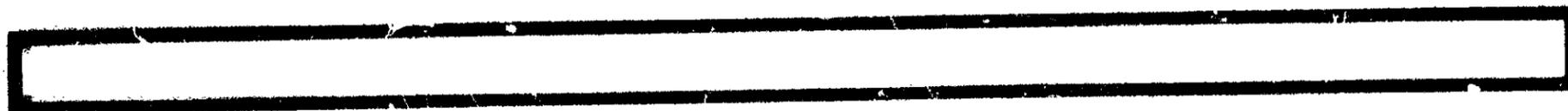
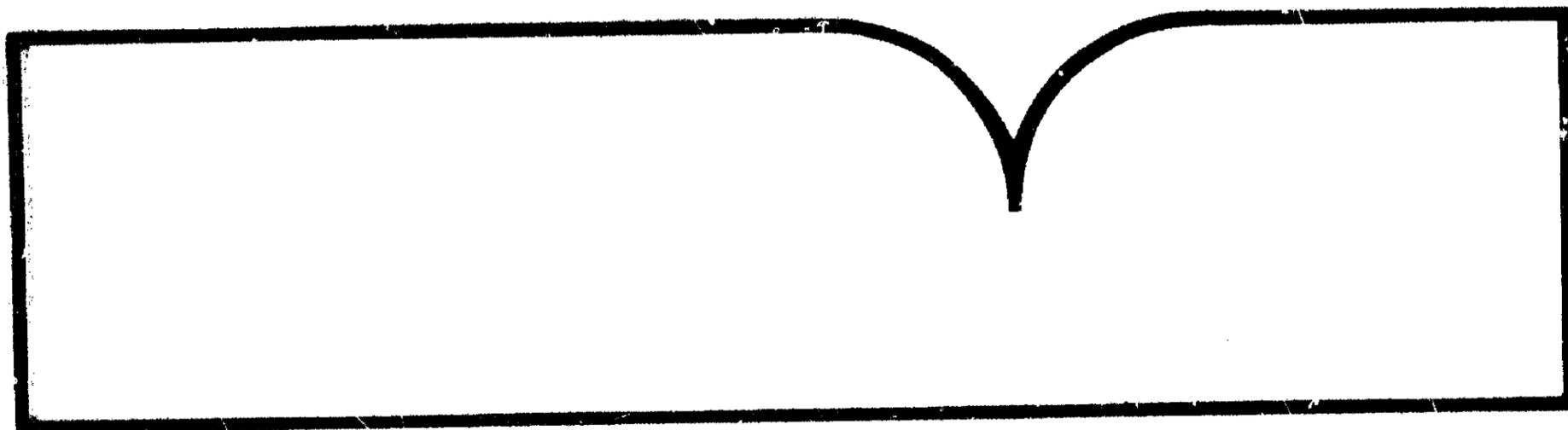


PB87-916209

Highway Accident Report
Multiple Collision with an Intercity Charter Bus
Passenger Car, and Transit Bus, State Route 495
North Bergen, New Jersey, October 9, 1986

(U.S.) National Transportation Safety Board
Washington, DC

27 Oct 87



U.S. Department of Commerce
National Technical Information Service



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16. Abstract About 7:34 a.m. on October 9, 1986, two charter intercity tour buses loaded with European tourists were traveling westbound in the right lane on State Route (SR) 495 in North Bergen, New Jersey, en route to Washington, D.C. As the westbound buses approached the Kennedy Boulevard exit on SR 495, the second bus suddenly veered leftward into the adjacent lane, struck the left rear of a passenger car traveling in that lane, then crossed into the eastbound contraflow lane, and struck a transit bus loaded with commuter passengers en route to New York City. One bus passenger aboard the transit bus was fatally injured and 26 other occupants aboard both buses sustained serious to minor injuries. The National Transportation Safety Board determined that the probable cause of this accident was the distraction of the charter busdriver from his driving duties while assisting a bus passenger with a CB radio which resulted in his failure to remain within the proper traffic lane while traveling in a construction zone.					
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EXECUTIVE SUMMARY

About 7:34 a.m. on October 9, 1986, two charter intercity tour buses loaded with European tourists were traveling westbound in the right lane on State Route (SR) 495 in North Bergen, New Jersey, en route to Washington, D.C. As the westbound buses approached the Kennedy Boulevard exit on SR-495, the second bus suddenly veered leftward into the adjacent lane, struck the left rear of a passenger car traveling in that lane, then crossed into the eastbound contraflow lane, and struck a transit bus loaded with commuter passengers en route to New York City. One bus passenger aboard the transit bus was fatally injured and 26 other occupants aboard both buses sustained serious to minor injuries.

The National Transportation Safety Board determined that the probable cause of this accident was the distraction of the charter busdriver from his driving duties while assisting a bus passenger with a CB radio which resulted in his failure to remain within the proper traffic lane while traveling in a construction zone.

This report discusses safety issues surrounding the inadequacies of traffic control devices in construction work zones, driver inattention and distraction concerning the use of citizens band radios on commercial vehicles, and motor carrier policies concerning driver operation.

The report concludes that State officials should monitor more closely the traffic control plans for interstate and primary routes to verify that traffic safety is not jeopardized during the construction of roadway improvements. The report also concludes that the motor carriers should install and require its drivers to use seatbelts while the vehicles are in motion. The report contains safety improvement recommendations that address these issues.

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D. C. 20594

HIGHWAY ACCIDENT REPORT

Adopted: October 27, 1987

MULTIPLE COLLISION WITH AN INTERCITY
CHARTER BUS, A PASSENGER CAR, AND A TRANSIT BUS
ON STATE ROUTE 495 NEAR NORTH BERGEN, NEW JERSEY
ON OCTOBER 9, 1986

INVESTIGATION

The Accident

On October 9, 1986, at 7:00 a.m. e.s.t. two charter buses operated by E. Vanderhoof and Sons departed New York City en route to Washington, D.C. on a day-long tour. The weather was clear and the roadway was dry with partial cloud cover. The charter buses traveled together from the Greyhound Bus Terminal facility in New York City through the Lincoln Tunnel and west on State Route (SR) 495 into New Jersey. About 1/2 mile west of the Lincoln Tunnel, both buses entered the approach for the highway construction area on SR 495. About 1 1/2 miles from the Lincoln Tunnel portal work was being performed to rebuild the bridge carrying SR 495 over U.S. Routes 1 and 9 (the North Bergen viaduct). Traffic was heavy and congested on the six-lane divided highway in the construction zone.

Shortly after both buses cleared the portal to the Lincoln Tunnel about 1 mile from the accident site, the busdriver of the lead bus contacted the busdriver on the second bus by citizens band (CB) radio advising him that the Austrian tour leader on the lead bus wanted to speak with his assistant tour leader. The busdriver of the second bus asked the tour escort, 1/ who was seated behind him, where the assistant tour leader was located. The tour escort went to the back of the bus and returned to the front of the bus with the assistant tour leader. The busdriver gave the assistant tour leader instructions on using the microphone on the CB radio. Using his left hand, the busdriver passed the microphone behind his head to the assistant tour leader. The assistant tour leader stretched the microphone cord out fully rearward to use the CB radio from the center aisle.

The second bus swerved from the right traffic lane to the center westbound traffic lane. The busdriver stated that he swerved left into the center westbound lane to avoid hitting a passenger car that had pulled in front of him. He contended that the passenger car had suddenly entered the flow of traffic on SR 495, crossed into the center westbound lane, and stopped. The busdriver also stated that he attempted to apply the service brakes but struck the left rear of the passenger car. The charter bus continued leftward into the next adjacent lane

1/ Not a passenger, but a paid guide escorting the tour group.

(an exclusive bus lane (XBL))^{2/} and sideswiped the left front and side of a transit bus owned by DeCamp Bus Lines traveling east in the XBL. The charter bus reentered the center westbound traffic lane and came to rest upright behind the passenger car involved in the first impact about 91 feet from the point it impacted the transit bus. The transit bus continued forward in the XBL approximately 93 feet from the point of impact and came to rest in an upright position. There were no tire marks leading up to the point of impact. There was one faint tire mark departing from the point of impact leading toward the rest position of the charter bus. (See figure 1.) There was no fire.

At the time of the collision the charter bus was loaded with 41 passengers and 1 driver, and the transit bus was loaded with 36 passengers and 1 driver.

Another New Jersey transit bus not involved in the accident was traveling west on SR 495 behind the second charter bus. The transit busdriver reported that the passenger car had not entered the westbound lanes from either the Kennedy Boulevard entrance ramp or other nearby entrances.

A motorist, who was waiting to enter the westbound SR 495 traffic at the Kennedy Boulevard entrance ramp, reported that she did not see any passenger car ahead of her crossing into the center westbound lane, nor did she observe any cars passing her car.

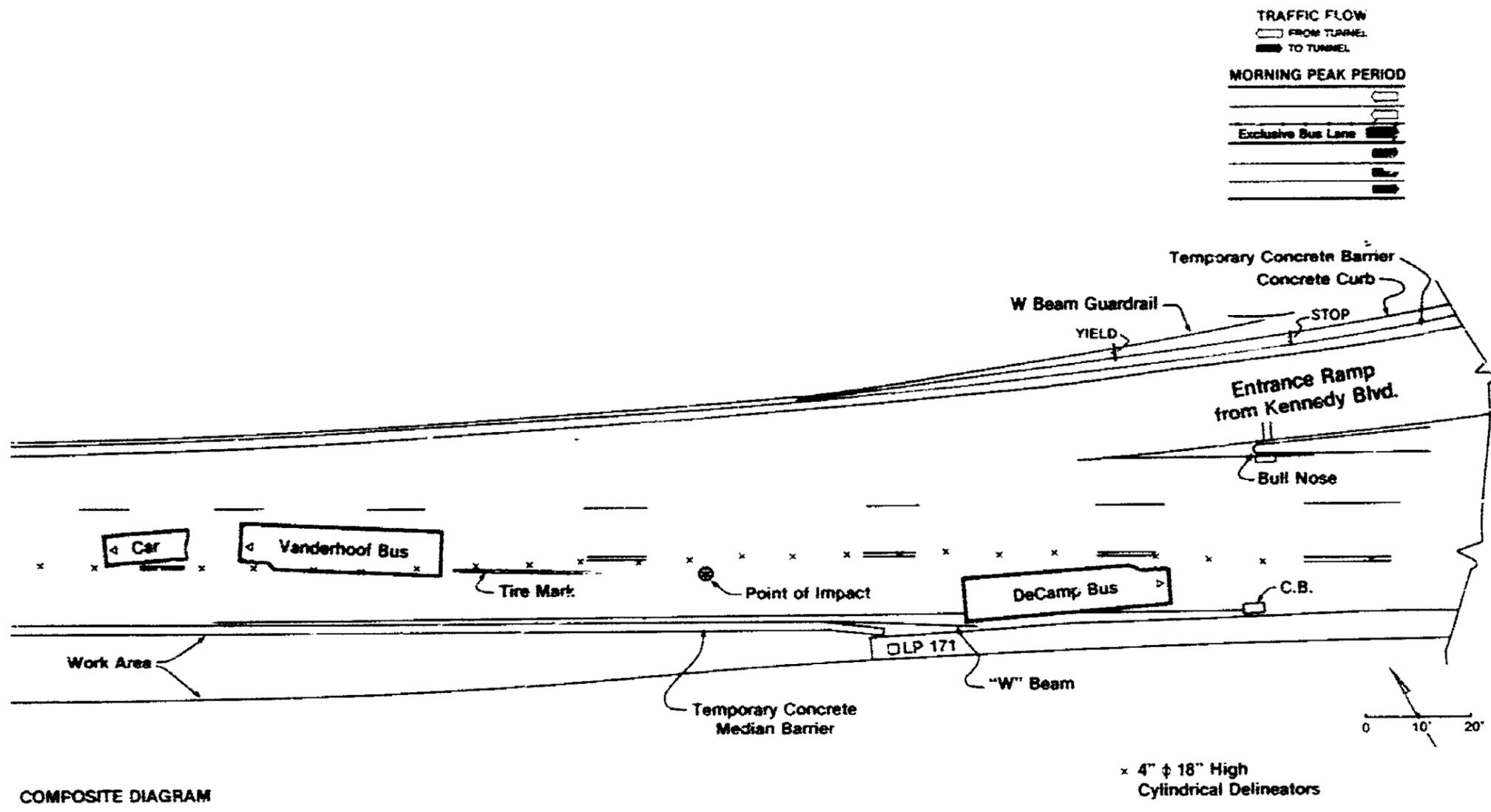
The driver of the passenger car involved in this accident testified at the Safety Board's public hearing that he had entered SR 495 about 0.8 mile before the Kennedy entrance ramp and that he had been driving in the center westbound lane 3 to 5 minutes before the accident occurred.

As a result of this accident, 1 transit bus passenger was fatally injured, 3 transit bus passengers sustained serious to severe injuries, and 23 passengers aboard both buses sustained minor injuries. The passenger car driver was not injured in the accident.

Emergency Response

A police officer for the Port Authority of New York and New Jersey (Port Authority) arrived on scene within seconds following the collision and immediately contacted the Lincoln Tunnel operations center about 7:34 a.m. by radio and requested emergency medical personnel, fire and rescue equipment, and additional police officers for assistance. The police dispatcher notified Port Authority fire and rescue personnel and area police personnel assigned to the Lincoln Tunnel. The first emergency medical service (EMS) units arrived on scene at 7:39 a.m., evaluated the situation, established a command post, established a triage onsite, and at 7:43 a.m. requested emergency medical technicians from nearby Weehawken, New Jersey. Additional ambulances from Union City, North Bergen, and Hoboken Volunteer Fire Departments, Hackensack Medical Center, Secaucus, East Rutherford, Nutley, and Clifton assisted in transporting the injured to hospitals.

^{2/} A special eastbound traffic lane operating over what is normally a westbound traffic lane designed exclusively for "rush hour" use by buses. The XBL has contraflow traffic (buses traveling in opposite direction) which is separated by temporary pylons and lanes with broken double yellow lines.



COMPOSITE DIAGRAM

Collision Between An Intercity Bus, Automobile & Transit Bus

Figure 1--Accident scene diagram.

The EMS supervisor at the command post contacted area hospitals in accordance with the Port Authority's medical emergency disaster plan. Within 45 minutes of the arrival of the first ambulance, all of the injured had been transported to one of five area hospitals, four of which were within 5 miles of the accident site.

All occupants of both buses remained inside the buses during the crash sequence; the charter bus passengers used the boarding door as an exit. Evacuation was not impeded by interior obstructions and only four passengers sustained minor injuries.

The transit bus was evacuated by passengers through four right side emergency windows. The boarding door at the right front of the bus was inoperative due to structural deformation, and passenger access to the windshield opening was obstructed by injured passengers and interior damage.

The majority of passengers were ambulatory. These passengers assisted those who were elderly and others who were unable to help themselves. Escape through the emergency side windows was slightly delayed because passengers inside the bus had a difficult time holding the windows open while others climbed out.

Injuries

	<u>Transit Bus</u>	<u>Charter Bus</u>	<u>Passenger Car</u>
Fatal (AIS-6)	1	0	0
Severe (AIS-4)	1	0	0
Serious (AIS-3)	2	0	0
Moderate (AIS-2)	0	0	0
Minor (AIS-1)	19	4	0
None (AIS-0)	14	38	1
Total	37	42	1

Note: "AIS" refers to the Abbreviated Injury Scale of the American Association for Automotive Medicine. (See appendix B for more details.)

Charter Busdriver

The 54-year-old charter busdriver had been employed as a driver by E. Vanderhoof and Sons for 1 1/2 years. Prior to then he had previously worked as a busdriver for the carrier about 3 months in 1968. His previous employment consisted of 17 years of part-time experience (8 to 10 days a month) as a charter driver in the New Jersey and New York City area as well as several years experience driving church buses and servicing buses. The driver did not receive any formal training as a commercial busdriver. The driver stated that he worked his way to the position of busdriver after performing bus maintenance and washing and parking buses at the carrier's maintenance facility. The driver obtained much of his driving experience by practice driving on his off-duty time. Both the driver's current and previous employers characterized the driver as "skillful, hardworking, and industrious."

The driver had a valid New Jersey Department of Transportation (NJDOT) commercial driver's physical examination certificate dated April 29, 1986. The only deficiency noted was his distance vision which was recorded by the examining physician as 20/25 and 20/50 in his right and left eyes, respectively. On the physical examination form, the examining physician failed to indicate "qualified only when wearing corrective lenses" as is required by Federal and State statute. The driver advised Safety Board investigators that because of religious convictions he did not drink alcohol or take any prescription or illicit drugs.

The driver held an unrestricted New Jersey commercial busdriver's license at the time of the accident. In a driver violation and accident history check of all 50 States and the District of Columbia, investigators determined that in Virginia and New Jersey the driver had been convicted of four moving violations, and he had been involved in one accident between 1985 and 1986 (see appendix D).

The charter busdriver was off duty on October 7 and 8; however, he worked 1/2 day on his part-time job on October 8, 1986. He stated that he went to bed the night before the accident about 7 p.m. and rested about 9 hours. On the day of the accident the busdriver arrived at the carrier's headquarters/maintenance facility at 5:30 a.m. and conducted the required vehicle safety inspection. He recalled checking the brakes, air pressure, tires, and mirrors after which he drove to the Greyhound Bus Terminal in New York City with another company driver assigned to drive the second bus on the tour. On arrival the drivers ate breakfast and about 6:45 a.m. boarded their passengers for the day-long tour of Washington, D.C. Since the other driver was more familiar with the route to Washington, D.C., it was decided he would lead the tour. At 7:00 a.m. the buses departed New York City. On entering SR 495, the accident busdriver stated he was traveling westbound at approximately 30 mph in the right most traffic lane and was following the lead bus by 1 1/2 bus lengths.

Transit Busdriver

The 52-year-old transit busdriver had been employed by DeCamp for about 8 months at the time of the accident. Previously the transit driver was a commercial busdriver for 14 years in the New York-New Jersey area. The driver advised Safety Board investigators that he completed a bus driving course in Cuba in the late 1960s which covered bus maintenance and operation as well as practical behind-the-wheel driving. The transit busdriver's supervisor stated that he was reliable, honest, and rated his driving skills as excellent.

He had a valid NJDOT physical examination certificate dated November 15, 1984, which required him to wear corrective glasses while driving. The driver stated that he was wearing his glasses at the time of the accident; this fact was supported by his passengers.

At the time of the accident the transit busdriver held a valid New Jersey commercial busdriver's license. Safety Board investigators conducted a nationwide traffic conviction and accident history check on the driver and determined that he had been convicted of speeding on October 26, 1984, and was involved in an accident but not charged or held at fault on July 24, 1985 (see appendix D).

The transit busdriver was off duty on October 7 and worked a full day on October 8. The busdriver stated that he spent the evening before the accident at home and obtained a normal night's sleep.

On the day of the accident the transit driver conducted a routine pretrip inspection of the transit bus. He then drove to his passenger pickup point in Nutley, New Jersey. After boarding the passengers, the transit busdriver proceeded to New York City via the XBL on SR 495.

The driver stated that as he approached the area where the accident occurred, he was concentrating on his driving duties because of the extremely narrow XBL. He was aware of the demanding nature of his driving task but did not recall an abrupt shift between the XBL and the adjacent westbound traffic lane. He recalls seeing the charter bus swerve, cross into the XBL, and then strike his bus. The transit busdriver also stated that the lane change made by the charter bus was so quick that he did not have time to brake. Bus passengers seated directly behind the transit busdriver stated that the driver was alert just before the accident occurred.

Because the Port Authority investigating officer who arrived immediately after the accident did not detect any odor of alcohol or abnormal behavior from the busdrivers, no toxicological tests were administered to either busdriver.

On December 6, 1985, the Safety Board issued a recommendation to the governors and legislative bodies of the 50 States:

H-85-49

Initiate legislation or take the necessary administrative action to require alcohol testing of all drivers involved in fatal highway crashes.

New Jersey responded to this recommendation on October 29, 1986, stating that an existing law required the alcohol testing of all fatally-injured drivers, but that there was a bill pending in the State legislature requiring the testing of all drivers involved in fatal accidents, whether fatally injured or surviving. In a December 18, 1986, letter to the governor of New Jersey, the Safety Board classified Safety Recommendation H-85-49 as "Open--Acceptable Action" and asked to be informed of the outcome of the legislation.

Vehicle Information and Damage

Charter Bus.--A postcrash inspection of the charter bus was conducted by Safety Board investigators and assisted by Port Authority police investigators, the NJDOT, and the carrier, E. Vanderhoof and Sons, on October 11, 1986.

The 48-passenger, three-axle, Silver Eagle Type 05 multipurpose coach was manufactured in 1970 by Bus and Car Company of Saint Michiels Bij Brugge, Belgium. It was last inspected by the NJDOT on April 25, 1986, and found to be in compliance with State standards.

The bus was equipped with a 280-horsepower diesel engine, torsion bar suspension system, mechanical steering gear, and air-mechanical service brakes. At the time of the accident the odometer on the bus indicated 147,739.2 miles, and its hubodometer showed 251,730.9. The bus was rated to carry a loaded gross weight of 38,700 pounds; its estimated weight at the time of the accident was 35,730 pounds. The driver's seat was not equipped with a seatbelt.

Primary damage to the charter bus was confined to the front left side (see figure 2). The front bumper was missing, both the right and left portions of the windshield were destroyed, and the windshield support post was collapsed inward about 3 inches. The maximum lateral penetration of the left front was 20 inches at the roof line and 30 inches at the left corner. Contact damage was also found on the right side of the front bumper which extended inward to about 4 feet to the center of the bumper.

A mechanical subsystem examination was conducted which included the suspension system, chassis, steering gear, engine, transmission, drive train, brake system, and tires. All components were found intact and undamaged. Also, Safety Board investigators conducted a brake systems test to determine if there were any signs of hardware failure or other malfunctions. The charter bus was equipped with an air-activated S-drum type service brake system. Air pressure for the postcrash test was supplied by an auxiliary air compressor. The brake system hardware was inspected and the slack adjustments were measured. The inspection did not reveal any discrepancies in the brake system hardware, however, the service brakes on the drive axle were not adjusted in accordance with the manufacturer's recommended specifications.

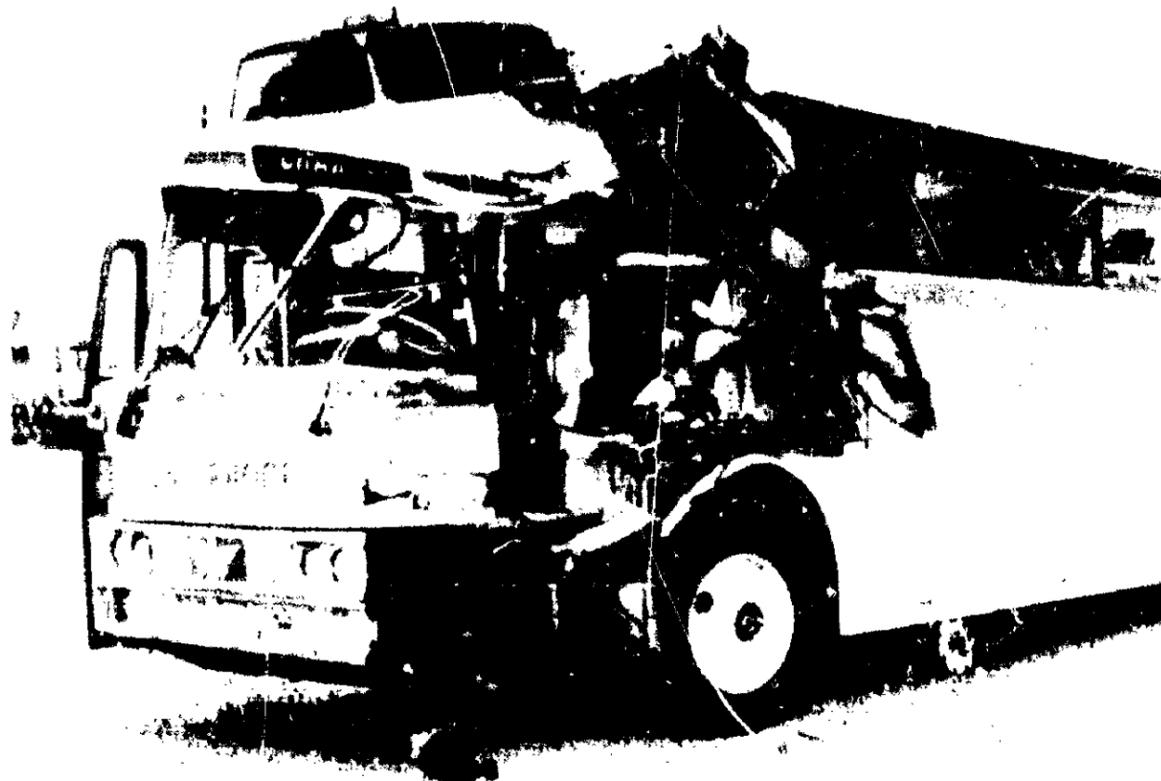


Figure 2 -- Charter bus.

Transit Bus.--A postcrash inspection of the transit bus was conducted October 12, 1986. The 49-passenger, two-axle, GMC Type S8M5304A was manufactured in 1972 by the General Motors Truck and Coach Division in Pontiac, Michigan. It was last inspected by the State of New Jersey and the State of New York on July 1, 1986, and found to be in compliance.

The transit bus was equipped with an 8V71 diesel engine, a four-speed manual transmission, air suspension, air-mechanical service brakes, and a tachograph^{3/} that was operating with a chart installed. The tachograph indicated 248,692 miles and the hubodometer indicated a total mileage of 654,248 miles. At the time of the accident the bus was estimated to weigh about 29,200 pounds. The driver's seat was equipped with a seatbelt.

The front bumper was collapsed rearward and inward 3 1/2 inches and the left front cowl was bent inward 6 inches. Both sides of the front windshield were broken and the left windshield post was displaced to the rear 36 inches (see figure 3).



Figure 3--Transit bus.

^{3/} A tachograph is an on-board paper recorder that monitors the driver's performance with respect to vehicle speed, driver hours of service, vehicle down time, and the number of vehicle stops made.

The driver's window and frame were missing as well as the sheet metal skin and vertical frame members past the front axle a distance of 7 1/2 feet. Damage extended inward approximately 27 inches; sideswipe damage extended 31 feet rearward from the front bumper. Damage to the interior of the bus was confined to the left front and extended rearward past the steering axle. The plywood floor decking near the driver's station was broken away from its anchorages.

The brake system hardware was inspected and the slack adjustments were measured. All service brakes were found to be adjusted in accordance with the manufacturer's recommended specification and no discrepancies were noted.

Passenger Car.--A postcrash inspection of the 1982 Cadillac four-door sedan was conducted on October 11, 1986. The damage was primarily confined to the left rear bumper, quarter panel, and trunk areas. The left side of the rear bumper and trunk lid were displaced forward about 6 inches. Contact damage was found on the bumper and trunk lid which extended from the car's center to the left. Both rear quarter panels and the trunk lid were shifted forward about 2 inches. (See figure 4.)

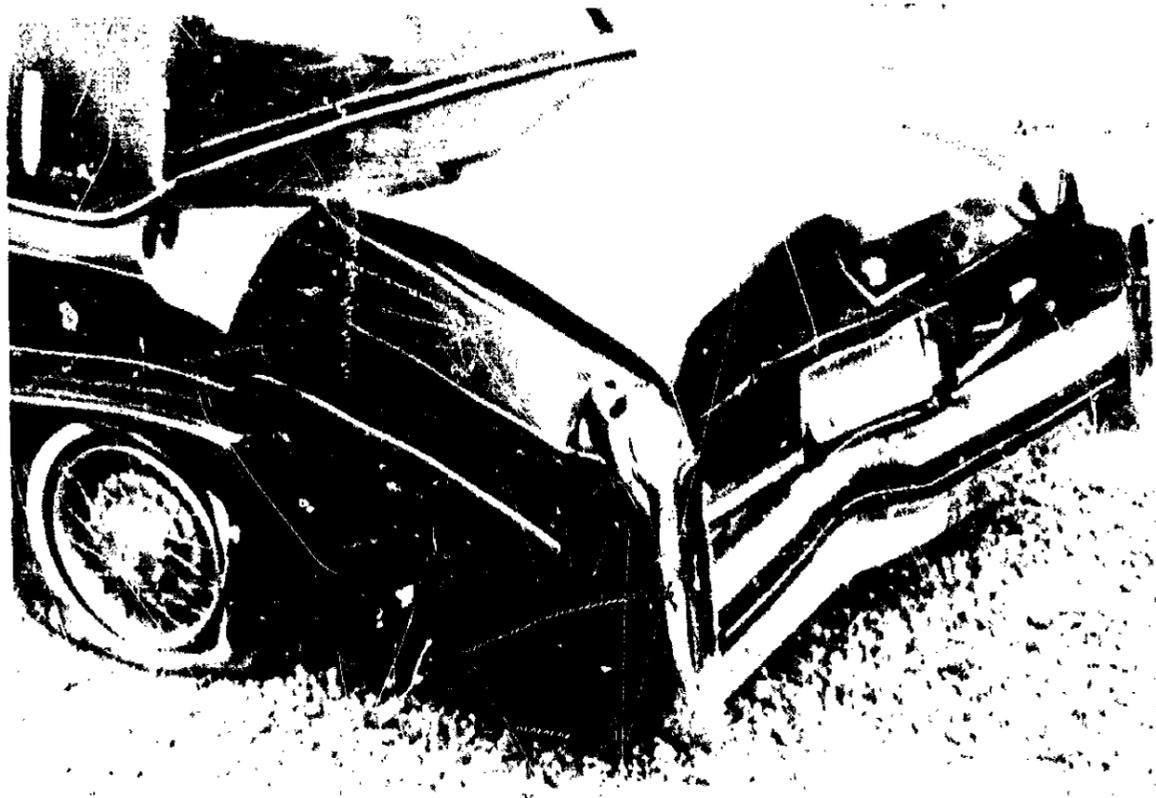


Figure 4--Passenger car.

Highway Information

SR 495 is a major east-west, limited-access highway that connects the New Jersey Turnpike (I-95) with New York City (via the Lincoln Tunnel), New Jersey Route 3, and U.S. Routes 1 and 9. The section of highway at the accident site was built by the Port Authority and opened to traffic in 1938. It was turned over to NJDOT in 1957. The highway was initially included as part of the interstate system and was designated as I-495. However, in 1979, the governor of New Jersey requested that the interstate designation be withdrawn; the highway is still part of the Federal-aid primary system.

The original highway consisted of two 32-foot-wide travel ways separated by a 5-foot-wide median and a deep rock cut. In 1957 the North Bergen viaduct was widened to eight lanes (four lanes in each direction). In 1968 the highway was resurfaced. In 1977 a New Jersey-type median barrier was constructed. The roadway was widened to 42 feet and resurfaced with asphalt concrete. A concrete T-type barrier delineates the right edge of the highway.

At the accident site near the westbound Kennedy Boulevard entrance ramp, the roadway slopes downward at a -4 percent grade from east to west. The westbound approach to the point of impact is approximately tangent with the lane lines slightly skewed to the right. The eastbound XBL lane contraflow lane^{4/} is tangent with the lane lines slightly skewed to the left. (See figure 5.) The skewed lines are in a transition area over 500 feet in length.

The roadway in the area where the accident occurred is within the construction work zone for rebuilding the North Bergen viaduct. In order to provide working room for the rehabilitation of the viaduct, the westbound traffic lanes were narrowed and shifted. At the point where the transition started (at the bull nose), ^{5/} the XBL lane was 11 feet and the adjacent westbound lanes were narrowed to 10 feet 3 inches. Due to construction zone restrictions and the entrance ramp from the Kennedy Boulevard, the temporarily reduced width travel lanes caused a potential area of congestion and required motorists to be alert. The westbound Kennedy Boulevard entrance ramp is normally closed during the construction period and operation of the XBL. However, on the morning of the accident, the ramp had not closed. Although the Port Authority Police were responsible for closing the ramp during morning rush hours, motorists often drove around the temporary barricades blocking the entrance ramp.

The average daily traffic was estimated at 121,360 vehicles in 1974 and was projected to be 124,200 vehicles in 1990; 14 percent of the traffic consists of trucks and buses. The design speed of the highway is 50 mph. The speed limit for both directions of traffic along SR 495 in the Township of North Bergen is 50 mph. Because of the reconstruction of the North Bergen viaduct, the existing speed limit was reduced to 35 mph.

^{4/} Contraflow traffic is opposing traffic in adjacent lanes separated by pylons and lane lines.

^{5/} A bull nose is the area immediately beyond the convergence of two roadways bounded by the edges of these roadways.

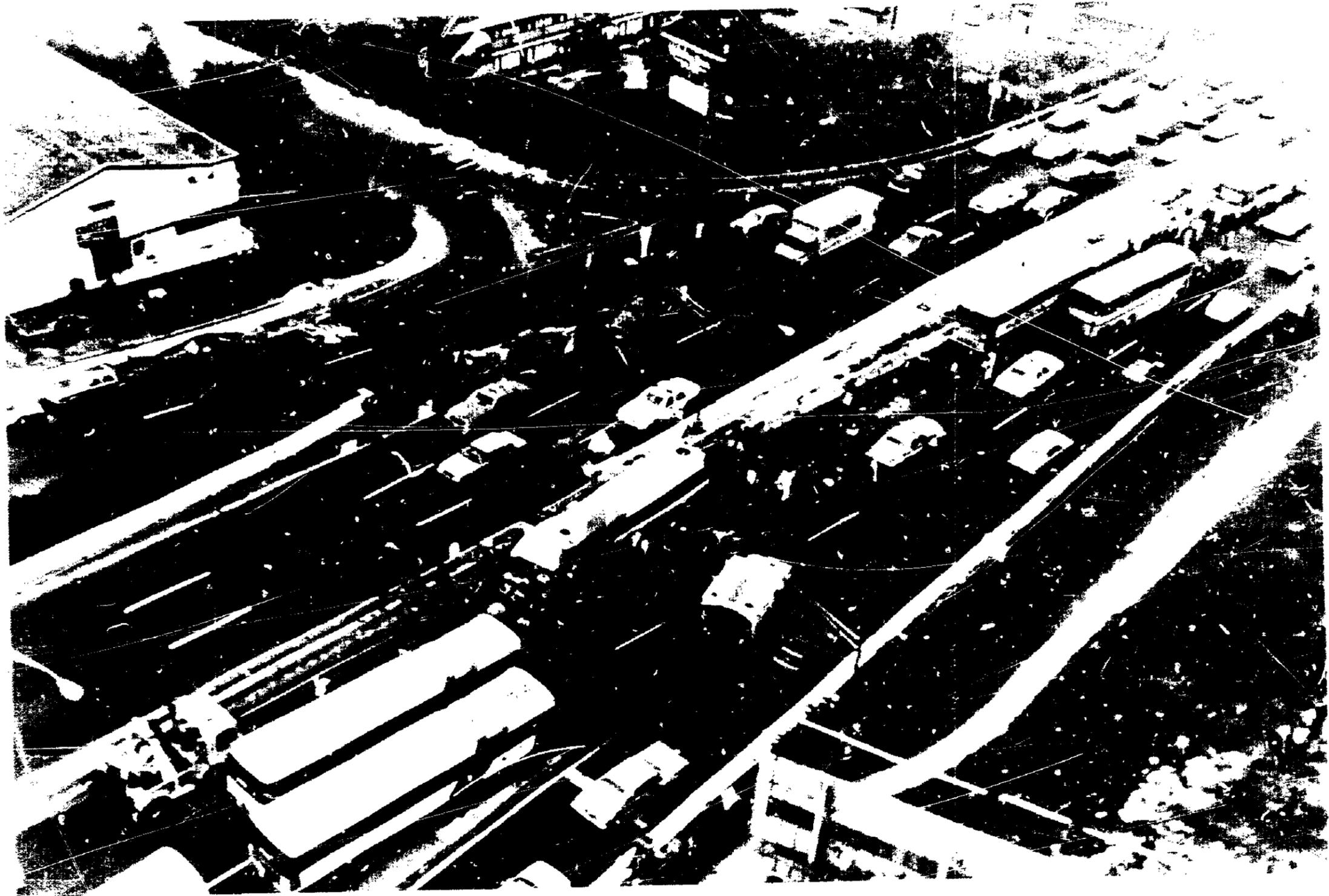


Figure 5--Aerial view of accident site.

Contraflow Lane.--The contraflow lane is a reserved traffic lane used for eastbound bus traffic into New York City. Operated exclusively for buses, it is a special eastbound lane operating over what is normally a westbound lane adjacent to the median and is open Monday through Friday from 0630 to 1000 (varies according to bus volumes). The contraflow lane is approximately 2 1/2 miles long and begins at the junction of SR 495 and the New Jersey Turnpike. During operation of the contraflow lane, the speed limit is 35 mph for buses in the contraflow lane and the conventional westbound traffic in the opposite direction.

Overhead lane signals control the traffic (a green arrow pointing downward for a lane open to traffic or a red "X" for a closed lane). In addition, there are two changeable message signs. Since March 1985, the signs have been controlled by the Lincoln Tunnel communications desk and verified by a police officer from the field. About 400 4-inch-diameter flexible cylindrical posts (18 inches high) are manually placed along the broken double yellow line to delineate the XBL lane when the lane is closed during the changeover operation from westbound "all-use" traffic to eastbound "buses only" traffic. The nominal spacing between cylinders is 40 feet; this spacing is decreased on curves, transitions, and other critical locations. At the time of the accident the cylindrical posts were spaced at 10-foot intervals.

Accident History.--From 1975 to June 1986 there were 18 personal injury accidents resulting from collisions between eastbound XBL buses and westbound vehicles in the 2 1/2-mile XBL segment. These accidents resulted in 4 fatalities and 76 injuries. Two of the fatal accidents involved pedestrians crossing the westbound lanes. The third fatal accident involved a motorist who suffered a heart attack while traveling in the westbound lane. The fourth fatal accident involved a motorist under the influence of alcohol.

North Bergen Viaduct Project.--The viaduct project was initiated by the NJDOT, Bureau of Bridges and Structures Design. The purpose of the project was to rebuild the median lane which had been decked in 1957 to provide an extra lane from the east end of the viaduct to the ramps leading to the New Jersey Turnpike and New Jersey SR 3. Besides redecking the median lane, rehabilitation included reconstructing the underlying steel girders and columns below the median lane, strengthening several crossbeams, repairing worn bearings, and widening the travel way. The design was done by Hardesty and Hanover, consulting engineers under contract with NJDOT. The project was divided into two stages.

Stage I of the project included widening the westbound lanes on the north side of the viaduct so that during Stage II, the XBL could be shifted to the north to allow work to be done underneath the existing bus lane.

In order to widen the travel way for Stage I, a temporary (portable concrete) barrier was installed along the north side of SR 495 from a point on the entrance ramp from Kennedy Boulevard to a point on the ramp leading to New Jersey SR 3. The ramp to U.S. Routes 1 and 9 northbound was closed while the ramp to U.S. Routes 1 and 9 southbound remained open. Traffic over the viaduct was reduced from four to three lanes. This created a work area 16 feet wide separated from westbound traffic by a temporary safety barrier along the north side of the viaduct.

Stage II involved removing the deck of the XBL and constructing a new one. For this construction, the temporary barrier was removed along the north side of the viaduct (but not east of the bridge abutment), while additional temporary barriers were placed parallel to the median barrier to provide a work zone for the reconstruction of the XBL. This stage required the realignment of the striping through the work area and the boring of new holes for the 18-inch-high cylinders (4 inches in diameter) delineating the XBL.

The original traffic control plan for Stage II of the viaduct project showed the temporary median barrier on the westbound roadway to start at the west edge of the pedestrian bridge or east of the end of the divisional island (bull nose) between the entrance ramp from Kennedy Boulevard and the westbound lanes of SR 495. The supervising engineer for Region II, Design, considered the plan drawing as conceptual only. The resident engineers, in an attempt to alleviate a lane-width problem identified in the field beginning east of the gore, actually installed the barrier farther west by 100 feet or approximately opposite the lane-width problem at the gore. Consequently, NJDOT made a change in the plans to relocate the beginning of the temporary barrier approximately 50 feet farther west. The terminal taper of the temporary median barrier was 50:1. The striping shown on the revised plan ("Construction Barrier Curb Transition Westbound Approach," dated July 23, 1986) indicated that the width of the XBL lane in the work zone was 12 feet and the width of the center lane was 11 feet at the point where the transition started. The plan further indicated the width of the XBL lane to narrow to 11 feet at a point approximately 120 feet to the east of the start of the transition.

The lane striping in the work zone at the time of the accident is shown in figure 6. A straight line drawn from the west end of the XBL broken-double yellow line opposite the end of the bull nose to the east end of the fourth marking west of the bull nose indicates that the striping and pylons at the time of the accident bowed northerly up to 2 feet over a distance of 165 feet from the intended alignment. The broken-double yellow line is shown on the temporary striping plan is straight and parallel to the temporary median barrier.

An overhead variable message sign faces westbound traffic as it leaves the Lincoln Tunnel. During operation of the contraflow lane the message states, "LEFT 2 LANES CLOSED/ 2-WAY TRAFFIC." In addition to the overhead signs, at least seven temporary and permanent signs are posted along the westbound approach from the Lincoln Tunnel to the accident site advising motorists of road construction ahead, of speed limit conditions when the left lane is closed, and about keeping to the right except to pass. At least five permanent signs were posted along the XBL eastbound approach to the accident site advising motorists of bus lane speed limits and road direction information. (See appendix E for details.)

On the single entrance ramp from Kennedy Boulevard, the following signs were in place where traffic merges with the westbound traffic: "SPEED LIMIT 25," "STOP AHEAD" (one on each side of the ramp), "STOP," and a symbol "YIELD" sign facing ramp traffic. The "STOP" sign had been installed as part of the traffic control plan necessary during the rehabilitation of the North Bergen viaduct. The plan did not call for the removal of the "YIELD" sign--an obvious omission. After the accident, it was removed.

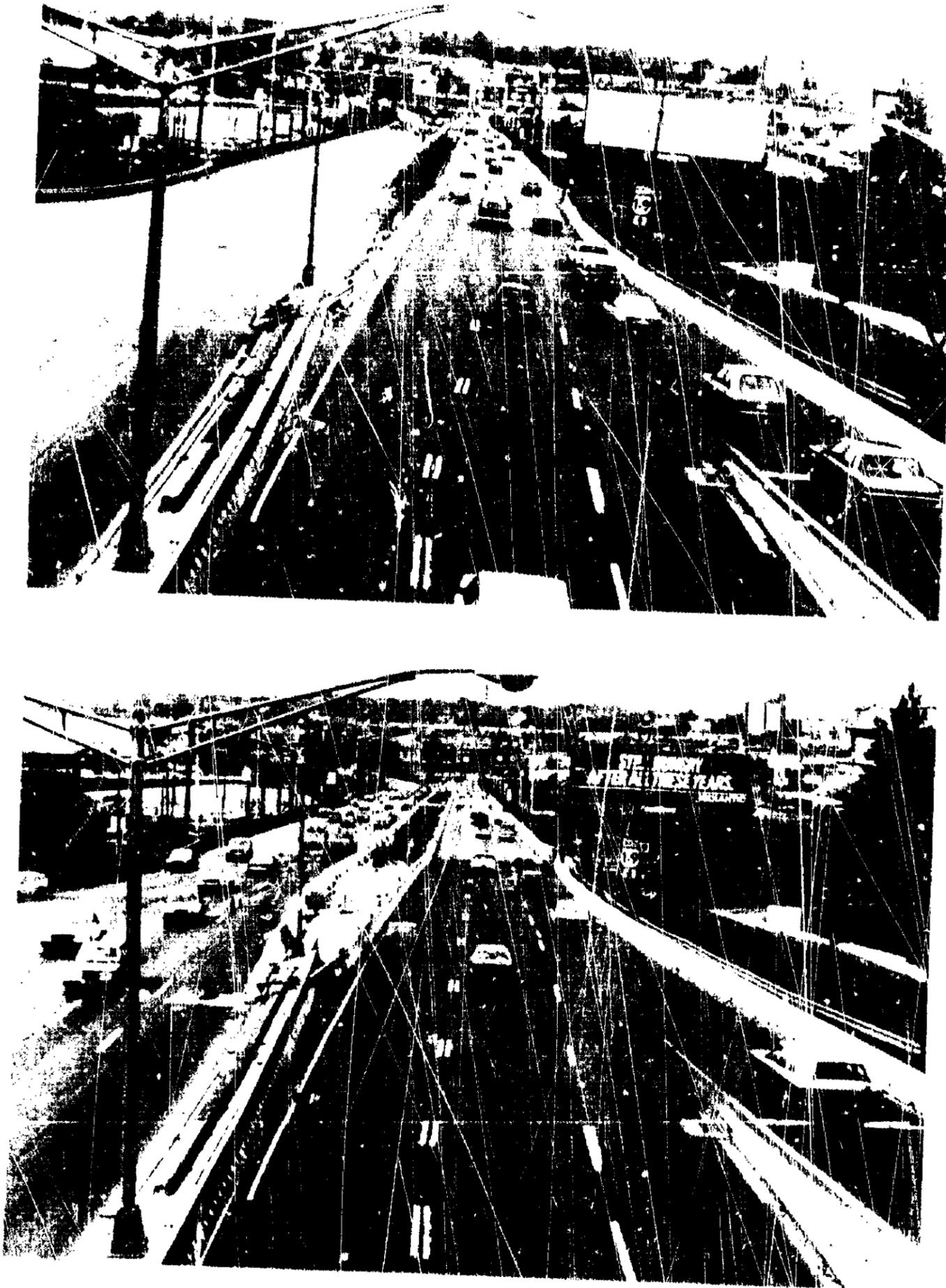


Figure 6 --Lane striping at the time of the accident (top) and changes made after the accident (bottom).

Federal/State Oversight of Construction Work Zones

Title 23 Code of Federal Regulations Part 630, Subpart J provides guidance and establishes procedures to assure that adequate consideration is given to motorists, pedestrians, and construction workers on all Federal-aid construction projects. The Federal Highway Administration (FHWA) directed that the regulation take effect under their transmittal 284, HHO-32 dated October 13, 1978. It is published as part of the Federal-Aid Highway Program Manual under Volume 6, Chapter 4, Section 2, Subsection 12 (FHPM 6-4-2-12).^{6/}

In February 1981 the NJDOT formally updated its procedure for the safety of motorists, pedestrians, and construction workers in highway and street work zones. The responsibilities were defined for persons involved in the planning, designing, implementing, and monitoring of the Traffic Control Plan ^{7/} (TCP) projects that use Federal funds. For the North Bergen viaduct project, the Region 2 Design Office had the responsibility for approving the TCP.

The Bureau of Traffic Engineering under the NJDOT TCP procedure is required to review all traffic control schemes, stage construction plans, proposed detours, and related specifications. The bureau reviewed the traffic control plans for the North Bergen viaduct project and a person from the bureau made field visits to the site.

In accordance with the TCP procedures, on August 26, September 9, and September 22, 1986, an inspector from the District II local aid office had inspected the North Bergen viaduct project under the TCP configuration which existed at the time of the accident. The inspector rode the project in the right westbound lane and did not leave his vehicle. He spent about 1 hour on each inspection. At the Kennedy Boulevard entrance ramp he did not notice the bowing of the broken-double yellow line (contraflow striping).

A night inspection was made by the local aid inspector on October 4, 1986, but it did not include the viaduct; instead, the inspection verified the times the westbound roadway over the viaduct had to be closed.

The local aid inspector who checked the TCP in August and September 1986 had been employed with NJDOT in this capacity since 1985, had received most of his safety training while on the job, and had attended a 3-day NJDOT course in safety in December 1985.

Each year, the NJDOT selects a representative sample of about 25 construction projects to cover the range of work zone conditions, project size, locations, and highway systems across the State to include in their annual TCP inspection program. These work zones are then reviewed in-depth under daylight and nighttime conditions relative to the TCP treatments and traffic control devices used for traffic flow and safety.

^{6/} NJDOT's procedure for complying with FHPM 6-4-2-12 was approved by FHWA by letter dated May 3, 1979.

^{7/} The TCP was designed by the consultant who did the design for the reconstruction of the viaduct. However, the design was reviewed by NJDOT.

The FHWA Division office in turn reviews the State's implementation of its TCP process annually for compliance with the approved procedures.

The North Bergen viaduct construction project was under Certification Acceptance (CA) as set forth in 23 CFR Part 640. In accordance with the approved CA procedures in New Jersey, the FHWA division area engineer, who was involved in the design phase of this project, did not have the occasion or cause to specifically visit this construction job site.

The Division Office Safety Coordinator (SC) is a participating member of the NJDOT's TCP inspection team. The SC also provides oversight comments and recommendations to the division administrator to support the FHWA acceptance of NJDOT's annual TCP review program. The division office evaluation of the TCP process is on an overall program review basis and is generally not project-specific except where the construction is otherwise inspected by FHWA personnel.

In their 1985 review and approval of the NJDOT TCP, the FHWA expressed reservations concerning the effectiveness of the local aid safety investigators and resident engineers in monitoring TCPs. The review stated, "...the TCP team review found shortcomings [of operating TCPs] which should have been noticed and already corrected through the efforts of Resident Engineers and the Local Aid Safety Investigators." NJDOT reviewed the procedures, found them to be adequate, and did not make any changes.

Medical and Patnological Information

Twenty-three passengers on board both buses sustained minor injuries consisting of multiple contusions, abrasions, and superficial lacerations to the face, head, and extremities. Four transit bus passengers were admitted to the hospitals. Two passengers sustained serious injuries including fractures of the ankle, face, fingers, hand, forearm, lower leg, and collarbone. One passenger sustained severe injuries consisting of a subarachnoid hemorrhage and cerebral concussion.

The fatally injured passenger was seated on the left side in the third window seat of the transit bus. Rescuers attempted to provide medical assistance; however, the passenger died at the scene. An autopsy was later performed and it revealed that the cause of death resulted from comminuted fractures on the skull, transection of the base of the skull, and a subdural hemorrhage.

Regulations Governing the Operation of Commercial Buses

Busdriver Qualifications.--The State of New Jersey's criteria for persons applying for a commercial bus operator's license in New Jersey are the same as the Federal requirements for drivers in interstate operations set forth in the Federal Motor Carrier Safety Regulations (FMCSR). (See the next subheading for discussion of these requirements.) Applicants must also successfully complete a road test administered by a State Department of Motor Vehicles inspector or by a qualified carrier.

Busdrivers operating in interstate commerce are subject to the prescreening requirements set forth under FMCSR, Title 49 CFR Section 391.11, Subpart B. In summary, to be qualified, an applicant must be at least 21 years old, read and speak the English language well enough to converse with the general public, successfully complete a road test administered by the motor carrier in the type of vehicle the applicant would be hired to operate, be medically qualified to drive, have a valid driver's license, and take a written examination which is also administered by the carrier (although it is not necessary to pass the written examination). The applicant must also complete and provide to the motor carrier an application for employment. Federal regulations specify the information that the application must contain, including a list of the names and addresses of the applicant's previous employers, a list of previous motor vehicle accidents, and a list of violations of motor vehicle laws and ordinances (other than parking violations) -- all for the 3 years before the date of the application.

Motor Carrier Operations.--The New Jersey Public Utilities Commission grants operating authority to motor carriers operating buses in the State. In addition, all motor carriers must comply with applicable vehicle registration, vehicle inspection, and driver licensing requirements. They must also maintain adequate records concerning driver qualifications, vehicle inspection, and maintenance as specified in the State of New Jersey Motor Vehicle Code.

Motor carriers engaged in interstate commerce are subject to the requirements set forth under the FMCSR Parts 390 through 399. The motor carrier must maintain a qualification file and a personnel file on each driver. (These files may be combined.) Part 391.51 of the FMCSR requires the motor carrier to retain, among other things, a medical examiner's certificate (or a copy) of the driver's physical qualification to drive, a note showing the company has conducted an annual review of the driver's driving record, a list of the driver's violations of motor vehicle laws and ordinances, the driver's employment application, the responses of State agencies and past employers to inquiries made at the time of the driver's application for employment, a certificate of the driver's carrier-administered road test, and a certificate of written examination, along with the questions, which were supplied by the FHWA, and the driver's answers.

The FMCSR require the motor carrier to make an inquiry into the driver's driving record in each State in which the driver has held a motor vehicle license and to make an investigation of the driver's employment record. These checks are to cover the 3 years before the date of employment and must be done within 30 days of the commencement of the driver's employment.

The motor carrier must also comply with the requirements outlined in Part 394 concerning the notification of accidents involving their vehicles, the limitations for maximum driving and on-duty time specified in Part 395, and all vehicle operation, maintenance, and equipment requirements specified in Parts 390, 392, 393, and 396.

E. Vanderhoof and Sons Company Operations

E. Vanderhoof and Sons, a family-owned and operated business for over 50 years, has its principal place of business in West Orange, New Jersey. The carrier primarily provides charter service for the east coast and local commuter

service in and around the Newark, New Jersey area. The carrier has Interstate Commerce Commission (ICC) operating authority in 48 States. At the time of the accident the company was operated by a general manager who supervised the administrative staff, maintenance operation, and busdrivers. Company maintenance operations are carried out by a staff of nine employees who work a staggered 12-hour shift. Bus maintenance and repairs are supervised by a maintenance manager and a foreman who are assisted by two mechanics, three helpers, and two cleaners. Company officials indicated that the bus fleet consists of 20 buses--10 over the road or coach-type buses, 2 suburban buses, and 8 transit buses. The company also employs 30 full-time drivers.

Safety Board investigators interviewed company officials and employees with regard to company policies and procedures. The carrier had no written guidelines which governed the hiring, training, or supervision of busdrivers. There are no company policies concerning the use of seatbelts by drivers. Federal regulations do require that seatbelts be installed and used by drivers engaged in interstate commerce.

The carrier's practice was to hire experienced drivers. Although a road test and past employment verification was done, the carrier did not provide preservice or in-service training for drivers. New driver performance was evaluated by the carrier primarily by other drivers who accompanied driver candidates on charter trips that require two buses. Customer complaints, commendation letters, notification of traffic violations or accidents by the driver, and ride-alongs by company supervisors can also be considered in the evaluation process. The carrier had no formal policies on disciplinary procedures for busdrivers.

A review of the driver qualification files for several current drivers revealed that the recordkeeping system employed did not include the driver background information, past employment check, road test information, or written examination as required by Federal regulations.

The carrier had no formal policy concerning the use of CB radios. However, 10 of the buses were equipped for CB radio operation. The general manager for the company testified during the Safety Board's public hearing that 10 full-time and 2 part-time busdrivers used CB radios while driving company-owned buses.

DeCamp Bus Lines Operations

DeCamp is a regional transit bus carrier that was established in 1870. Originally known as the DeCamp Stages, it is a family-owned corporation operating under ICC authority in New York and New Jersey. The carrier's primary service is providing commuter transportation from the northern New Jersey suburbs to New York City and limited charter service. The carrier's principal place of business is Montclair, New Jersey. Company management is provided by an operations staff and a maintenance department. The carrier is staffed by about 135 employees and operates 78 transit buses.

The operations manager is responsible for the hiring, training, testing, and supervision of the company's 60 full-time and 14 part-time busdrivers. In testimony provided in the February 12, 1987, public hearing conducted by the Safety Board, the operations manager outlined the carrier's policy regarding the hiring of busdrivers. On receipt of an application and medical certificate, the operations manager reviews the application. If the applicant appears qualified, the operations manager schedules a road test with the carrier's safety officer. Driver applicants who pass the road test work with an experienced company driver for 2 weeks after which they are evaluated for retention. In addition, the new drivers must complete a 60-day probationary period before the driver is placed on permanent status. Employment verification by the carrier was initiated by mail or telephone on each applicant accepted for probationary employment. Additionally, the applicant driver's license and traffic violation record are requested through the NJDOT by the carrier in accordance with State and Federal statutes. Copies of company policies and rules are provided to the drivers when they are hired.

A maintenance supervisor oversees the carrier's 17 maintenance and 10 cleaning employees in the six-bay maintenance shops. There are seven journeyman mechanics, seven apprentice mechanics, and three general laborers who receive in-house on-the-job training by the maintenance supervisor. Supplemental training for journeyman mechanics is provided through industry-sponsored schools.

Oversight of Carriers

State.--The New Jersey State Police maintain a Motor Carrier Inspection and Enforcement Branch which, at the time of the accident, was limited to the enforcement of traffic violations and the enforcement of hazardous material regulations. Since the accident, the State has expanded its enforcement role to include conducting roadside safety inspections, driver hours of service requirements, and qualification requirements in accordance with the provisions of the FMCSR that have been adopted as part of the New Jersey State Code in accordance with the provisions of the Motor Carrier Safety Assistance Program.

The NJDOT is responsible for performing semiannual inspection of commercial vehicles and investigating carrier complaints, and accidents involving commercial vehicles. According to the officials of NJDOT, semiannual inspections had been conducted on vehicles operated by the motor carriers involved in the accident. However, no audits had been performed on the carrier's driver qualification files.

Federal.--The U.S. Department of Transportation's Office of Motor Carrier Safety (OMCS) is charged with the oversight and enforcement of the FMCSR. The OMCS normally conducts safety audits to determine if carriers are complying with the FMCSR. Occasionally, the OMCS also conducts safety audits after a carrier is involved in a serious accident.

On October 28 and 29, 1986, the OMCS conducted a postaccident safety compliance review on the E. Vanderhoof and Sons Company. OMCS investigators testified during the public hearing that the carrier audit revealed 21 violations in the following areas:

1. failing to require drivers to furnish list of motor vehicle traffic violations for at least 12 months;
2. using a physically unqualified driver;
3. failing to retain proper records in the driver's qualification file such as the medical examiner's certificates on drivers and copies of inquiries on driver employment histories; and
4. failing to keep maintenance records on vehicles operated in interstate commerce.

As a result of this review, the carrier was rated overall as satisfactory. Before this review, the carrier had never been audited by the OMCS.

During the postaccident safety compliance review, it was discovered that the driver of the accident charter bus had a distance visual acuity for the left eye which did not meet the minimum Federal specifications (actual 20/50; criteria 20/40). On December 16, 1986, the OMCS sent the charter busdriver an official notice of driver disqualification. The charter busdriver was retested by a licensed optometrist, and it was determined that his distance visual acuity in the left eye was 20/40. Based on the new test results, on January 21, 1987, the OMCS rescinded its previous letter of disqualification, permitting the busdriver to engage legally in interstate commerce again.

On October 17 and 21, 1986, a safety compliance review was conducted on the DeCamp Bus Lines. The review uncovered a total of 11 violations in the following areas and the carrier was rated overall as "conditional":

1. using a driver who has not completed the written examination;
2. failing to investigate driver's employment history;
3. failing to maintain copies of inquiries on driver employment histories in the driver's qualification file; and
4. failing to give immediate notice to FHWA of a fatal accident.

Motor carriers can receive a rating of "satisfactory," "conditional," or "unsatisfactory" during an in-depth audit. Carriers who receive less than a satisfactory rating will be placed into the OMCS Selective Compliance and Enforcement (SCE) program. Carriers are placed into this program when they have inadequate safety management controls, are not in compliance with safety regulations, or are experiencing high preventable accident rates. A followup compliance review will be performed on all carriers placed in the SCE program. The compliance review will provide a basis for changing a prior rating, designating a carrier for future selective monitoring, or initiating enforcement action, if necessary. In New Jersey, followup compliance reviews would not be scheduled for carriers that are rated "conditional" until all compliance reviews for carriers with unsatisfactory ratings have been completed.

The OMCS had previously conducted a safety compliance review on DeCamp Bus Lines in January 1984 and rated the carrier satisfactory at that time.

Tests and Research

Highway.--Safety Board investigators surveyed the roadway near the accident site with a laser transit and were able to establish the dimensions of the roadway, as well as the location of the roadway, lane lines, and other items of evidence. Additionally, the roadway was mapped with "perspective photographs." This photographic technique used four points in the photograph whose location relative to each other was established with measurements taken with the laser transit. Using these control points a three-dimensional grid was established.

Vehicle.--After the accident the tachograph chart was removed from the transit bus and examined. The chart indicated that at the time of the accident the transit bus was traveling at about 32 mph when impact occurred (jolting the tachograph stylus). The tachograph read 7:32 a.m. when it stopped working. (See figure 7.)

Other Information

In January 1980, the FHWA issued a "Notice of Policy" encouraging the use of CBs as an in-vehicle communication system. The notice stated that CBs can offer a significant contribution to safety and emergency service on the nation's highways. The Federal policy was also adopted by the ICC and the Federal Communications Commission.

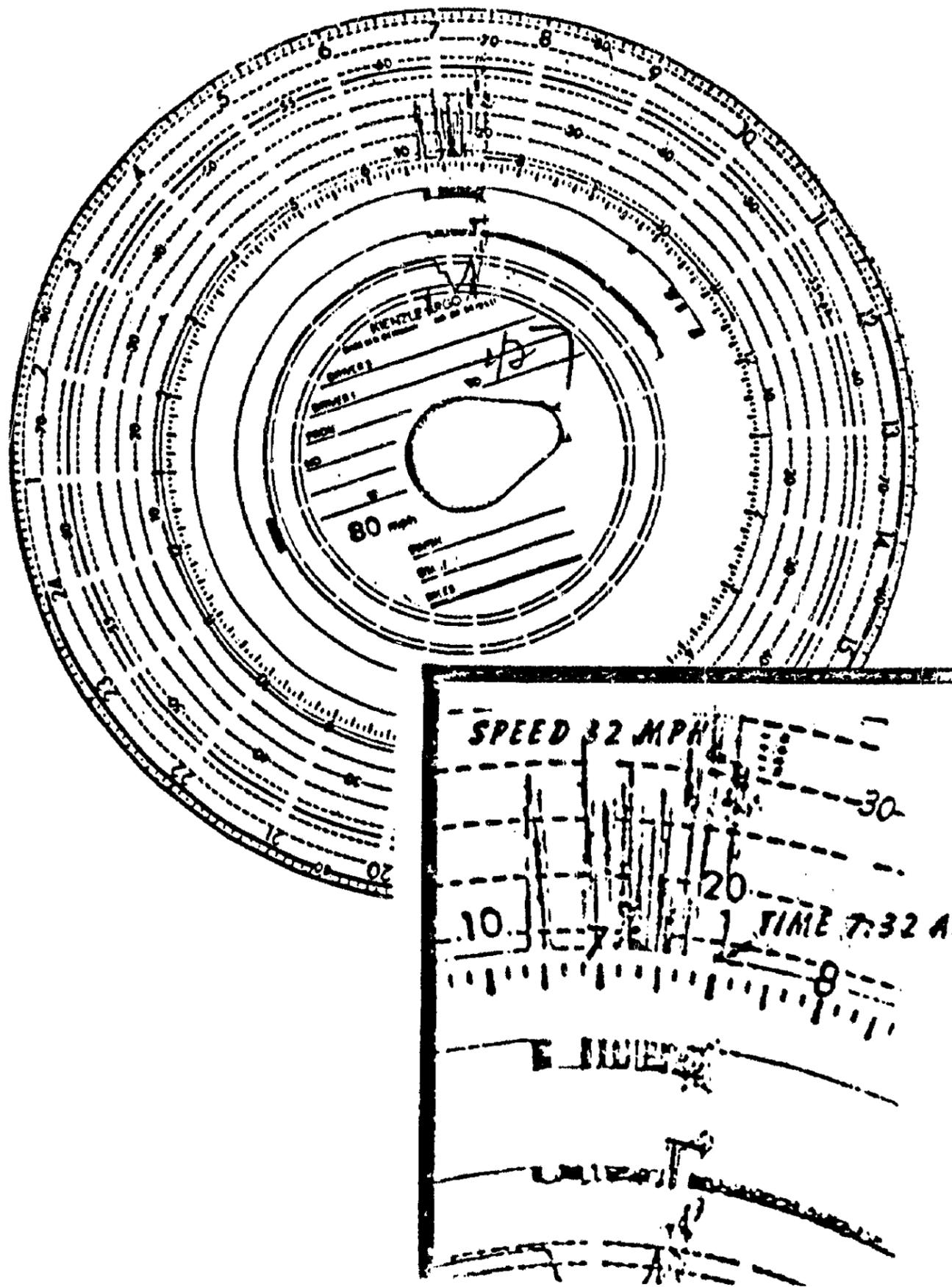


Figure 7. Tachograph card removed from DeCamp commuter bus.

ANALYSIS

It is unlikely that fatigue or busdrivers' familiarity with the operation of their buses were factors in this accident. Both drivers were experienced in operating commercial buses and had driven the accident buses or similar vehicles previously. Both drivers had rested normally the night before the accident and were working within their normal routine schedules when the accident occurred.

The service brakes on the drive axle of the charter bus were out of adjustment. However, the absence of visible brake marks at the scene indicate that the busdriver probably did not attempt to use his service brakes fully during the accident sequence. In view of this, it is unlikely that the reduced braking capability of the charter bus was a factor in this accident.

The Accident

Witness statements indicate that the charter bus was traveling westbound on SR 495 in the right lane when it suddenly veered leftward. Based on the damage patterns of the accident vehicles, the charter bus struck the left rear of the passenger car and then sideswiped the left front and left side of the transit bus. Based on the witness statements and physical evidence (debris and tire marks) on the roadway, the charter bus initially struck the passenger car in the center westbound lane, then veered leftward, and sideswiped the transit bus in the XBL eastbound lane.

The Safety Board concludes that the transit bus was traveling about 32 mph when impact occurred based on its recorded tachograph chart measurements and estimates that the charter bus was traveling between 20 and 30 mph when it sideswiped the transit bus. The estimate is based on the fact that neither driver fully applied his brakes after impact (since no brake marks were observed onscene), the tire to pavement coefficient of friction at the accident site was no more than 0.4 in the light braking situation, and that minimal momentum was lost in the previous collision between the charter bus and the passenger car. The speeds of the buses were also corroborated by driver statements and traffic conditions at the time of the accident.

At the time of the accident, it would have been extremely difficult for the transit busdriver to make an avoidance maneuver after realizing that impact was imminent. Near the accident site the lane width in the XBL was reduced from 11 feet to 10 feet 3 inches and bus traffic was very heavy. The only other options for the transit busdriver would have been to veer leftward into the opposing westbound traffic lanes or to veer rightward into the concrete barrier.

In an attempt to determine why the charter busdriver veered abruptly into the center lane, the Safety Board considered several scenarios that may have precipitated the accident. The charter busdriver alleged that a passenger car entered SR 495 (supposedly from the Kennedy Boulevard entrance ramp) and pulled in front of him before stopping in traffic. It would have required considerable skills on the part of the passenger car driver to move the car from the entrance ramp, accelerate between two moving buses in the right westbound lane, and maneuver his car into the center westbound lane before stopping.

In addition, a witness who testified at the Safety Board's public hearing stated that while she was waiting to enter the flow of traffic at the Kennedy Boulevard entrance ramp, she did not see any automobiles ahead of her nor did any pass her. Another witness, who was driving a transit bus behind the westbound charter buses, reported that she did not see a passenger car enter either the roadway at the Kennedy Boulevard entrance or cross from the right to the center westbound lanes.

It is also possible that the charter busdriver could have intentionally moved from the right to the center westbound lane on SR 495 as he approached the Kennedy Boulevard entrance ramp. Normally the entrance ramp was closed during the XBL operation period. However, on the morning of the accident the ramp was not closed. Incoming traffic entering SR 495 from the ramp was heavy and had caused considerable congestion in the area. The charter busdriver may have perceived this and decided to move from the right lane to the center westbound to avoid the incoming traffic.

However, the accident bus had been following the lead charter bus for at least 1 1/2 miles on SR 495 in the right lane because he was not familiar with the routes to Washington, D.C. Also, neither busdriver had been observed moving from lane to lane on SR 495 until they reached the accident site. Thus, it is unlikely that the accident charter busdriver would have moved into the center westbound lane independent of the lead bus unless his performance was influenced by some other factor. A more plausible explanation that might account for the charter busdriver's actions is that his attention may have been diverted as he approached the accident site.

Because the traffic lane widths were restricted on the westbound approach to the accident site to 11 feet, it was imperative that the busdriver commit his full attention to his duties. The charter bus was approximately 8 feet wide and had only 1.5 feet on each side to maneuver within the lane. Any slight movement to the left could easily cause the bus to encroach on the traffic in the center westbound lane.

Inattention/Distraction.--The charter busdriver was most likely distracted from his driving duties while he was helping a passenger use the CB radio. When the buses cleared the Lincoln Tunnel, the lead charter busdriver asked the charter busdriver to put the assistant tour leader of the Austrian touring group on the CB radio. To explain the operation of the CB radio to the Austrian assistant tour leader, the busdriver had to identify the person to whom he was speaking, wrap the cord behind his head to enable his passenger to use the microphone radio, and drive within narrow traffic lanes with commuter traffic at the same time. His instructions to the assistant leader probably were more difficult because the Austrian spoke limited English.

Although the charter busdriver testified that he simply gave the microphone to the passenger and told him to "press the lever and talk," it is probable that some additional instruction on the use of the CB was necessary as well as identifying the person with whom he would be speaking. The tour escort seated immediately behind the driver's position observed the charter busdriver passing the microphone and giving instructions to the assistant leader of the tour group

just before the collision. In view of this, the Safety Board concludes that the interaction between the charter busdriver and the assistant tour leader may have temporarily distracted the busdriver and prevented him from paying full attention to his driving duties.

Medical Factors.--At the time of the accident, the charter busdriver was not qualified to drive commercially because his left eye exceeded 20/40 for uncorrected distance vision. The physician who performed his April 1986 physical examination did not limit his medical certificate with "qualified only when wearing corrective lenses." The physician explained that an arrangement had been made with the charter busdriver that would enable the driver to continue working while he obtained an appointment with an optometrist. However, the charter busdriver did not consult with an optometrist until October 1986.

The charter busdriver was retested by an optometrist and it was determined that his distance visual acuity for the left eye was 20/40 and within the limits specified by the FMCSR. The OMCS later requalified the busdriver in January 1987. It should be noted that the variability between 20/40 and 20/50 is not uncommon, and this probably accounts, in part, for his physician's attempt to be cooperative. In addition, because the charter busdriver was well rested, he had just begun his trip, and the visibility at the time of the accident was good, it is unlikely that the driver's eyesight caused or contributed to this accident.

Training and Experience.--The charter busdriver was not formally trained in his bus driving skills. According to testimony at the public hearing, he began driving a church bus and sometime later received on-the-job training from other busdrivers at E. Vanderhoof and Sons. Although he acknowledged that part of his experience with buses had been in service and maintenance, he was frequently required to move the buses in and around the garage areas. Most of his experience with driving buses on the road was with another company where he drove 8 to 10 days a month for 17 years. There is no indication that he received any instruction that would provide insight into either the value of undivided attention to driving tasks or that he was aware of alternative ways to handle situations involving a passenger using the bus-to-bus communication system. Although the charter busdriver had received no formal instruction for his driving tasks, he had accumulated 18 1/2 years of commercial driving experience and was considered qualified as a road driver through his previous driving experience.

Use of CB Radios

The Safety Board has investigated at least one previous accident involving the use of CB radios by commercial drivers. On August 27, 1981, a tractor-semitrailer loaded with steel pipe was traveling across a bridge on Interstate 10 near Lake Charles, Louisiana, when the tractor's left fuel tank was punctured by a dislodged steel plate used as a temporary cover for a bridge expansion joint.^{8/} As a result of the puncture, 75 gallons of diesel fuel leaked on to a 1/2 mile section of highway and caused 26 vehicles to be involved in a series of collisions. Three persons were killed and 18 persons were injured in the collisions.

^{8/} For more detailed information, read Highway Accident Report--"Truck Engine Fuel Tank Puncture by Bridge Repair Plate, Diesel Spill, and Multiple Vehicle Skidding Collisions, Interstate 10, Lake Charles, Louisiana, August 27, 1981," (NTSB-HAR-82-4).

The investigation disclosed that the CB radio network was beneficial in providing advance warning of the presence of the diesel spill to some truck drivers approaching the accident site. These drivers were able to react more appropriately to the diesel fuel spill once they entered it.

As a result of its investigation into the Lake Charles, Louisiana, accident, the Safety Board on July 15, 1982, recommended that FHWA:

H-82-25

Issue an On-Guard Bulletin to advise truckdrivers of the circumstances of this accident and the potential benefits to be derived from the use of the citizens band radios, when properly used, and encourage positive reaction to messages that are transmitted over this network.

In its response to this recommendation, dated November 23, 1982, the FHWA indicated that it had commissioned the National Academy of Sciences, Transportation Research Board (TRB) to conduct a study that would investigate the effects of CB radio use on commercial bus safety, on passenger safety, and on the health and convenience of the bus industry. Since the findings of the study potentially had application to all commercial carriers, the immediate issuance of the On-Guard Bulletin was postponed.

In a follow-up response to Safety Recommendation H-82-25, dated December 4, 1985, the FHWA indicated that the TRB study entitled "Study of Safety Benefits and Cost of Using Citizen Band Radios on Intercity Buses" had been completed. The study concluded that the use of CB radios on intercity buses does not appear to encourage speeding, to distract or stimulate drivers, or to annoy passengers. The study also concluded that there was no evidence of a significant number of on-board or external incidents or accidents which might have been ameliorated by the use of the CB radio. The study recommended that the previous Federal Policy, dated January 1980, remain unchanged, and that individual carriers should determine for themselves whether or not commercial drivers should use CB radios while on the job. The FHWA also indicated in its response that they had published an On-Guard Bulletin entitled "CB's: A Safety Tool" which highlighted the results of the TRB study. This safety recommendation has been classified as "Closed--Acceptable Action."

Highway Issues

Signing.--Although it is doubtful that proper signing would have affected the outcome of the accident, deficiencies in the placement of the signs were noted at the time of the accident. For example, the "STOP" and "YIELD" signs facing westbound traffic coming from the Kennedy Boulevard entrance ramp probably had no effect on the accident. There was no sign indicating that there was an abrupt lane shift in the work zone due to the misalignment of the double yellow striping. Such a sign is not required in the Federal Manual on Uniform Traffic Control Devices (MUTCD), but NJDOT has been using a sign to designate lane shifts on construction projects for several years. It is normally used when the lanes are shifted so that a shoulder is used as a travel lane. On many interstate projects,

officials have used a modified reverse curve sign (WI-4). NJDOT and some other States and jurisdictions have depicted lane shifts by using parallel reverse curve symbols on an orange diamond background and have placed this sign in advance of a lane shift(s). The number of parallel reverse curves indicate the number of lanes shifted.

Interviews with FHWA personnel both at the division and headquarters level indicated that the lane-shift sign may be an effective traffic control device since it appears to meet the basic requirements of such devices, by fulfilling a need; commanding attention; conveying a clear, simple meaning; and commanding respect of road users. As a result of the Safety Board's verbal communication with FHWA, the FHWA has decided to test the "Lane Shift" sign on its driver simulator at its research laboratory in McLean, Virginia. If the results are positive, as expected, FHWA will formally consider the sign for inclusion in the MUTCD this fall.

Striping.--According to the MUTCD, special care should be taken in applying traffic control techniques in construction areas. This apparently was not done in the signing or the striping. In the striping of the lane shift, the broken-double yellow line bulged out up to 2 feet from the intended alignment.

The bulge in the broken-double yellow line caused a narrowing of the lane adjacent to center lane. Before the transition started, the width of this lane (about 11 feet) was already below recommended guidelines of 12 feet established for limited access highways. The minimum width of 10 feet 3 inches in the transition area left little clearance space for the buses and trucks using this lane.

The NJDOT corrected the misalignment a few days after one of its traffic engineers made a site review with a Safety Board highway investigator. The traffic engineer straightened the line by moving the first three broken-double yellow lines west of the bull nose. No changes were made to the alignment of the white dashed lane line. The realignment widened the center lane and brought the lane widths into conformance with the originally designed detour lane widths.

Accident History.--The accident record of the contraflow lane does not indicate that the XBL was a significant hazardous operation. Since 1975 there have been four fatal accidents on the SR 495 approach to the Lincoln Tunnel involving the contraflow lane. Two of the accidents involved a bus in the XBL striking a pedestrian who was illegally attempting to cross the highway. Two other accidents involved westbound vehicles, whose drivers were physically impaired or incapacitated, that veered from the adjacent westbound lane into the XBL traffic. In view of the fact that the roadway accommodates relatively high density traffic (in both directions) on the westbound side in morning rush hours and has had a relatively low accident record during the 16 years of the XBL operation, it is unlikely that the operation of the XBL was a factor in this accident.

Traffic Control Plan.--Although the NJDOT had a TCP for the SR 495 viaduct project, there were deficiencies. NJDOT's method of using a "third party" (the Local Aid Safety investigators) to check the TCP proved ineffective in identifying deficiencies. For example, the inspectors apparently did not notice that the "STOP" and "YIELD" signs controlled the same traffic entering from the Kennedy Boulevard entrance ramp, nor did they notice that the guide sign was directing traffic to exit at a blocked exit. These investigators also did not notice that the striping was out of alignment by nearly 2 feet.

A Local Aid Safety investigator "inspected" the job while driving in the right lane of SR 495. Obviously, such an inspection cannot be very thorough considering all the items in the TCP and the speed at which the inspection was made (not only in time spent, but the speed at which he was traveling in his automobile). The Safety Board urges the State of New Jersey to implement procedures to verify that safety reviews of traffic control schemes, stage construction plans, proposed detours, and related specifications are thorough and properly conducted.

Carrier Policies

E. Vanderhoof and Sons.--Although the E. Vanderhoof and Sons Company was cited for violation of several Federal recordkeeping requirements for driver qualifications, none of these violations were relevant to the accident. However, several of the company's management practices could be improved.

In particular, one management practice, the procedure for evaluating candidate driver performance on the road, is not adequate. Management does not necessarily observe the over-the-road driving skills of new drivers. New drivers are retained beyond the probationary period based on recommendations from experienced drivers who accompany driver candidates on the tours that use two buses. No actual evaluation of a driver's skills is performed by company management beyond administering the initial driving test.

The carrier had no current policy concerning the use of seatbelts by busdrivers on official duty. The accident bus was not equipped with seatbelts at the driver's seating position. It is important that whenever the bus is moving the driver wear the seatbelt that is provided. The ability to maintain control of the bus in an emergency or crash situation is seriously jeopardized if the driver is thrown from the seat. In a 1972 crash in Virginia, ^{9/} a car ran a stop sign and hit a large schoolbus. The bus ran off the road and partially overturned. All the bus occupants were injured. The Safety Board found that "the second collision of the bus into the embankment was caused by loss of driver control; the nonuse of available seatbelts by the driver prevented the regaining of control." Thus, to prevent a loss of control during an accident Vanderhoof should require its drivers to wear their seatbelts whenever the vehicle is in motion.

^{9/} For more detailed information, read Highway Accident Report -- "Schoolbus-Automobile Collision and Fire near Reston, Virginia, February 29, 1972" (NTSB/HAR-72-2).

DeCamp Bus Lines.--Although OMCS noted several minor discrepancies with the company, DeCamp Bus Lines had a formal structure for prescreening drivers and supervising their daily operations. In contrast to E. Vanderhoff and Sons, new drivers of DeCamp Bus Lines receive a management-supervised probationary period of driving for 2 weeks before they are permitted to drive alone, regardless of prior driving experience. In addition, DeCamp company rules are published and distributed to all employees and drivers when they were hired.

Safety Board investigators did note that the DeCamp bus was equipped with a lapbelt at the driver's position, and the busdriver was not wearing the belt at the time of the accident. Federal law requires seatbelts to be installed and used by all busdrivers engaged in interstate commerce. Thus, DeCamp officials should periodically monitor its drivers to verify that they wear seatbelts when operating company vehicles.

Survival Aspects

Although the occupants aboard both buses were subjected to forward accelerations during the impact sequence, occupants aboard the charter bus sustained minor or no injuries. The most seriously injured persons were seated in the transit bus.

At impact, maximum penetration into the passenger compartment of the transit bus was 27 inches. The direct impact area began at the driver's position and extended rearward to include the first three rows of seats on the left side. The fatally injured passenger and all serious or severely injured passengers were seated in this area. All three serious to severely injured passengers on the transit bus were ejected from their seats and thrown forward into the front modesty panel, stanchion, and metal aisle gate that was closed while the vehicle was in motion. The installation and use of lapbelts would have prevented their ejection and possibly reduced the severity of injuries for the two passengers in seats 1B and 2B (see appendix C). However, the injury outcome for the remaining seriously injured passenger seated in 1A and the fatally injured passenger is less predictable. Had these passengers been restrained with lapbelts, the passengers would have remained in the direct impact area that was intruded by the charter bus during the impact sequence. Although their injuries could have been different, it is not known if their injuries would have been less severe had they been restrained with lapbelts.

The installation and use of lapbelts is not likely to have lessened the outcome of the passengers and drivers who sustained minor injuries in the accident. The restrained passengers and drivers would have been subjected to contact with seatbacks, sidewalls, window, and other sharp objects inside the bus during the collision sequence, which could easily have produced similar injuries. It should also be noted that the floor and seats in the bus would have to be substantially upgraded to be retrofitted with lapbelts.

Emergency Response

The emergency response was adequate and executed timely, orderly, and efficiently. EMS personnel arrived onscene about 5 minutes after the collision, established a command center, and began the on-scene triage process. All injured persons received prompt medical attention and were transported to five area hospitals within 45 minutes of the arrival of the first ambulance.

CONCLUSIONS

Findings

1. The weather was not a factor in this accident.
2. There were no mechanical defects which may have caused or contributed to the cause of the accident.
3. The estimated speed of the westbound charter bus at impact was between 20 and 30 mph. The transit bus was traveling at about 32 mph at impact based on the recorded speed of its tachograph chart.
4. At the time of the accident the charter busdriver was not qualified to operate in interstate commerce because of his vision; however, this condition did not contribute to this accident.
5. At the time of the accident the charter busdriver's attention was divided between his driving task and assisting a passenger using the CB radio.
6. The temporary lane line striping was not properly aligned.
7. The traffic control plan did not include all necessary sign changes required to safely and adequately facilitate traffic flow through the construction zone.
8. The NJDOT local aid safety inspector did not adequately review and inspect the traffic control plans for the construction zone site.
9. The NJDOT engineer assigned to the North Bergen viaduct project failed to recognize the misaligned striping and deficient signing.
10. Seatbelts were not installed in the charter bus and the transit busdriver was not wearing the available seatbelt at the time of the accident.
11. Lapbelts would probably have reduced the injury severity for two transit bus passengers who sustained serious to severe injuries.
12. The injury outcome of the remaining serious and fatally injured passengers is less predictable since they would have been restrained in an area that was intruded by the charter bus.
13. Lapbelts probably would not have lessened the injury outcome for passengers and drivers who sustained minor injuries.

Probable Cause

The National Transportation Safety Board determined that the probable cause of this accident was the distraction of the charter busdriver from his driving duties while assisting a bus passenger with a CB radio which resulted in his failure to remain within the proper traffic lane while traveling in a construction zone.

RECOMMENDATIONS

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

--to the E. Vanderhoof and Sons Bus Company:

Install seatbelts at the driver's station in all company buses engaged in interstate commerce and require all drivers to wear them while operating company buses. (Class II, Priority Action) (H-87-55)

--to the DeCamp Bus Lines:

Periodically monitor your drivers to verify that they wear seatbelts when operating company buses. (Class II, Priority Action) (H-87-56)

--to the New Jersey Department of Transportation:

Implement necessary procedures to verify that local aid inspectors and other related personnel effectively review and inspect traffic control plans at construction zones. (Class II, Priority Action) (H-87-57)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ PATRICIA A. GOLDMAN
Vice Chairman

/s/ JOSEPH T. NALL
Member

/s/ JAMES L. KOLSTAD
Member

JOHN K. LAUBER, Member, did not participate.

October 27, 1987

APPENDIX A

INVESTIGATION AND PUBLIC HEARING

Investigation

The National Transportation Safety Board was notified of the accident on October 9, 1986. Investigators were dispatched from the Safety Board's Washington, D.C. headquarters and arrived onscene October 9, 1986.

Parties to the investigation included representatives from the New York and New Jersey Port Authority Police, the Federal Highway Administration and the Office of Motor Carrier Safety, the New Jersey Department of Transportation, E. Vanderhoof and Sons Bus Company, and the DeCamp Bus Lines.

Hearing

The Safety Board convened a public hearing in Secaucus, New Jersey, on February 11 and 12, 1987, to further inquire into the crash. The Safety Board examined the institutional aspects of the accident and its potential impact on safety.

APPENDIX B

DRIVER INFORMATION

Charter Bus

Mr. James Smith, age 53, has been operating commercial buses for about 18 1/2 years. He has a valid unrestricted New Jersey commercial busdriver's license. His valid commercial driver's physical examination certificate dated April 29, 1986, contained no limitations.

Transit Bus

Mr. Marcelino Aroche, age 52, has been operating commercial buses for 14 years. He has a valid commercial busdriver's license. His valid commercial driver's physical examination certificate dated November 15, 1984, contained no limitations.

Passenger Car

Mr. Castillo held no commercial driver licenses but has a valid operators permit.

North Bergen, N.J.
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APPENDIX C
BUS/OCCUPANT SEATING CHART

SILVER EAGLE INTERCITY BUS

Note:

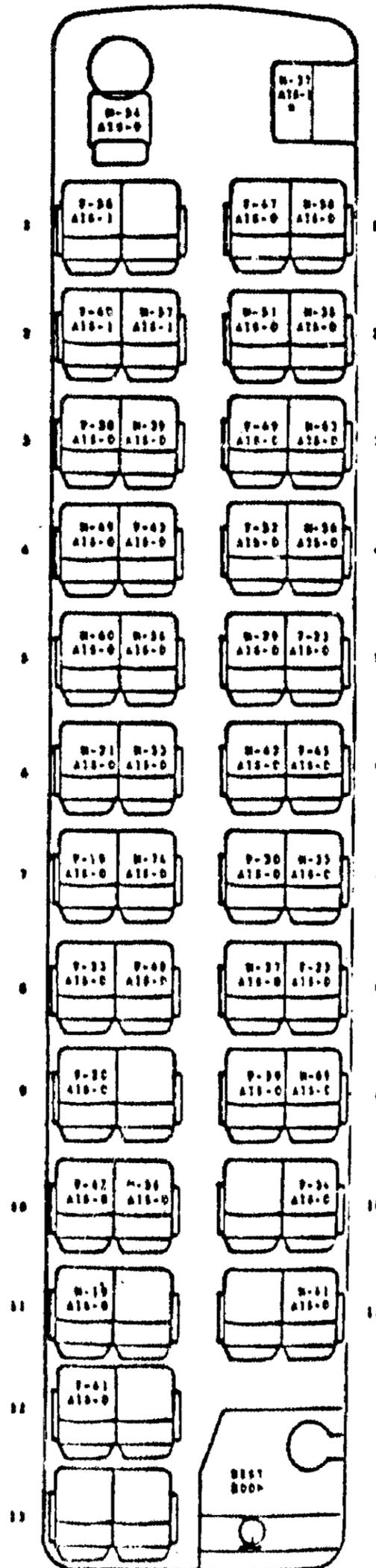
1. Age and Sex of each occupant is shown.

2. Abbreviated Injury Scale:

- AIS-0 Not Injured
- AIS-1 Minor Injury
- AIS-2 Moderate Injury
- AIS-3 Serious Injury
- AIS-4 Severe Injury
- AIS-5 Critical Injury
- AIS-6 Virtually Unsurvivable
- AIS-9 Injury Unknown

3. * Standee

Seat location shown represents a composite of information based on occupant statements and information supplied by the Port Authority Police of New York and New Jersey.



APPENDIX C Con.

North Bergen, N.J.
October 9, 1986
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G.M.C. INTERCITY BUS

Note:

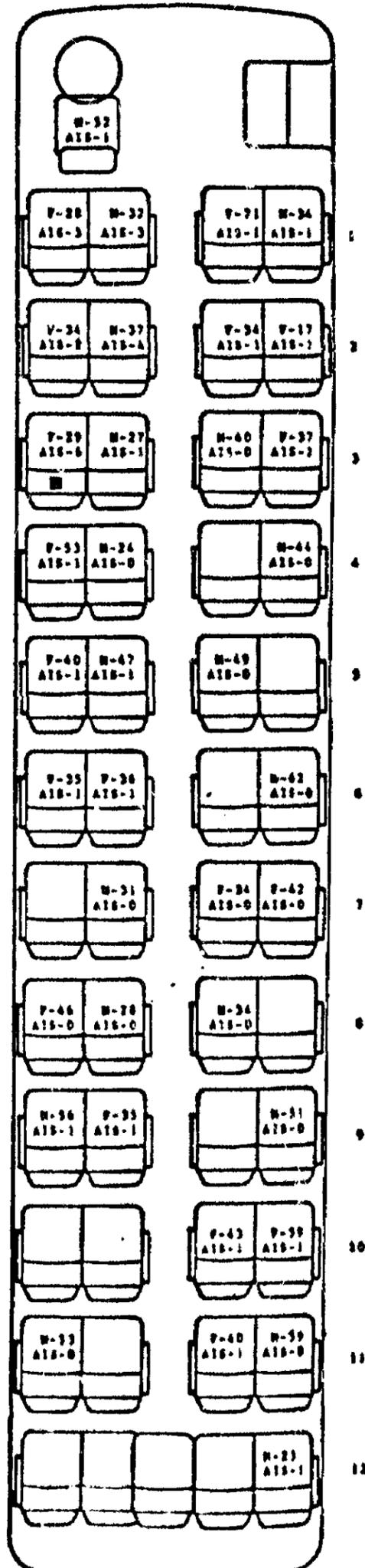
1. Age and Sex of each occupant is shown.

2. Abbreviated Injury Scale:

- AIS-0 Not Injured
- AIS-1 Minor Injury
- AIS-2 Moderate Injury
- AIS-3 Serious Injury
- AIS-4 Severe Injury
- AIS-5 Critical Injury
- AIS-6 Virtually Unsurvivable
- AIS-9 Injury Unknown

3. ■ = Deceased

Seat location shown represents a composite of information based on occupant statements and information supplied by the Port Authority Police of New York and New Jersey.



APPENDIX D
TRAFFIC VIOLATION AND ACCIDENT RECORDS

Charter Bus Driver

<u>Date of Occurrence</u>	<u>Charge</u>	<u>Disposition</u>
March 18, 1985	Involved in Accident	Not charged
June 26, 1985	Speeding 70/55 Zone	Convicted
April 4, 1986	Failed to Observe a Traffic Control Device	Convicted
January 24, 1986*	Speeding 64/55 Zone	Convicted
January 24, 1986*	Speeding 71/55 Zone	Convicted

* Violation occurred in Virginia.

Note: On September 25, 1986, the driver was awarded 3 points credit for "Annual Safe Driving".

Transit Bus Driver

<u>Date of Occurrence</u>	<u>Charge</u>	<u>Disposition</u>
July 24, 1985	Speeding 65/55 Zone	Convicted
October 26, 1984	Involved in Accident	Not charged

Note: On June 20, 1983, and June 20, 1984, the driver was awarded safe driving points for a total credit of 6 points.

APPENDIX E

SIGNING ON THE WESTBOUND APPROACH TO THE CONSTRUCTION ZONE ON I-495

The first construction signing for the I-495 viaduct appears between Hudson Avenue and the Palisades Avenue overpass, about 3,600 feet in advance of the accident site. It was a construction warning sign and read, "Road Construction 1/2 Mile." A speed limit sign, reading "SPEED LIMIT 35 WHEN LEFT LANE CLOSED" was also posted at this location.

Between 32nd Street and New York Avenue another "SPEED LIMIT 35 WHEN LEFT LANE CLOSED" sign was posted.

Between Bergenline Avenue and Central Avenue a "ROAD CONSTRUCTION 500 FEET" sign was posted with two warning lights. An overhead variable message sign was also posted on the Central Avenue overpass facing westbound traffic. During contraflow operation it also stated "LEFT LANE CLOSED/2-WAY TRAFFIC."

Between Central and Summit Avenues there was another "SPEED LIMIT 35 WHEN LEFT LANE CLOSED" sign. An overhead informational sign on Summit Avenue gave advance notice of the exit for State Routes 1 and 9 which were a 1/2 mile ahead.

Between Summit Avenue and Kennedy Boulevard a "ROAD CONSTRUCTION 1000 FEET" sign with two warning lights was posted. It was located north of the exit ramp to Kennedy Boulevard approximately 30 feet north of the right westbound and edgeline of the through traffic lanes.

A permanent sign along this stretch of highway carried the legend "NJ LAW/KEEP RIGHT EXCEPT TO PASS."

Facing eastbound traffic, an overhead "BUS LANE/SPEED LIMIT 35" was posted on the Central Avenue overpass above the contraflow lane.

On the pedestrian bridge, just east of the accident site, a directional sign stated "1 - 9 SOUTH 2nd RIGHT." A second sign, mounted adjacent to it stated "NORTH" and had a 2 o'clock arrow. The numbers "1 - 9" and the letters "TH" of "NORTH" were taped over. Apparently the letters "NOR" had previously been taped.

There was a ground-mounted merging traffic sign and a "SPEED LIMIT 35" sign on the right side of the traveled way just before the pedestrian overpass.

Just before the blocked exit ramp to 1-9 north was a ground-mounted guide sign. It stated that routes 1-9 south were straight ahead and that route 1-9 north and Ridgefield were to the right.

In front of this guide sign was a vertical sign assembly with the following markers (from bottom top): (1) "UP" arrow; (2) a U.S. route marker with the route numerals "1-9"; (3) a cardinal direction marker with the legend "NORTH"; and (4) a "DETOUR" marker.