannot rule out this possibility.

On the afternoon before the accident, the busdriver acknowledged to a friend that he felt tired and did not feel well. Post mortem toxicological tests disclosed the presence of chlorpheniramine and phenylpropanolamine in the busdriver's blood and urine. The presence of these drugs in the busdriver's system indicates that he had probably treated himself with some medication, probably obtained over-the-counter, in an attempt to alleviate the symptoms of a cold or influenza.

Chlorpheniramine is an antihistamine routinely contained in over-the-counter medications used to treat the symptoms of hay fever and colds such as nasal drip and eye irritation. Its side effects include drowsiness, dizziness, loosened coordination, rash, headache, and stomach distress.

Phenylpropanolamine is a nasal decongestant which is contained in some, but not all, over-the-counter cold and hay fever remedies. It is also present in numerous over-the-counter diet aids which may contain as much as 75 mg of phenylpropanolamine per tablet. The drug is capable of causing dizziness, nervousness, insomnia, palpitations, and cardiac arrhythmias. 2/

Phenylpropanolamine is contra-indicated for a person diagnosed with diabetes mellitus. This contra-indication is associated with long-term use of the drug, which leads to an increase in atherosclerosis. Even though the use of this drug is believed to increase the risk of atherosclerosis in diabetics, there is no evidence that this was a causative factor in this accident.

The therapeutic blood concentration of chlorpheniramine is about .017 mcg/ml, and the therapeutic blood concentration of phenylpropanolamine is .05 to 0.1 mcg/ml. 3/ The concentration of chlorpheniramine present in the busdriver's blood was reported by the NJME to be .04 mcg/ml, a level considerably higher than the listed therapeutic concentration. The CHT did not report the presence of chlorpheniramine because of the limited quantity of the available sample.

The concentration of phenylpropanolamine in the busdriver's blood as reported by the NJME was 1.10 mg/l, which is about 10 times the listed therapeutic concentration. Although the blood concentration of this drug reported by CHT (0.62 mcg/ml) is lower than that reported by NJME, the CHT value is about six times the listed therapeutic concentration.

Because over-the-counter medications that contain both phenylpropanolamine and chlorpheniramine contain these drugs in comparable concentrations, it is reasonable to expect that nearly equal concentrations of these drugs would be present in the busdriver's blood during the first few hours after ingestion. However, since phenylpropanolamine is eliminated from the blood at a faster rate than chlorpheniramine, 4/ the level of phenylpropanolamine would decrease at a faster rate as compared to the level of chlorpheniramine as the time after ingestion grew longer.

The elevated level of the phenylpropanolamine present in the busdriver's blood over that which could reasonably be expected to be present if the busdriver was using a cold or flu medication alone suggests to the Safety Board that there may have been an additional source of phenylpropanolamine, such as a diet aid, which the busdriver ingested before the accident. The use of a diet aid would help to account for the presence of phenylpropanolamine at a level significantly greater than its therapeutic range, and higher than that relative to the concentration of chlorpheniramine, had these drugs both been obtained from a cold medication alone.

2/ Baselt, R.C., "Disposition of Toxic Drugs and Chemicals in Man," Biomedical Publications, 1982.

3/ Winek, C.L., "Drug and Chemical Blood-Level Data 1985," Fisher Scientific, 1985.

4/ Baselt, Ibid.

While the side effects of these two drugs in combination is unknown, the phenylpropanolamine probably affected the busdriver's ability to obtain proper rest while off duty. This lack of rest probably resulted in a decrease in the busdriver's level of alertness when he resumed his driving duties.

Driver Fatigue

Although it was reported that he normally slept 6 hours each night, the busdriver slept no more than 4 hours the night of September 4/5 and slept no more than 5 1/4 hours the night of September 5/6. The actual amount of sleep he obtained, if any, could have been considerably less.

The busdriver drove a line run to and from Atlantic City in addition to his usual morning and evening commuter runs 2 days before the accident, and he did not complete the run until 6 a.m. the day before the accident. Although he was off duty on the day before the accident from 6 a.m. until about 5:30 p.m., he had the opportunity to sleep for a maximum of 3 1/2 hours between 8:30 p.m. and noon (appendix B).

Friends reported that the busdriver routinely slept in his bus in the bus parking lot at Atlantic City while he was waiting for his passengers. Based on the fact that another ALI busdriver reported that he saw the busdriver getting undressed in his bus late on the evening of September 5, the Safety Board believes that it is reasonable to presume that he followed his usual routine the night before the accident and stayed in his bus to sleep.

Although the busdriver may have obtained some sleep before the accident, the quality of any such sleep, obtained while lying on a portable folding bed which was 6 feet long and only 19 inches wide and installed in the aisle of his bus was probably not sufficient to make up for the 6 hours sleep he usually obtained. The Safety Board concludes that the busdriver probably was experiencing the adverse effects of fatigue due to sleep deprivation at the time of the accident.

Driver Alertness, Work-Rest Cycle, and Time of Day

Studies have established that lapses in attentive alertness occur during relatively monotonous work such as driving and at predictable times of vulnerability, particularly between 2 a.m. and 7 a.m. 5/ This phenomenon is attributed to the effects of circadian rhythms--the biological rhythm of humans with reference to cycles in nature including day/night cycles.

The relationship between circadian rhythms and the commercial driving task is addressed in research initiated by the DOT in which the researchers examined, among other things, work periods that are irregular with respect to the day/night cycle. The research indicates that, on the basis of heart rate measurements, diurnal (daily) variations in the level of physiological arousal occurred in professional truckdrivers who drove during both daytime and nighttime hours; however, a disproportionate number of accidents involving "sleepy or inattentive" drivers occurred between midnight and 8 a.m. when indices of physiological arousal are generally at their lowest levels. 6/

The "normal" work day of the busdriver involved in this accident lasted from about 5:30 a.m. to about 8 a.m. and from about 4 p.m. to about 7 or 8 p.m. each business day. After 8 p.m., he usually

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5/ Association of Professional Sleep Societies, Committee of Catastrophes, "Catastrophes, Sleep, and Public Policy: Consensus Report," June 1986.

6/ "A Study of the Relationships Among Fatigue, Hours of Service, and Safety of Operations of Truck and Bus Drivers," U.S. Department of Transportation, Federal Highway Administration, Bureau of Motor Carrier Safety, 1972

was off duty until 5:30 a.m. the next day. However, on the two consecutive evenings before the accident, the busdriver drove on late evening/early morning trips to Atlantic City. The Safety Board concludes that this variation of the busdriver's working hours may have disturbed his normal sleep-work pattern and resulted in circadian disharmony and a lowered level of vigilance at the time of the accident.

The Safety Board believes that the busdriver's vigilance just before the accident was reduced to a virtually ineffective level. This was due to a combination of sleep deprivation, a cold or influenza, and the presence of drugs which may have caused loss of sleep and resultant drowsiness. Further, the Safety Board believes the busdriver's vigilance was also reduced because of inadequate rest the night before the accident, his irregular work hours the 2 days before the accident, and the fact that human performance reaches its lowest level in the early morning hours before dawn.

In the few minutes after stopping to pay a toll at the Asbury toll booth and preceding the collision, the busdriver apparently was still capable of performing the minimal tracking tasks required to keep his vehicle on the road and in the proper lane. However, because of the lack of any evidence showing braking and of any attempt to steer the bus around the curve, the Safety Board concludes that the busdriver was inattentive and probably was asleep when his bus collided with the guardrail.

Survival Factors

The available evidence leads the Safety Board to believe that after passing several vehicles to its left, the bus traveled straight ahead on a line tangent to the 3,200-foot-radius curve and struck the guardrail. Because the curve at the accident site has a relatively large radius, the Safety Board concludes that the bus struck the guardrail at a relatively shallow angle estimated to be about 10°. (See figure 4.)

If the bus struck the guardrail at a 10°-angle while traveling about 70 mph, the deceleration forces experienced by the bus occupants at the time of this first impact would not have been severe. When the bus left the guardrail and struck it a second time, the impact angle was again probably shallow, which again resulted in low deceleration forces.

At-scene measurements indicated that the bus traveled 145 feet from the initial point of impact to its final rest position. By using the estimated velocity of initial impact (70 mph) and the total stopping distance of 145 feet, the average estimated deceleration, or G, forces experienced by the occupants were a relatively low 1.1 average Gs.

Since the low deceleration forces experienced when the bus struck the guardrail were essentially aligned with the longitudinal axis of the bus, the passengers were most likely not ejected from their seats and consequently, they sustained little or no injury while the bus remained upright.

The 50°-angle of the scrape marks on the right side of the bus and the fact that these scrape marks were only 2 to 4 feet in length indicate that the forward motion of the bus had almost stopped when the bus overturned. The lateral forces that occurred when the bus overturned were probably the highest G forces the occupants experienced during the accident sequence. It was probably during this lateral deceleration that passengers were thrown from their seats.

Therefore, most, if not all, of the minor or moderate injuries sustained by the surviving passengers probably occurred when the bus overturned. If the bus had been equipped with lapbelts for the passengers, use of available lapbelts would not have prevented the passengers from striking the seats in front of them, the side walls of the bus, or the passenger seated in the adjacent seat. If lapbelts were used, the surviving passengers' injuries may have been different, but they probably would not have been any less severe.

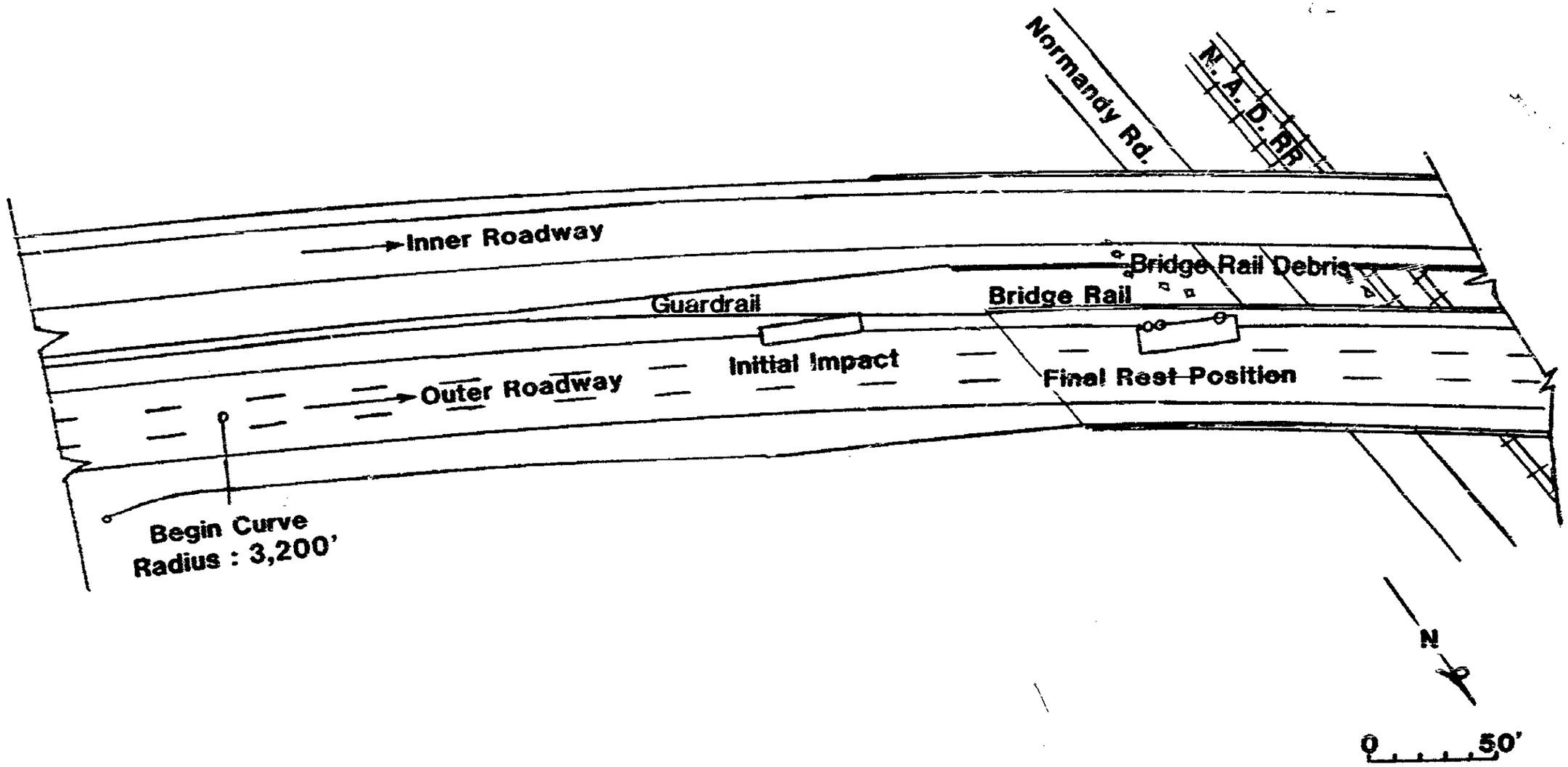

Figure 4.—Impact with guardrail and final rest position of the bus.

Both fatally injured occupants were seated in the forwardmost portion of the bus. The passenger, according to a survivor's statement, was seated in the first row of seats in the right aisle seat. The passenger's fatal injuries were probably the result of the intrusion of railing and fencing material into the front of the bus, and the use of a lapbelt would not have prevented his fatal injuries.

In addition to the intrusion of railing and fencing material, the busdriver's fatal injuries can also be attributed to the 12-inch rearward displacement of the steering wheel. The fact that the rear half of the steering wheel was displaced upward at a 30°-angle indicates that the rib and sternum fractures sustained by the busdriver were probably caused by the rearward intrusion of the steering wheel into the busdriver's occupied space.

The fact that the busdriver's body was found lying out of his seat in the stepwell of the overturned bus after the fence was removed indicates that the busdriver was not using the available lapbelt. However, use of the lapbelt would not have prevented the busdriver from sustaining his fatal injuries.

Witnesses reported that at the time of the accident, the bus was traveling about 70 mph, which is 15 mph above the posted speed limit at the accident site. Although it is reasonable to assume that collision forces would have been reduced had the bus been traveling at the posted speed limit, the Safety Board is unable to determine if operation of the bus at 55 mph would have prevented the intrusion of the chainlink fence and bridge rail material into the front of the bus.

The bridges for the express roadways were constructed with 32-inch-high New Jersey-type concrete barriers topped with chainlink fence at the accident site. If the bridge for the local roadway had been similarly equipped with a New Jersey barrier rather than the steel bridge rail, the Safety Board believes that, given the relatively shallow collision angle, the New Jersey-type concrete barrier may have successfully redirected the bus back into the travel lanes before it encountered the chainlink fence. The Authority reported that it plans to replace the existing steel bridge rail at the accident site with a 32-inch-high New Jersey-type barrier.

A number of bridge rail designs have been successfully crash tested and were approved for use in 1986 by the FHWA for new or reconstructed bridges. The 42-inch-high concrete barrier used by the New Jersey Turnpike Authority is on the approved list. (See appendix C for details.)

While the 32-inch-high barrier has been proven effective for redirecting vehicles at shallow angles, higher barriers are more effective in redirecting large vehicles such as buses at larger impact angles and at higher speeds. In view of this, the Safety Board believes that the Authority should replace existing steel bridge rail on the Garden State Parkway with 42-inch-high extended New Jersey Safety Shape bridge rail.

Federal Motor Carrier Safety Regulations

Medical Examinations and Certification.--In another accident on February 24, 1983, near Willow Creek, California, a dumptruck crossed the highway centerline and collided with a schoolbus. 7/ The investigation disclosed that the dumptruck driver had several medical problems, including loss of memory, dizziness, and loss of vision due to renal glycosuria (an abnormally large amount of sugar in the urine).

7/ Highway Accident Report--"Collision of Humboldt County Dump Truck and Klamath-Trinity Unified District Schoolbus, State Route 96, Near Willow Creek, California, February 23, 1983" (NTSB/HAR-83/05).

The Safety Board concluded that the truckdriver did not properly advise the doctor who performed the DOT-required medical examination of all his medical problems, and that the failure to volunteer this information hampered the physician's ability to accurately assess the driver's fitness to work and drive.

As a result of its investigation of the Willow Creek, California, accident, the Safety Board on December 5, 1983, recommended that the Federal Highway Administration (FHWA):

> H-83-68
>
> Revise Federal Motor Carrier Safety Regulation 49 CFR 391.43 to incorporate a provision, similar to that specified in 14 CFR 67.20(a) for airmen medical certification, which will prohibit the falsification or omission of medical information in connection with a medical certification physical examination.

On May 31, 1985, a northbound tractor-semitrailer collided head-on with a southbound schoolbus on U.S. Route 13 near Snow Hill, North Carolina. 8/ The truckdriver and 6 of the 27 schoolbus passengers were killed, and the schoolbus driver and the remaining schoolbus passengers were injured. As a result of its investigation of this accident, the Safety Board concluded that the truckdriver, who had been diagnosed as having a seizure disorder in 1976, had deliberately concealed his seizure disorder from his State driver-licensing agency, his employer, and the physician who performed his DOT-required medical examination.

On August 25, 1985, a westbound intercity bus went out of control and struck the left side of a bridge rail on the Monocacy River on Interstate 70 near Frederick, Maryland. 9/ The busdriver and 5 passengers were killed, and 11 other passengers were injured. During its investigation of this accident, the Safety Board found that the busdriver had received a kidney transplant in February 1985, and at the time of the accident was being treated for high blood pressure, an insulin-dependent diabetic condition which predated his kidney failure, and a recent urinary tract infection.

When the busdriver involved in the Frederick, Maryland, accident received his DOT-required medical examination on June 19, 1985, from another physician who was not familiar with his complete medical history, he did not advise the examining physician of his diabetic condition which required daily insulin for control.

On May 24, 1985, the FHWA responded to Safety Recommendation H-83-68 stating that an advance notice of proposed rulemaking (ANPRM) had been published in the Federal Register on January 23, 1985, which prohibited the falsification of information given in conjunction with the performance of a medical examination to determine a driver's fitness to operate commercial vehicles in interstate commerce. As a result of this notification, Safety Recommendation H-83-68 was classified "Open--Acceptable Action" pending adoption of an acceptable rule by the FHWA.

On May 13, 1986, a Notice of Proposed Rulemaking (NPRM) which had been developed by the FHWA from the January 1985 ANPRM was published in the Federal Register. Since the May 1986 NPRM was published without a provision prohibiting the falsification of medical information, Safety Recommendation H-83-68 was classified "Closed--Unacceptable Action" in the Frederick, Maryland, accident report which was adopted by the Safety Board on January 22, 1987.

8/ Highway Accident Report--"Multiple Vehicle Collision and Fire, U.S. 13 near Snow Hill, North Carolina, May 31, 1985" (NTSB/HAR-86/02).

9/ Highway Accident Report--"Intercity Bus Loss of Control and Collision with Bridge Rail on Interstate 70 near Frederick, Maryland, August 25, 1985" (NTSB/HAR-87/01).

In an April 15, 1987, letter from the FHWA, it advised the Safety Board that, concerning Safety Recommendation H-83-68:

> A notice of proposed rulemaking relative to this recommendation will be published soon. The provision prohibiting falsification will initially be stated in Part 390. Later, after a medical conference redesigns the physical examination form (49 CFR 391.42), it will be stated in Section 391.43.

Pending the Safety Board's review of the final FHWA rulemaking initiative cited in the FHWA's April 1987 letter, Safety Recommendation H-83-68 will remain "Closed--Unacceptable Action."

In another accident which occurred on May 30, 1986, a southbound intercity charter bus went out of control while negotiating an S-curve on U.S. Route 395 about 11 miles south of Walker, California. 10/ The bus veered across the highway, struck a rock retaining wall, crossed into the northbound lane, overturned and slid on its left side, rolled back over, and came to rest upright in the Walker River. As a result of the accident, 21 passengers died, and the busdriver and 19 passengers were injured.

Following the Walker, California, accident, the busdriver, who sustained moderate injuries, displayed a medical examiner's certificate dated April 21, 1985. The physician whose name appeared on the certificate reported to the Safety Board that he had last seen the busdriver on October 17, 1983, while he was treating the busdriver for a diabetic condition and that he had not examined or treated the busdriver since that date. He also stated that the signature on the 1985 medical examiner's certificate was "an obvious forgery."

The Safety Board was unable to locate the physician who allegedly performed the March 1987 physical examination of the Middletown, New Jersey, accident busdriver. The physician's address given on the certificate on file with ALI was reported by the Clearwater (Florida) Police Department to be the site of a furniture store that had been in business at that location for several years. The Safety Board concludes that the medical examiner's certificate the busdriver gave to ALI when he was re-employed in July 1987 was a forgery.

Available records indicate that in January 1982, December 1984, and July 1987, the busdriver completed DOT-required written examinations for drivers and correctly answered questions concerning disqualifying medical conditions for interstate commercial vehicle drivers. It is likely that the busdriver took additional similar examinations as a condition for his employment on other occasions before or after 1982 when the busdriver was employed by other trucking companies that could not be contacted by Safety Board investigators.

The busdriver was, therefore, familiar with the FMCSR and was almost certainly aware that certain types of diabetic conditions would disqualify a driver from driving. Although the FMCSR prohibition against driving does not apply to diabetics who can control their condition by oral medication or diet, it is possible that the busdriver may have believed that the type of diabetes he was diagnosed as having would disqualify him from operating commercial vehicles in interstate commerce. The Safety Board believes that the busdriver presented a false medical examiner's certificate to ALI when he was re-employed in July 1987 in an attempt to conceal his diabetic condition from ALI. ALI did not verify the authenticity of the medical examiner's certificate, and there is no Federal requirement that it attempt to do so.

10/ Highway Accident Report--"Intercity Tour Bus Loss of Control and Rollover into the West Walker River, Walker, California, May 30, 1986" (NTSB/HAR-87/04).

The concealment of potential disqualifying conditions from examining physicians by drivers may be only partially addressed by the implementation of Safety Recommendation H-83-68. The existence of a rule that prohibits the falsification or omission of medical information may deter some driver applicants from this practice, but it is unrealistic to expect that all drivers will act against their own perceived self-interest and volunteer medical information that may disqualify them from further driving.

However, unlike medical conditions which can be concealed, it is a relatively simple procedure to verify that a medical certificate presented by a driver applicant to a potential employer is authentic. The medical examiner's certificate form for interstate commercial drivers presently specified in 49 CFR 391.43 has a space for the examining physician's name (to be printed), the physician's address, and signature. If this information is supplied on the certificate, a potential employer can in most cases contact the examining physician and verify the authenticity of the certificate.

The Safety Board is aware that some motor carriers, as a part of their own internal screening procedures, will not accept a medical examiner's certificate unless the examination is performed by a carrier-selected (and usually carrier-compensated) physician. Some carriers may also require that the original certificate be mailed directly from the physician to the carrier to preclude the driver's making any alterations to the certificate. In addition, although the present rule permits the acceptance of a legible copy, some carriers require that the driver submit an original certificate for the driver qualification file.

The Safety Board believes that verification of the authenticity of the medical examiner's certificate is at least as important as the presently-required inquiries into a driver applicant's driving conviction and past employment records which must be completed within 30 days of the driver's employment.

In cases where a driver applicant presents a medical examiner's certificate prepared by a physician who has not been selected by the motor carrier, the Safety Board believes that the existence of a Federal rule requiring that an employer verify the authenticity of such a certificate will, in itself, discourage forgeries, and enable motor carriers to better identify driver applicants with potential disqualifying medical conditions during any employment screening process.

Monitoring Driver Hours of Service.--A strict interpretation of the Federal rules defining "on-duty" time and what constitutes a sleeper berth leads the Safety Board to believe that the time the busdriver probably spent resting on the bed he placed in his bus would have to be counted as "on-duty" time because the bed did not meet the minimum dimensional requirements to be classified as a sleeper berth.

If the time spent resting on this bed was included in the busdriver's total on-duty time, the available evidence indicates that the busdriver had been on duty about 11 1/2 hours since his last 8 or more hours off duty, about 5 hours of which had been driving. Although it is possible that the busdriver may have obtained part-time employment which may have placed him in violation of the hours of service rules, the Safety Board was unable to find any evidence of another job. The available evidence, therefore, indicates that at the time the accident occurred, the busdriver was not driving in violation of Federal rules which limit the number of hours a driver may drive.

However, because ALI did not have duty status records on file for the accident busdriver even though it was ALI's stated policy that such records be submitted daily, the Safety Board concludes that ALI was lax in following its own procedures and was not adequately monitoring the busdriver's hours of service.

The facts and circumstances of this accident point out the difficulties that may be encountered by motor carriers in monitoring their drivers' fitness to accept driving assignments when the amount and quality of rest obtained during "off-duty" periods is unknown. Motor carrier oversight of

drivers' current hours of service has been a concern of the Safety Board, and the Safety Board believes that the FHWA should reinstitute recently-eliminated regulatory controls to better define motor carrier responsibilities to monitor drivers' current hours of service.

Between 1938 and 1977, interstate commercial drivers were required by Federal regulation to record and report their hours of service to their employers on a driver daily log. Drivers were required either to turn in their log for the previous 24 hours when they reported for duty at their employer's facility the next day or to mail it to the employing carrier immediately after the 24-hour period was completed if they were not to return to the employer's facility within the time required for a normal mail delivery. This regulatory scheme, in effect, required motor carriers to be aware of their drivers' recent hours of service.

In 1976, the Congressional Commission on Federal Paperwork (CFP) determined that the driver daily log was an excessively burdensome Federal paperwork requirement and recommended that it be discontinued and an alternate monitoring system be devised to ensure compliance with the Federal hours of service regulations. When the CFP was dissolved, the implementation of its recommendations was assigned to the Office of Management and Budget.

As a result of a Federal rule change in 1977, drivers were allowed to use either a single-day log or a form covering 8 days. The stated purpose of the rule change was to reduce paperwork. The rule pertaining to filing of either the single-day or the multiday logs stated:

> The driver shall deliver the original log sheet immediately upon completion of the last log to his home terminal or to the carrier's principal place of business. Log sheets must be mailed to the carrier when the driver will not return within 5 days of the completed log page.

As a result of this rule change, drivers using the 8-day log had an additional 5 days--a total of 13 days from the first date on the log sheet--to forward the log sheet to the employing motor carrier.

A rule amendment effective January 1, 1983, revoked the requirement for recording driver on-duty time on prescribed single or multiday log forms and permitted the incorporation of a time grid into any other document maintained or used by the employing motor carrier. Also, Section 395.8(i) of the FMCSR was amended to allow a driver to submit or forward by mail the original driver's duty status record to the employing motor carrier within 13 days of the completion of the form.

The rulemaking which took place from 1977 to 1983 affected only the requirements governing when the driver was required to forward the duty status record to the employing motor carrier. The requirement that the duty status record was to be maintained currently to the time of the last duty status change remained the same (see 49 CFR 395.8(f)(1)). Thus as of January 1, 1983, the FMCSR required that, although a duty status record had to be maintained currently, it was not required to be turned in to the employing motor carrier for up to 13 days after it had been completed. In effect, motor carriers were no longer required by any Federal rule to be aware of their drivers' recent hours of service.

On July 18, 1984, an intercity bus struck the rear of a tractor flatbed-semitrailer on Interstate 25 about 3 miles south of Cheyenne, Wyoming. 11/ The estimated vehicle speeds were 65 to 75 mph for the bus and 55 mph for the truck at the time of the collision. Of the 11 bus passengers, 1 passenger was killed, 1 passenger sustained moderate injuries, and 9 passengers received minor

11/ Highway Accident Report--"Fatigue-Related Commercial Vehicle Accidents: Cheyenne, Wyoming, July 18, 1984, and Junction City, Arkansas, October 19, 1984" (NTSB/HAR-85/04).

injuries. The busdriver sustained serious injuries, including the traumatic amputation of his right foot.

The Safety Board determined that, in addition to his work for the bus company where he was employed as a part-time driver, the busdriver was also employed full-time as a firefighter by the Air National Guard (ANG) and worked as a part-time driver/helper for an interstate moving and storage company in the Denver, Colorado, area. Since the ANG was not a motor carrier, the rule in effect at the time of the accident defining "on-duty" time did not include time spent working for the ANG.

At the time of the accident, the busdriver involved in the Cheyenne, Wyoming, accident had been "on duty," as was then defined in the FMCSR, for both the moving and storage company and the bus company for 19 hours since his last 8 or more hours off duty. He had obtained a maximum of 3 1/2 hours sleep during the 27 hours 35 minutes before the accident.

The last entry in the busdriver's record of duty status was on July 9, 1984, 9 days before the accident. When he reported for duty the evening before the accident, bus company officials did not ask him for a statement of his previous hours of service or for current daily logs before he started the accident trip.

Local bus company personnel advised the Safety Board and FHWA investigators that, as a result of the January 1983 FHWA rule change, the local company had instituted a policy not to request daily logs from drivers until 13 days had passed from the date logs were required to be prepared. There was, therefore, no documentation available to either the bus company or to Federal investigators which could be used to determine the busdriver's hours of service on the days immediately preceding the accident.

The Safety Board concluded that the bus company failed to monitor the busdriver sufficiently to prevent the operation of a vehicle while the busdriver was fatigued, and that "motor carriers also should review their internal procedures for determining and controlling the hours of service of full-time and part-time drivers to ensure that fatigued drivers are not permitted to drive."

The Safety Board also concluded that the rule that permits a driver to retain custody of the duty status record for up to 13 days after it is prepared, not only does not reduce any paperwork burden, but it also has weakened the capability of the DOT to promptly investigate and detect hours of service violations. Since a driver may retain custody of the original duty status record for up to 13 days, the record can be changed to conceal a driver's true activities and a driver may "backtrack" and spread out the amount of work performed over a longer period and insert fictional rest breaks when none in fact were taken.

The Safety Board determined that the probable cause of the Cheyenne, Wyoming, accident was the busdriver's inattention due to lack of sleep and acute fatigue, which resulted in his failure to recognize that he was overtaking a slower-moving vehicle. As a result of its investigation, the Safety Board issued two safety recommendations to the FHWA:

H-85-20

Revise Section 395.8(i) of Title 49, Code of Federal Regulations, to require that drivers forward each duty status record to the employing motor carrier immediately upon completion.

H-85-21

Revise Section 395.2 of Title 49, Code of Federal Regulations, to add all time worked by a commercial vehicle driver for all full-time and part-time employers to the definition of "on-duty" time.

Effective November 30, 1987, the DOT's definition of "on-duty" time as defined in 49 CFR 395.2 was revised to include all time performing any compensated work for any nonmotor carrier entity. As a result of the FHWA's modification of the definition of "on-duty" time, Safety Recommendation H-85-21 was classified "Closed--Acceptable Action" on February 17, 1988.

In its initial July 29, 1986, response to Safety Recommendation H-85-20, the FHWA advised the Safety Board that it would consider this recommendation in the next rulemaking action covering Part 395 of the FMCSR. As a result of this notification, Safety Recommendation H-85-20 was classified "Open--Acceptable Action" on September 16, 1986.

On November 24, 1987, the FHWA notified the Safety Board that it felt that the Safety Board's conclusion that the 13-day rule has weakened the capability of the FHWA to promptly investigate and detect hours of service violations was unsubstantiated. The Safety Board disagrees with the FHWA's position, and believes that recent proposed FHWA rulemaking (see below) necessitates the adoption of Safety Recommendation H-85- 20.

On April 17, 1985, the FHWA published a notice in the Federal Register reporting that it had granted an exemption from the record of duty status recordkeeping requirement to permit a motor carrier to use an on-board computer in lieu of the hand-prepared record of duty status. The FHWA, between 1985 and October 1987, published subsequent notices which either requested comments on similar requests from other motor carriers or which provided notice that such exemptions had been granted.

On October 1, 1986, the Insurance Institute for Highway Safety (IIHS) petitioned the FHWA to make the use of such recorders mandatory. This petition was denied by the FHWA on December 22, 1986. In response to an IIHS petition for reconsideration, on July 13, 1987, the FHWA published an ANPRM requesting comments about the use of on-board recording devices in motor vehicles operating in interstate commerce.

On March 14, 1988, the FHWA published a notice requesting comments on proposed changes to the driver's record of duty status requirements which would permit the use of on-board recorders to document driver's hours of service as an alternative to the present hand-prepared record. In the preamble to the proposed rule, the FHWA stated "that hours of service of drivers is an important element to safety and that monitoring the hours of service of drivers should be a high priority for motor carriers. . . ."

In the preamble, the FHWA also stated that the proposed rule would:

> . . . contain the requirements for use of the on-board devices and support systems. These include the requirement for the device to immediately generate information needed by enforcement personnel and for home terminal support systems to generate summaries of the hours of service information.

However, Section 395.15(h)(2) of the proposed rule still permits up to 13 days for the transmittal, either electronically or by mail, of the record of duty status. The Safety Board believes that the proposed rule permits expansion of the number of available methods for motor carriers to obtain recent driver hours of service data, and the Safety Board supports this concept. Timely driver hours of service data would enhance a motor carrier's ability to make prudent decisions concerning the dispatching of drivers, particularly those with irregular work schedules and those who have other employment.

Permitting up to a 13-day lag from the time a duty status record is required to be prepared to the time it is required to be turned in will hamper a carrier's ability to monitor a driver's recent hours of service if the carrier chooses to adopt this practice. In an extreme case, such as a serious accident, the existence of the 13-day rule permits a carrier to state that it did not know, and is not required by any Federal regulation to know, that a driver was operating in violation of hours of service rules. Not all

carriers will be using newly-available technology innovations, and hand-written duty status records will probably continue to be the method of choice for recording driver hours of service by most carriers in the near future.

Based on the November 1987 FHWA response to Safety Recommendation H-85-20 and on the contents of the March 1988 Federal Register publication concerning duty status records, the Safety Board reiterates Safety Recommendation H-85-20 to the FHWA and classifies it "Open- - Unacceptable Action."

CONCLUSIONS

Findings

1. The weather and the condition of the highway did not contribute to the accident.

2. There was no mechanical defect on the ALI bus that may have caused or contributed to the accident.

3. The ALI busdriver had the necessary skills to operate the bus safely.

4. The ALI busdriver's driving conviction record was not sufficiently serious to disqualify him from operating commercial vehicles in interstate commerce.

5. The ALI busdriver did not perceive that his vehicle was leaving the roadway and was not actively operating the driving controls of the bus at the time of the accident.

6. It could not be determined if the ALI busdriver's diabetic condition was a factor in this accident.

7. The busdriver's ingestion of drugs to treat a cold or influenza and to control his weight may have affected his ability to obtain proper rest, which resulted in a decrease in his level of alertness when he resumed his driving duties.

8. At the time of the accident, the ALI busdriver probably was experiencing the adverse effects of fatigue due to sleep deprivation.

9. The variations of the ALI busdriver's working hours during the 2 days before the accident may have disturbed his normal sleep-work pattern, resulting in circadian disharmony and a lowered level of vigilance at the time of the accident.

10. The ALI busdriver was inattentive and probably was asleep when his bus collided with the guardrail.

11. The bus struck the guardrail at a relatively shallow angle estimated to have been about 10°.

12 Most, if not all, of the injuries to the surviving passengers probably occurred when the bus overturned. The installation and use of lapbelts by the passengers would probably not have mitigated their minor or moderate injuries.

13. The fatal injuries sustained by the passenger seated in the right front seat are attributed to the intrusion of railing and fencing material into the front of the bus. The use of a lapbelt would not have mitigated this passenger's fatal injuries.

14. The fatal injuries sustained by the busdriver are attributed to the intrusion of railing and fencing material into the front of the bus and the intrusion of the steering wheel into the busdriver's occupied space. Use of the available lapbelt would not have prevented the busdriver from sustaining his fatal injuries.

15. The Safety Board is unable to determine if operation of the bus at 55 mph would have prevented the intrusion of the chainlink fence and bridge rail material into the front of the bus.

16. The available evidence indicates that the medical examiner's certificate that the busdriver gave to ALI when he was re-employed in July 1987 was a forgery.

17. The available evidence indicates that the busdriver was not operating his vehicle in violation of Federal hours of service regulations at the time of the accident.

18. ALI was lax in following its own procedures for monitoring the accident busdriver's hours of service.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the busdriver's lack of vigilance which resulted in his failure to perceive that his vehicle was leaving the roadway. The busdriver's lack of vigilance resulted from the combined adverse effects of sleep deprivation, illness due to a cold or influenza, and a high dosage of medication probably ingested to treat the symptoms of that illness and to control his weight.

RECOMMENDATIONS

As a result of its investigation of this accident, the National Transportation Safety Board reiterated Safety Recommendation H-85-20 to the Federal Highway Administration:

> Revise Section 395.8(i) of Title 49, Code of Federal Regulations, to require that drivers forward each duty status record to the employing motor carrier immediately upon completion.

In addition, the Safety Board issued the following recommendations:

--to the Federal Highway Administration:

> Revise Part 391 of the Federal Motor Carrier Safety Regulations to require a motor carrier to verify the authenticity of a medical examiner's certificate if the certificate has been prepared by a physician who has not been selected by the motor carrier to perform the examination. Information concerning the fact that verification was made should be retained as part of the driver's qualification file. (Class II, Priority Action) (H-88-24)

--to the New Jersey Highway Authority:

> Replace existing steel bridge rail on the Garden State Parkway with 42-inch-high extended New Jersey Safety Shape bridge rail. (Class II, Priority Action) (H-88-25)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ JAMES L. KOLSTAD
Vice Chairman

/s/ JOHN K. LAUBER
Member

/s/ JOSEPH T. NALL
Member

May 24, 1988

APPENDIXES

APPENDIX A

INVESTIGATION

Investigation

The National Transportation Safety Board was notified of this accident through news media reports on September 6, 1987. Highway accident investigators were dispatched from the Safety Board's Washington, D.C. headquarters and arrived on scene at 4 p.m. on September 6, 1987. Participating in the investigation were the New Jersey State Police, the New Jersey Highway Authority, the Trenton, New Jersey, Motor Carrier Safety Office of the Federal Highway Administration, and Academy Lines, Inc.

Depositions and Hearing

There were no depositions taken and no public hearing held in conjunction with the investigation of this accident.

APPENDIX B

96-HOUR SUMMARY OF BUSDRIVER'S ACTIVITIES BEFORE THE ACCIDENT

Wednesday, September 2, 1987 - No work performed for ALI

0730	Left home to visit friend who lived nearby.
0745 - 0900	Traveled with friend to Department of Motor Vehicles (DMV) office in Trenton; ate together (bagels and diet sodas).
0900 - 1400	In Trenton at DMV office; traveled back to ALI terminal in Leonardo, New Jersey.
1600 - 1715	Met another friend at luncheonette where they talked and drank sodas.
1715 - 1730	Returned home.
1730 - 2200	Ate dinner; remained at home and relaxed.
2200 - 0400*	Slept at home in bed (6 hours).

Thursday, September 3, 1987 - Work Day

0400 - 0445	Took shower; ate breakfast (possibly soup); left for work.
0515	Arrived at Leonardo terminal.
0530 - 0545	Counted buses at Union Hill, New Jersey.
0615	Departed Gordon's Corner en route New York City (NYC).
0715	Arrived NYC; went off duty.
1030 - 1035	Called friend on telephone; was in Middletown area at this time.
1100 - 1200	At luncheonette; ate lunch (probably sandwich).
1230 - 1300	Returned home took shower; had son with him; indicated that he had to be back at work at 1400.
1620	Departed NYC enroute Lakewood.
1810	Arrived Lakewood.
1855	Arrived Leonardo; went off duty.

evening	Returned home; had dinner; left to go visit his son.
2200 - 0400*	Returned home; went to bed; alarm clock set for 0400 (6 hours).

Friday, September 4, 1987 - Work Day

0515	Arrived Leonardo terminal.
0530 - 0545	Counted buses at Union Hill.
0600 - 0715	Departed Union Hill enroute NYC.
0715	Arrived NYC; went off duty.
1100 - 1200	At luncheonette with son; ate lunch (hamburger, diet pepsi, toasted almond ice cream bar).
1620	Reported for duty in NYC.
1620 - 1730	Departed NYC en route Union Hill.
1745	Arrived at Hazlet passenger pick-up area. At relatives' home-dropped off his son; the two had just eaten at a fast food restaurant.
1845 - 1945	Departed Hazlet en route Asbury Park picking up passengers for Atlantic City line run.
2118	Arrived Atlantic City area.
2130	Arrived at casino in Atlantic City.
2205	Arrived Hansen's Bus World (HBW) Atlantic City; went off duty.

Saturday, September 5, 1987 - Work Day

0252	Went back on duty; left HBW for passenger pick-up.
0315	Departed Atlantic City en route Asbury Park.
0440	Exited Parkway near Hazlet.
0440 - 0540	Dropped off passengers between Asbury Park and Hazlet.
0600	Arrived Leonardo terminal ; went off duty.
0800 - 0830	At luncheonette with unknown woman; prepared his own meal (either egg or hamburger).

1200 - 1205	At relatives' home; picked up his son.
1445 - 1500	At luncheonette with son; did not eat.
1515 - 1545	Returned home with son; had cup of soup; left to go to work.
1730 - 1735	At ALI's Leonardo terminal.
1815	Departed NYC en route Atlantic City.
2110	Arrived casino, Atlantic City.
2138	Arrived HBW, Atlantic City; went off duty.
2140*?	Observed by another ALI driver getting undressed in his bus at HBW

Sunday, September 6, 1987 - Work Day

0245*	Bus was observed parked at same location at HBW parking lot (possible 5 1/4 hours of sleep).
0257	Returned to duty; departed HBW.
0330	Picked up passengers at casino.
0500	Accident occurred.

* Possible periods of sleep

APPENDIX C

FEDERAL HIGHWAY ADMINISTRATION'S BRIDGE RAIL MEMORANDUM

Memorandum

U.S. Department of Transportation
Federal Highway Administration

Washington, D.C. 20590

Subject Bridge Rails

Date August 28, 1986

Reply to Attn of HNG-10
HHS-10

From Executive Director

To Regional Federal Highway Administrators
Regions 1-10
Direct Federal Program Administrator

The current requirements for designing bridge rails are contained in Section 2.7 of the American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications for Highway Bridges. The design procedure is based on the horizontal application of a 10 kip static load on the railing and distributed at specified location(s) depending on the railing geometry. A minimum rail height of 27 inches, minimum vertical spacing between horizontal elements, and smooth and structurally continuous design are also specified.

The current specification does not require crash testing. The specification does provide that "Railing configurations that have been successfully tested by full-scale impact tests are exempt from the provisions of this Article." Over the past several years, a number of bridge rail designs have been crash tested in general conformance with the criteria contained in National Cooperative Highway Research Program Report (NCHRP) 230. All tests have included full size and small automobiles, and some bridge rail designs have also been tested to more rigorous criteria. Not all bridge rails designed under the current AASHTO specifications have met NCHRP 230 criteria when crash tested. Attachment A is a listing of all successfully tested rails and the conditions under which they were tested. Attachment B includes design details on several of the successfully crash tested railing designs.

The AASHTO has requested the FHWA to assist them in the development of a new bridge rail specification. Considerable work has already been done, but it is still too soon to predict when and in what form this new specification will be accepted by the AASHTO and approved by the FHWA. One element we feel confident will be included, however, is satisfactory performance when subjected to full-scale crash testing.

In the interim, the information already gained from recent crash test programs is substantial, and should be considered in railing designs used for new and reconstructed bridges on Federal-aid projects. A number of bridge rail designs of varying strengths and heights have been successfully crash tested and are available for use. For example, the railing designs listed in Attachment A can be used with no further testing needed. Other bridge railing designs should be sucessfully crash tested in accordance with NCHRP 230 criteria (or equivalents) before their use on future Federal-aid projects is approved.

R. D. Morgan

2 Attachments

AUG 28 1986

ATTACHMENT A
Bridge Rails That Meet NCHRP 230 Criteria

BRIDGE RAIL	RAIL HEIGHT IN.	TEST VEHICLE	IMPACT SPEED MPH	IMPACT ANGLE DEGREES	COMMENTS
NCHRP SL1 Thrie Beam, Wood Posts	32	2,250 lb. Car	63.0	18.7	Developed for lower service level use only. (See NCHRP 239.)
		2,250 lb. Car	60.1	15.9	
		4,500 lb. Car	61.9	14.5	
NCHRP SL1 Thrie Beam, Steel Posts	32	1,987 lb. Car	61.4	14.1	Developed for lower service level use only. (See NCHRP 239.)
		2,250 lb. Car	58.6	16.0	
		2,250 lb. Car	60.0	16.0	
		20,000 lb. Bus	44.7	7.7	
Texas Type T6 (Tubular W-beam)	27	2,280 lb. Car	58.0	14.0	
		4,500 lb. Car	61.6	27.5	
Aluminum Tru-Beam (Modified AASHTO BR5)	32	2,150 lb. Car	61.3	21.5	
		4,500 lb. Car	58.9	27.2	
AASHTO BR_2 (California Type 9)	27	1,929 lb. Car	60.9	13.1	
		4,540 lb. Car	57.0	26.0	
Texas Energy Absorbing Bridge Rail	27	1,972 lb. Car	62.6	16.0	
		4,500 lb. Car	61.0	25.5	
Texas T101 Bridge Rail	27	2,780 lb. Car	57.3	15.0	
		4,660 lb. Car	60.2	15.0	
		4,630 lb. Car	59.8	25.8	
		6,900 lb. Bus	53.4	15.0	
		19,940 lb. Bus	55.3	15.2	
		20,010 lb. Bus	52.0	13.2	
		31,880 lb. Bus	58.4	14.0	Bus was contained, but rolled on its side.
Ohio Box Beam Rail (W-beam backed up with box beam)	27	1,980 lb. Car	60.6	19.6	
		4,790 lb. Car	60.0	25.0	
Modified Kansas Corral (Open Concrete Beam & Post)	27	1,971 lb. Car	59.0	18.9	
		4,690 lb. Car	59.2	24.9	
Oklahoma Modified TR-1 Bridge Rail (Open Concrete Beam & Post)	29	1,980 lb. Car	58.7	18.9	
		4,660 lb. Car	59.1	25.4	
Nebraska Tubular Thrie Beam	32	1,970 lb. Car	61.4	20.0	
		4,700 lb. Car	58.4	24.3	

AUG 28 1986

2

ATTACHMENT A

Bridge Rails That Meet NCHRP 230 Criteria

BRIDGE RAIL	RAIL HEIGHT IN.	TEST VEHICLE	IMPACT SPEED MPH	IMPACT ANGLE DEGREES	COMMENTS
Oregon - 2 Tube Mounted Rail (Curb Mounted)	32	1,994 lb. Car	58.6	18.0	
		4,640 lb. Car	60.0	25.0	
North Carolina - Standard 1 Bar Metal Rail	32	1,990 lb. Car	59.7	18.0	
		4,660 lb. Car	59.6	25.0	
		19,920 lb. Bus	57.3	14.0	Bus was contained, but rolled on its side.
California Type 25 (N. J. Concrete Safety Shape)	32	4,540 lb. Car	38.0	7.0	
		4,540 lb. Car	65.0	7.0	
		4,540 lb. Car	63.0	25.0	
N.J. Concrete Safety Shape	32	1,970 lb. Car	60.4	15.0	
		1,968 lb. Car	61.3	20.0	
		4,500 lb. Car	60.1	25.2	
		18,240 lb. Truck	60.1	15.0	Truck rolled over.
		19,990 lb. Bus	60.9	16.0	Bus rolled over.
		20,000 lb. Bus	57.7	15.0	Bus rolled over.
		20,270 lb. Bus	61.6	15.0	Bus overturned.
		40,000 lb. Bus	41.6	11.5	
		40,000 lb. Bus	51.6	6.6	
		40,000 lb. Bus	52.9	16.0	
		40,020 lb. Bus	54.0	16.2	
		40,030 lb. Bus	54.0	14.0	
		40,030 lb. Tractor-Trailer	53.0	15.0	Vehicle mounted and straddled the barrier.
V Profile Concrete Safety Shape	32	2,250 lb. Car	56.4	14.3	
		4,370 lb. Car	61.4	15.2	
		4,500 lb. Car	62.9	25.0	
California Type 18 (See-Through, Collapsing Ring)	36	1,850 lb. Car	59.7	12.0	
		4,530 lb. Car	60.7	23.0	
California Type 20 (N. J. Safety Shape with Rail)	39	4,895 lb. Car	47.0	5.0	
		4,895 lb. Car	54.0	5.0	
		4,895 lb. Car	57.0	5.0	
		4,895 lb. Car	62.0	5.0	
		4,895 lb. Car	57.0	10.0	

APPENDIX C

ATTACHMENT A

AUG 28 1986

3

Bridge Rails That Meet NCHRP 230 Criteria

BRIDGE RAIL	RAIL HEIGHT IN.	TEST VEHICLE	IMPACT SPEED MPH	IMPACT ANGLE DEGREES	COMMENTS
Nevada Safety Shape Parapet	19	1,911 lb. Car	60.7	19.3	
		4,650 lb. Car	61.4	24.9	
		40,000 lb. Bus	58.9	16.4	
New Jersey Turnpike Heavy Vehicle Barrier (Extended N. J. Safety Shape)	42	2,110 lb. Car	59.9	14.5	
		4,880 lb. Car	58.6	16.5	
		80,180 lb. Tractor-Trailer	52.1	16.5	
Collapsing Ring Bridge Railing	59	2,090 lb. Car	55.7	23.5	
		4,400 lb. Car	62.0	22.7	
		40,000 lb. Bus	53.9	15.1	
		40,000 lb. Tractor-Trailer	57.0	15.6	
		70,000 lb. Tractor-Trailer	44.1	10.0	
Texas T5 Modified (Extended N. J. Safety Shape)	90	80,120 lb. Tank Type Tractor-Trailer	51.4	15.0	

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