Log H-595 SR-1

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: August 5, 1998

In reply refer to: H-98-8 through -13

Honorable Kenneth R. Wykle
Administrator
Federal Highway Administration
Washington, D.C. 20590

About 5:52 a.m. on February 12, 1997, a doubles truck with empty trailers, operated by Consolidated Freightways, Inc., (CF) that was traveling northbound on U.S. Route 41, a four-lane divided limited access highway, near Slinger, Wisconsin, lost control and crossed over the 50-foot depressed median into the southbound lanes. A flatbed truck loaded with lumber, operated by McFaul Transport, Inc., that was traveling southbound on U.S. Route 41 collided with the doubles truck, lost control, and crossed over the median into the northbound lanes. A northbound passenger van with nine adult occupants struck and underrode the right front side of the flatbed truck at the landing gear. A refrigerator truck loaded with produce, operated by Glandt/Dahlke, Inc., that was also traveling northbound, struck the right rear side of the flatbed truck. Although it had snowed from about 8 p.m. to 3 a.m. the night before, it was clear at the time of the accident. Other motorists and the emergency responders to the accident scene reported icy patches in the roadway. Eight of the nine van occupants suffered fatal injuries, and the remaining occupant suffered serious injuries. Two of the three commercial truckdrivers were treated for minor injuries and released; the third refused treatment.[1]

The National Transportation Safety Board determined that the probable cause of the accident was the doubles truckdriver's lack of judgment in driving too fast for the configuration of his truck under the hazardous highway weather conditions. Contributing to the severity of the injuries and the reduced potentiality for survival was the lack of restraint use by the unrestrained occupants of the passenger van.

One of the concerns raised by the accident was the sufficiency of the doubles truckdriver's training. The Safety Board examined the doubles driver's training and experience with regard to operating doubles. The doubles driver had participated in and successfully completed a 1-week course on operating doubles at the United Parcel Service in November 1995.

[1]For further information, read Highway Accident Report—*Multiple Vehicle Crossover Accident, Slinger, Wisconsin, February 12, 1997* (NTSB/HAR-98/01).

The course specifically addressed the dynamics of doubles trailers and the operation of doubles in adverse weather, including snow and ice. At the conclusion of the training, the driver demonstrated proficiency in operating doubles and was certified to operate them. While CF does not have its own training program that specifically addresses doubles operations, the firm only hires drivers who have either graduated from an acceptable driving school or who have at least 1 year's experience with comparable equipment. The doubles driver met this CF requirement.

When hired by CF, the driver successfully passed a road test driving doubles and was certified by CF to operate them. Furthermore, the driver had been driving doubles virtually every day since he was hired by CF in October 1996 until the accident; thus, he would have operated doubles for about 4 months in all types of weather. He said that he had driven this particular route about once a week since October 1996 and was comfortable with operating doubles in this area. He had no accidents or incidents involving doubles trailers before the Slinger accident. Although this was the first time that the driver had driven two empty trailers on this route, he had previously driven empty doubles. Therefore, based on his training and experience, the Safety Board concluded that the doubles truckdriver had received training driving doubles equivalent to the degree of training provided under normal minimum industry practices.

Although the CF driver had received doubles training consistent with industry norms, the training did not ensure that the driver properly recognized and responded to the dangerous circumstances inherent in the combination of vehicle and highway conditions confronting him. While the Safety Board could not determine whether training using a simulator or a skid pad would have influenced the judgment of the CF driver, experience in other transportation modes suggests that simulator training can prepare operators to respond appropriately to hazardous conditions and thus help prevent accidents.

The Safety Board examined several recent truck accident studies in light of this accident. A 1996 analysis[2] of truck accidents carried out for the U.S. Department of Transportation Office of Motor Carriers by the University of Michigan Transportation Research Institute (UMTRI) indicates that most truck accidents occur on dry pavement. Another study,[3] conducted in Indiana, found that, compared to single-trailer vehicles, double-trailer vehicles with single-drive axles had fewer crashes on dry and wet pavements (excluding snow, ice, and slush) and fewer crashes involving multiple vehicles. However, this study also showed that doubles were over-represented in crashes on road surfaces with ice, snow, or slush. (The Indiana study excluded accidents on ramps, which minimized the number of rollover accidents included in the study group.)

The over-representation of doubles in crashes involving roadway conditions of ice, snow, and slush is likely due to the special susceptibility of doubles to these environmental factors.

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[2] *Truck and Bus Accident Factbook, 1994,* prepared by the Center for National Truck Statistics, UMTRI, for the Office of Motor Carriers, FHWA, October 1996, UMTRI-96-40, p. 21

[3] Braver, Elisa, R.; Zador, Paul, L.; Thum, Denise; Mitter, Eric. L.; Baum, Herbert, M.; and Vilardo, Frank, J.; "Tractor-Trailer Crashes in Indiana: A Case-Control Study of the Role of Truck Configuration," *Accident Analysis and Prevention,* Vol. 29, No. 1, 1997, pp. 79-96

Doubles, in general, are more reactive to wind (which is often present under such wintry conditions) than are single-trailer vehicles, because they have more points of articulation, making them more sensitive to sway. Doubles with single-drive axle tractors are also more susceptible to low-friction roadway surfaces, because they have fewer contact points with the road and less effective traction than single-trailer vehicles with dual-drive axle tractors. Therefore, the Safety Board concluded that the greater instability of double-trailer vehicles with single-drive axles renders them more vulnerable to accidents on ice, snow, and slush than single-trailer vehicles with dual-drive axles.

Research has shown that empty or lightly loaded doubles are more susceptible to wind than heavily loaded doubles. One study carried out at UMTRI[4] demonstrated the sensitivity of empty doubles and triples to crosswind-induced offtracking and rollover. This study simulated wind gusts of up to 25 mph. Phase 4 vehicle dynamics model simulations conducted for the Safety Board with regard to the Slinger accident show that, with crosswinds of 0 to 3 mph (and all other things being equal), the empty doubles truck would remain stable. However, when the crosswinds rise to 8 mph, the truck becomes only marginally stable. Therefore, based on these findings, the Safety Board concluded that lightly loaded or empty doubles trucks can be susceptible to even slight crosswinds.

The Slinger accident also raised issues concerning the possible safety benefits of traction control devices. Jackknife can result from the drive axle's loss of traction caused by locked, retarded, or spinning wheels. Although speed was a significant factor in the Slinger accident, the Safety Board sought to determine whether use of a traction control device or system could have sufficiently ameliorated the wheel spin on the drive axle of the doubles truck to have prevented its jackknife. The Board contracted with UMTRI staff to run Phase 4 vehicle dynamics model simulations with input parameters from the Slinger accident to simulate the effect that a traction control system might have had on it.

The Phase 4 model simulations indicated that, without traction control and under the conditions known about the accident, the doubles truck would have jackknifed at a speed of 58 mph. The known conditions include the prevailing wind and road friction. The wheel spin initiating the jackknife was caused by excess power for the available road friction. The inclusion of a traction control system in the Phase 4 simulations significantly increased the ability of the doubles truck to avoid jackknifing. Although the simulations showed that the tractor instability was not prevented by the traction control mechanism, its use generally diminished the rapidity of the loss of control. Therefore, the Safety Board concluded that, at the speed and under the conditions in which the accident took place, antilock brake and traction control technology would have given the doubles truckdriver more time to respond to the loss of stability.

The Safety Board considers that traction control devices help drivers maintain stability, particularly for single-drive axle vehicles operating with light loads on low-friction roadways.

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[4]MacAdam, Charles, C., "The Crosswind Sensitivity of Unladen Doubles and Triples Combinations and Their Susceptibility to Wind-Induced Offtracking and Rollovers," Supplement to *Vehicle System Dynamics*, Volume 20, August 1991, pp. 432-445.

Truck brake manufacturers are currently marketing traction control devices as performance equipment and antilock brakes as safety equipment. Although traction control devices can be added to antilock brake systems at minimal cost, traction control devices are not required.

The icy roadway conditions were also a factor in this accident. Consequently, the Safety Board examined the snow and ice removal procedures followed by the Washington County, Wisconsin, maintenance personnel. The personnel on duty prior to the accident indicated that the accident area had received two applications of salt and wetting agent. The application rate was above the required State contract level and within the ranges used by other northern States. Therefore, the Safety Board concluded that, although Washington County more than fulfilled the criteria in the Wisconsin Department of Transportation snow and ice removal contract, its countermeasures did not prevent ice from forming on the roadway.

The Safety Board found several possible explanations as to why these countermeasures were ineffective. The lack of natural windbreaks (evergreen trees and shrubs) exposed the roadway surface to winds, which may have reduced the effectiveness of the salt and wetting solutions. Traffic could have blown the salt and wetting agent off the roadway before they had a chance to melt the ice. The temperature had dropped to around 15°F, a temperature point at which the salt and wetting agent become less effective, and abrasives were not applied to provide traction.

Conventional winter maintenance operations involve deicing techniques, that is, sending plows and trucks loaded with salt and other materials to clear the roadways after a storm has begun. The principle of anti-icing is to inhibit the bond between the pavement and packed snow and ice by applying a chemical that lowers the freezing point of water. The Strategic Highway Research Program (SHRP) undertook a project[5] to examine five of the available types of chemical brines commonly used in anti-icing: sodium chloride, calcium chloride, magnesium chloride, calcium magnesium acetate, and potassium acetate. Chemical applications were made before a storm, early in the course of a storm, or during a storm, as plows created bare or nearly bare pavement. The chemical could be applied to the roadway to prevent frost or black ice if road surface temperatures were expected to drop below freezing. Sections of roadway could be selected for different anti-icing treatments based on such variables as traffic flow or pavement type. Through this project, the SHRP found that an anti-icing strategy coupled with a road weather information service could reduce winter maintenance costs, improve travel conditions, and help protect the environment.

Subsequently, the FHWA and the States conducted a field test to evaluate the anti-icing technologies tested and reviewed in the SHRP project. The field test included a two-winter experimental anti-icing evaluation and analysis of the experimental data. The recently issued

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[5]Blackburn, R. R.; McGrane, E. J.; Chappelow, C. C.; Harwood, D. W.; and Fleege, E. J.; *Development of Anti-Icing Technology*, Report No. SHRP-H-385, National Research Council, Washington, D.C., 1994

report[6] of this evaluation concluded that well-timed initial chemical applications can prevent or mitigate reductions in friction, as well as support the anti-icing objective of preventing a strong bond from developing (between the ice and the pavement). Based on these findings, the Safety Board concluded that new adverse weather countermeasures and anti-icing technologies have been shown to be effective, are readily available, and should be aggressively adopted by Wisconsin and other States.

The American Association of State Highway and Transportation Officials (AASHTO) Winter Maintenance Policy Committee's Snow and Ice Cooperative Pooled Fund Program sponsored, in cooperation with 34 States, the American Public Works Association, and the National Association of County Engineers, a conference in Minneapolis in April 1997. One of the outcomes of this conference was the recognition of the need for training in new anti-icing and road weather information service technologies. The Safety Board appreciates that the FHWA, AASHTO, and the Transportation Research Board are working together to develop guidelines for snow and ice removal. The guidelines could then be used as a basis to create training materials. The next step would be to provide the materials and training to the government entities that are responsible for ice and snow removal.

Because this was a cross-median accident, the Safety Board also reviewed several median issues raised by the Slinger accident. The 1996 AASHTO *Roadside Design Guide* warrants for median barriers on high-speed, controlled-access roadways that have relatively flat medians consider traffic volumes, median widths, and accident histories. Based on the standards provided in this guide, the average daily traffic and median width on U.S. Route 41 in the area of the accident indicate that median barriers are not necessary at this location.

The AASHTO *Roadside Design Guide* warrants, however, are based on a 1968 "limited analysis of median crossover accidents" and 1974 research on barrier performance. Like many highway design criteria, the warrants do not address the volume of heavy trucks using the roadway. For the accident area, the 1993 traffic counts show average traffic distributions that include 20 percent trucks. In addition, the warrants do not take into consideration the higher speed limits or changes in the characteristics of the passenger vehicle fleet of recent years. According to the National Highway Traffic Safety Administration (NHTSA), the light truck and van weight class that includes sport utility vehicles now constitutes 30 percent of the passenger vehicle fleet and 40 percent of the new car market.

Some States have recognized these concerns. In June 1997, for example, the California Department of Transportation (Caltrans) changed its policy regarding its freeway median barrier volume/width study warrant.[7] Caltrans recognized that a 25-percent increase in freeway traffic; changes in vehicle designs; adjustments in driver skills, abilities, and attitudes; and increases in speed limits had altered the historical trend surrounding the probability of cross-median

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[6]Ketcham, S. A.; Minsk, L. D.; and Danyluk, L. S.; *Test and Evaluation Project No 28 Anti-icing Technology, Field Evaluation Report,* FHWA-RD-97-132, March 1998.

[7]Caltrans internal memorandum to all district directors from Traffic Operations, dated June 27, 1997.

accidents. Caltrans extended its policy to a 75-foot median-barrier-freeway-volume/width-study warrant. Caltrans expects to cut the annual number of fatal cross-median accidents on the State's freeway system in half by this action.

Based on the foregoing information, the Safety Board concluded that current AASHTO median barrier warrants do not take into account the composition and characteristics of the current vehicle fleet.

In addition, a review of the individual accident reports showed that this location did not have a history of cross-median accidents. One of the criteria for determining the need for median barriers in any location is a history of cross-median accidents at that location. Median barriers can prevent and ameliorate accidents, and such barriers might have made a difference in the Slinger accident. Accurate and complete data on crossover accidents are important because they help ensure that median barriers are installed where they are needed. Yet most States do not have a cross-median data element on their official accident reporting forms.

Since the Slinger accident occurred, the Safety Board has investigated several other cross-median accidents and has found that cross-median accident histories are not readily available. For example, about 9:55 p.m. on April 25, 1997, a southbound doubles truck operated by the United Parcel Service lost control and crossed over the 64-foot grass median of Interstate 95 in Jacksonville, Florida. The doubles truck collided with a passenger car and a tractor semitrailer in the northbound lanes. All vehicles were damaged extensively and four fatalities resulted. While trying to determine the accident history for this location, the Safety Board was told by Florida Department of Transportation officials that they had experienced difficulty in identifying median crossover accidents. For example, at one location, a few miles in length, they were aware of several median crossover accidents, yet their efforts to identify these accidents by searching the records were unsuccessful. On the official report of the Jacksonville accident, both the contributing circumstance and the harmful event were coded as "other."

A review of the NHTSA publication, *State Accident Report Forms Catalog, 1995 Update,* revealed that only six States, (Hawaii, Indiana, Louisiana, Massachusetts, Michigan, and Missouri) have a data element on their reporting forms for "median crossover" accidents. NHTSA, the FHWA, and the National Association of Governors' Highway Safety Representatives are currently developing a *Guideline for Minimum Uniform Crash Criteria.* The Safety Board reviewed the October 1997 draft of this document and found no mention of crossed medians as a data element.

Because reporting forms typically lack a cross-median data element, individual accident reports must be reviewed or other codes, such as head-on collisions, must be employed to capture cross-median accident data. In addition, cross-median data may be coded as "other," making it very difficult to separate from unrelated data. Consequently, the Safety Board concluded that cross-median accidents are probably underreported because most accident reporting forms do not have a separate data element for them, and using other reporting elements to capture cross-median accidents may not result in full and accurate accounting.

Therefore, the National Transportation Safety Board makes the following safety recommendations to the Federal Highway Administration:

> Work, together with the National Highway Traffic Safety Administration, the American Trucking Associations, the International Brotherhood of Teamsters, and the Motor Freight Carrier Association, to encourage the development and use of simulator-based training for heavy truck operators. (H-98-8)
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> Work, together with the National Highway Traffic Safety Administration, the American Trucking Associations, the International Brotherhood of Teamsters, and the Motor Freight Carrier Association, to conduct laboratory and truck fleet testing to assess the safety benefits of adding traction control devices to antilock brake systems and report your findings to the National Transportation Safety Board. (H-98-9)
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> Work, together with the National Highway Traffic Safety Administration, the American Trucking Associations, the International Brotherhood of Teamsters, and the Motor Freight Carrier Association, to encourage the trucking industry to gain experience with traction control devices through fleet tests. (H-98-10)
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> Distribute materials and provide funding through the Local Technology Application Program centers for the training of State and local government officials in the new anti-icing technologies. (H-98-11)
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> Review, with the American Association of State Highway and Transportation Officials, the median barrier warrants and revise them as necessary to reflect changes in the factors affecting the probability of cross-median accidents, including changes in the vehicle fleet and the percentage of heavy trucks using the roadways. (H-98-12)
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> Include a data element for cross-median accidents in the *Guideline for Minimum Uniform Crash Criteria*, which you are developing with the National Highway Traffic Safety Administration and the National Association of Governors' Highway Safety Representatives. (H-98-13)

Also, the Safety Board issued Safety Recommendations H-98-14 through -17 to the National Highway Traffic Safety Administration; H-98-18 to the National Association of Governors' Highway Safety Representatives; H-98-19 through -23 to the American Trucking Associations, the International Brotherhood of Teamsters, and the Motor Freight Carrier Association; H-98-24 to the American Association of State Highway and Transportation Officials; H-98-25 to the Wisconsin Department of Transportation; and H-98-26 to the Independent Truckers and Drivers Association, the National Private Truck Council, and the Owner-Operators Independent Drivers Association, Inc.

Please refer to Safety Recommendations H-98-8 through -13 in your reply. If you need additional information, you may call (202) 314-6484.

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

By: Jim Hall
Chairman