LSS 584B

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: NOV 27 1995

In Reply Refer To: H-95-38

Commissioner John C. Egan
New York State Department of Transportation
W.A. Harriman Campus
Building 5
Albany, New York 12225

About 12:30 a.m., on July 27, 1994, a tractor cargo-tank semitrailer loaded with 9,200 gallons of propane (a liquefied petroleum gas) and operated by Suburban Paraco Corporation was traveling east on Interstate 287 in White Plains, New York. The truck drifted across the left lane onto the left shoulder and struck the guardrail; the tank hit a column of the Grant Avenue overpass. The tractor and the semitrailer separated, and the front head of the tank fractured, releasing the propane, which vaporized into gas. The resulting vapor cloud expanded until it found a source of ignition. When it ignited, according to an eyewitness, a fireball rose 200 or 300 hundred feet in the air. The tank was propelled northward about 300 feet and landed on a frame house, engulfing it in flames.

The driver was killed, 23 people were injured, and an area with a radius of approximately 400 feet was engulfed by fire.[1]

The National Transportation Safety Board determines that the probable causes of this accident were the reduction in the alertness of the driver (consistent with falling asleep) caused by his failure to properly schedule and obtain rest and the failure of the management of Paraco Gas Corporation, Inc., to exercise adequate oversight of its driver's hours of service. Contributing to the accident was the design of the highway geometrics and appurtenances, which did not accommodate an errant heavy vehicle. Contributing to the severity of the accident was the vulnerability of the bridge to collision from high-speed heavy vehicles.

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[1]For more information, read Highway Accident Report--*Propane Truck Collision with Bridge Column and Fire, White Plains, New York, July 27, 1994* (NTSB/HAR-95/02).

When the truck left the traveled way onto the negatively sloped shoulder and foreslope, its rollover speed was considerably reduced. Calculations based on a 0.26g rollover threshold show that in the center lane, which curved at a 1,522-foot radius and had a 6-percent superelevation, the rollover speed was 85 mph. On the shoulder, with a 1,542-foot radius and a minus 2-percent superelevation, the rollover speed was reduced to 74 mph. However, since the tiremarks on the shoulder and foreslope indicate steering input at a maximum radius of 930 feet, the rollover speed on the shoulder was reduced to 58 mph. Once the truck was on the foreslope, with a superelevation of -12 to -16 percent, the rollover speed was reduced even further, from 36 to 44 mph.

The highway geometry beyond the traveled way, in combination with the tight turning radius of the steering input, reduced the vehicle's rollover speed, resulting in an unstable condition. At highway speeds of 55 to 58 mph, the truck would have traveled 79 to 84 feet per second. The tiremarks left the traveled way 200 feet, or 2.5 seconds, before the truck reached the bridge. Even had there been rumble strips on the shoulder, the driver did not have enough time to perceive, react to, and avoid the hazard. Even if there had been time, once the truck lost stability, the driver could not recover. The Safety Board concludes that the truck exceeded its minimum rollover speed when it left the traveled way, at which point the vehicle lost stability and the driver was unable to recover.

Each design feature that the truck encountered, the pavement drop (3.5 inches), the slope of the ditch (-0.125 to -0.169), and the location of the guardrail, met the minimum American Association of State Highway and Transportation Officials (AASHTO) design guidelines in *A Policy on Geometric Design of Highways and Streets* and in the 1988 *Roadside Design Guide*. Each design feature by itself probably would not have created instability problems for the truck; but encountered together, they created a condition from which the driver could not recover. Because a passenger car has a much lower center of gravity and thus a higher rollover threshold, it probably could have negotiated these design features without stability problems; but this truck, with its high center of gravity and lower rollover threshold, could not. Therefore, the Safety Board concludes that the minimum AASHTO guidelines for the geometric design of highways are not always satisfactory for heavy trucks, especially those with high centers of gravity.

At the accident location, the guardrail was mounted on the backslope of the ditch; thus it did not prevent vehicles from transversing the ditch. According to the 1976 AASHTO *Barrier Guide*,[2] no barrier is required if the steepness of the foreslope is the only consideration. The *Barrier Guide* states that "although specific warrants for barrier protection of ditches do not exist, the designer should recognize their potential hazard. Ditches near the traveled way can be a significant hazard if their cross section[3] cannot be easily traversed by an

[2]AASHTO, *Guide for Selecting, Locating, and Designing Traffic Barriers*, Prepared for the FHWA, Washington, D.C., 1976.

[3]The elements of a cross section include, but are not limited to, the sideslope, the right shoulder, the traveled way, the left shoulder, the median, and ditches and drainage.

errant vehicle." The *Guide* also indicates that a median barrier should be placed on the side of the greatest slope difference if neither slope requires protection and if the difference in the slope rate is greater than about 0.1.[4]

About 150 feet west of the column, the backslope was about 9 percent. The maximum foreslope up to 132 feet west of the column was 19 percent. The design met the AASHTO guidelines, as did the placing of the guardrail on the north side of the median.

Nevertheless, the placement of the guardrail did not reflect the best engineering practice, since it is usually better to place guardrail on the outside of curves and at the side of the ditch where the slope is greater. Additionally, since there was an upstream hazard in the westbound direction, preceded by a drainage catch basin, it would have been better to put the guardrail on the eastbound side. In this accident, the location of the guardrail was not that important because the guardrail was hit by a truck too heavy for it to redirect. Had a higher performance barrier, such as a 42-inch one, been in place nearer to the edge of the shoulder, or had the slope been relatively flat from the edge of the shoulder, the truck might have been redirected.

The purpose of placing the guardrail beyond the ditchlines might have been to give errant vehicles room to recover. Passenger cars, because of their lower centers of gravity, might have been able to recover in the ditch; however, vehicles with a high center of gravity would not.

A 1978 Federal Highway Administration publication stated that "Safety priorities suggest that certain guardrail installations are more critical than others and conformance with current data is essential. As an example, guardrails on the outside of curves immediately in advance of severe hazard, or at locations where geometry may compromise barrier performance, should receive priority."[5] This guardrail was on the outside of the curve in advance of the median bridge pier (the hazard), and the slope of the roadway compromised the barrier performance.

The publication also stated that "Safety upgrading...should consider traffic volumes, barrier accident statistics, degree of deviation from current standards, potential effectiveness of existing barriers, and available resources."[6] After the accident, the NYSDOT replaced the guardrail with another guardrail of the same design. The Safety Board is concerned that the barrier on I-287 is insufficient to ensure the safety of trucks.

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[4]AASHTO, *Guide for Selecting, Locating, and Designing Traffic Barriers*, pp. 137-138.

[5]FHWA Highway Safety Review--*Report of the Safety Review Task Force to the Federal Highway Administrator*, December 1978, p. 9.

[6]See preceding footnote.

A heavy-truck hazardous-materials accident in an urban area can be catastrophic. Some jurisdictions have designed and constructed highways that exceed the minimum AASHTO guidelines, especially in areas where the number of trucks is high. For instance, the New Jersey Turnpike Authority uses a 42-inch-high concrete median barrier.

The Safety Board concludes that highways that are heavily traveled by trucks should be designed for them. The Safety Board believes that when I-287 is redesigned, the NYSDOT should recognize that the route is a corridor for trucks carrying hazardous materials and that the geometrics and safety appurtenances should be designed with the characteristics of heavy trucks in mind.

The National Transportation Safety Board therefore issues the following safety recommendation to the New York State Department of Transportation:

> When Interstate 287 is redesigned, design the geometrics and safety appurtenances for the vehicle characteristics of heavy trucks. (Class II, Priority Action) (H-95-38)

Also, the Safety Board issues Safety Recommendations H-95-32, -33, -34, -35, and 36 to the Federal Highway Administration, Safety Recommendation H-95-37 to the Research and Special Programs Administration, Safety Recommendation H-95-39 to the American Association of State Highway and Transportation Officials, Safety Recommendation H-95-40 to the American Association of Motor Vehicle Administrators, Safety Recommendation H-95-41 to the American Trucking Associations, Inc., and Safety Recommendations H-95-42 and -43 to Paraco Gas Corporation, Inc. The Safety Board reiterates Safety Recommendations H-94-5, H-95-3, and H-95-5 to the Federal Highway Administration.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any action taken as a result of its safety recommendations. Therefore, it would appreciate a response from you regarding action taken or contemplated with respect to the recommendation in this letter. Please refer to Safety Recommendation H-95-38 in your reply. If you need additional information, you may call (202) 382-6813.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT and GOGLIA concurred in these recommendations.

By: Jim Hall
Chairman