

Log R-567B



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: January 13, 1987

In reply refer to: R-86-58 through -60

Mr. Paul C. Oakley
President
Operation Lifesaver, Inc.
50 F Street, N.W.
Washington, D. C. 20001

The National Transportation Safety Board has had a longstanding objective to improve safety at railroad/highway grade crossings. In calendar year 1985, the Safety Board investigated 75 accidents involving passenger/commuter trains to determine safety issues that could be successfully addressed by Federal agencies, States, and other organizations responsible for the public's safety. As a result of a safety study ^{1/} based on these 75 accidents, the Safety Board remains concerned that the public (motor vehicle occupants and passengers on trains) and railroad employees are placed in life-threatening situations daily at grade crossing locations, where the Safety Board believes safety improvements can be accomplished.

From 1981 through 1985, the number of collisions between trains and motor vehicles at grade crossings averaged 7,350 annually. These collisions produce the largest single group of fatalities and injuries from railroad operations — an average of 580 fatalities and 2,700 injuries a year. In 1985, the Safety Board undertook a special accident investigation program to look at passenger/commuter train and motor vehicle collisions at grade crossings. Certain collisions were selected for this special investigation primarily because the passenger loads on these trains elevated the risk exposure to the traveling public at these locations.

The safety study addressed the following safety issues:

- o Obstructions, both movable and immovable, limiting the driver's sight distance.
- o Ineffectiveness of a train's audible warning system.

The passenger/commuter train and motor vehicle accidents investigated by the Safety Board in 1985 show visibility (sight distance) as a continuing and troublesome concern. Indeed, in 24 of the accidents investigated by the Safety Board, visibility was cited as a cause.

^{1/} For more detailed information, read Safety Study Report—"Passenger/Commuter Trains and Motor Vehicle Collisions at Grade Crossings (1985)" (NTSB/SS-86/04).

The driver's view of the train's approach to the grade crossing was obscured in most cases by vegetation (16 cases), followed by fixed structures (9 cases), standing/stored railroad cars (4 cases), curvature of track (4 cases), and terrain (3 cases). In some accidents, the driver's view was obscured by more than one of these conditions.

Sight obstructions render many grade crossings unsafe for motorists. Even at crossings with active warning systems, sight obstructions increase the opportunity for collisions; at crossings with no warning systems or only passive systems, such obstructions are especially dangerous. However, no Federal standards prohibit these obstructions, require their removal, or require additional, strongly worded warning signs for motorists approaching a sight-obstructed crossing. In 1978, the FHWA did publish some guidance to State, municipal, and railroad authorities concerning recommended sight distances at grade crossings in the Railroad-Highway Grade Crossing Handbook. However, this guidance is not mandatory and is frequently and widely ignored.

Federal standards should be promulgated for the two main categories of sight obstructions found at grade crossings: movable (vegetation, standing railroad cars) and non-movable (buildings or the terrain itself). For movable obstructions such as vegetation, the standards should require the railroad to maintain, at each grade crossing, that portion of the "sight triangle" that is within the railroad right-of-way. In most cases this would entail periodically removing vegetation or keeping it to some defined maximum height within "the sight triangle." The State should be responsible for maintaining the portion of the "sight triangle" not on railroad right-of-way. For such movable obstructions as standing rail cars, Federal standards should simply prohibit them within the appropriate sight triangle.

Non-movable obstructions obviously require a different approach. Since they cannot be moved, it is important that approaching motorists receive adequate warning that they may be unable to see an approaching train in time to stop and that special caution is therefore required. Such warning is particularly necessary at crossings used by high speed trains. Roadway advance signing, with messages such as "HAZARD/OBSTRUCTED VIEW/HIGH SPEED TRAIN" or "DANGEROUS TRAIN CROSSING/OBSTRUCTED VIEW" should be placed at all crossings with non-movable obstructions within the minimum "sight triangle." First priority should be given to signing crossings with high speed trains.

The "Operation Lifesaver" program should develop projects to reduce obstructions to sight distance at grade crossing locations by alerting and providing information to the railroads and appropriate State or local government officials of poor visibility conditions.

Another factor in grade crossing accidents is the ineffectiveness of the train audible warning system, which in 27 cases was cited as a factor in the collision between motor vehicles and passenger/commuter trains.

In the early days of automobile and train transportation, the steam whistle from a slow moving, approaching train easily alerted the slow moving motorist approaching a crossing; often, the motor vehicle was an open or cloth-covered vehicle. In fact, the whistle may have been the primary alerting device at crossings with no active warning or watchman, and only limited bells and wigwags. Today, the train's warning horn has become an ineffective warning device. Trains move at speeds of up to 79 mph, and motor vehicles approach crossings at speeds up to 55 mph. With the windows up, air conditioning or heater fan on, wipers on, and/or radio equipment blaring, the motor vehicle operator does not hear the train until it is too late to take evasive action, as seen in repeated

accident investigations. The Safety Board's audibility tests have repeatedly indicated that, in a truck, the engine noise alone will usually mask an Amtrak or freight train horn until 1 or 2 seconds before impact, if the motor vehicle's windows are up. To hear a train's horn, a truckdriver must stop, let the engine idle, turn off fans, wipers, and radios, and roll the window down. At passive crossings, truckdrivers must be especially cautious. At active crossings, sun glare or other obstructions to the active devices can reduce their effectiveness, thus making the train's horn a more critical part of the overall warning system than it can adequately fulfill.

One of the first Safety Board accident investigations to include audibility tests of train horns was in 1967. ^{2/} The accident occurred on October 2, 1967, when a schoolbus carrying 13 children was driven across a highway grade crossing with passive warning devices and was struck by a train. Four of the children on the bus were killed and the other nine injured. The Safety Board's report of this accident stated that:

The data collected and [their] analysis strongly support the proposition that the bus driver, with the bus door closed, could hear the train whistle for...approximately 6 seconds or 510 feet prior to the locomotive's arrival at the crossing. With the front door of the bus open, the whistle could be heard for...approximately 13.5 seconds or 1,150 feet away...The analysis of horn and other sounds reported in this report establishes that the train was too far away for the driver to hear the horn while the bus was stopped even if the door was open, and that once the door was closed and the bus was moving toward the tracks in low gear, the horn could not be heard inside the bus until it was too late for the bus to stop short of the crossing.

In response to the Board's safety recommendation from this accident (H-68-8), ^{3/} the FRA sponsored an audibility study ^{4/} that described adequate audible warnings as a function of three factors:

- o Sound level at the vehicle.--For a motorist in a vehicle moving less than 35 mph, a sound level of at least 101 decibels is needed; for those moving at 36 to 50 mph, the required level is 105 decibels; for those at 51 to 65 mph, 109 decibels.
- o Required distance.--The required decibel level must be perceived by the motorist before he or she has passed the threshold of the stopping distance needed for the speed at which he or she is traveling.

^{2/} For further information, see Highway-Railroad Accident Report--"Public School Bus-Union Pacific Railroad Company Freight Train Accident, Waterloo, Nebraska," issued September 2, 1968 (NTSB/RHR-1).

^{3/} The Safety Board's Safety Recommendation (H-68-008) reads as follows: "FHWA and FRA study the questionable audibility of external sound signals within motor vehicles and work toward creating a unified system of warnings and reliable reception, to be made effective through Federal regulations or State laws." The status of this recommendation is "Closed--Acceptable Action."

^{4/} John P. Aurelius and Norman Korolow, "The Visibility and Audibility of Trains Approaching Rail-Highway Grade Crossings," FRA-RP-71-2, May 1971.

- o Sound attenuation.--Power in a sound dissipates as it moves away from its source (as light does); the power varies from the level at the source by the inverse square of the distance (between 1 and 4 feet from the source, the sound has spread out over an area 16 times larger than the area affected at the source, and the power is 1/16 as great).

Amtrak's Nathan K5LA air horns (five forward-facing horns) produce 113 to 114 decibels of sound at 100 feet directly in front of the train. However, if the train were moving at 50 mph, it would traverse approximately 100 feet in little more than 1 second--hardly sufficient warning. When measured at a 45° angle from head-on, the sound was 112.5 decibels at 100 feet, and from a 90° angle and 100 feet, it was 109.5 decibels--an even lower level of warning effectiveness.

Locomotive train horns (freight or passenger) are required to meet Federal standards of only "96 [decibels] at 100 feet forward of the locomotive in its direction of travel..." The Federal standard also permits a measurement variation of 4 decibels. ^{5/} The Safety Board believes that the Federal standard should at least meet the decibel warning levels produced by the Amtrak train air horns. This would give motorists who cautiously approach railroad highway grade crossings a much improved safety warning from the train's audible warning systems. The present FRA standard is inadequate.

The 1971 FRA study concluded that "railroad horns [as designed now] cannot reliably warn motorists when either the train or motor vehicle is going [faster than] 50 mph." As the author put it:

To "warn" a motorist, the sound must penetrate into his [or her] vehicle and override ambient noise... while the vehicle is far enough away from the crossing to still be able to stop. It is not suggested that horns are seldom heard by motorists, but rather that they fail to reach some motorists and are thus questionable as [a] primary warning device.

The authors recommended the following:

- o Use a high output horn, such as the five-chime type, because of its alerting qualities, its ability to override masking sounds, and its lesser nuisance value.
- o Mount horn high and on the front to reduce the nuisance to the crew and improve performance.
- o Mount a horn on each end of bi-directional locomotives.
- o Lower the highway speed limits at the approaches to crossings where audible warnings must have a primary role (poor visibility, no active control devices).

The Safety Board believes that the "Operation Lifesaver" program should develop educational materials to warn motorists that a train's audible warning system cannot be relied on to adequately warn of its approach and that motorists should treat grade crossings with passive warning devices as extremely hazardous locations.

^{5/} 49 CFR 229.129, "Audible Warning Devices," Railroad Locomotive Safety Standards.

Therefore, as a result of its safety study of collisions at railroad/highway grade crossings, the National Transportation Safety Board recommends that Operation Lifesaver, Inc.:

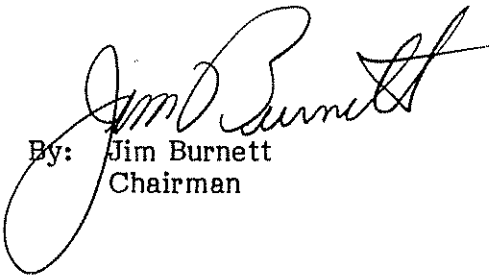
Expand the "Operation Lifesaver" program to include projects to identify obstructions to sight distances at grade crossing locations. Motorists should be encouraged to provide information to the railroads and appropriate State or local government officials of poor visibility conditions. (Class II, Priority Action) (R-86-58)

Expand the "Operation Lifesaver" program to include projects to warn motorists that train audible warning systems cannot be relied on to warn of an approaching train and that motorists should consider grade crossings with passive signing as extremely hazardous locations. (Class II, Priority Action) (R-86-59)

Expand the "Operation Lifesaver" program to deal specifically with the problems of trucks carrying bulk hazardous materials, especially petroleum products, over grade crossings. (Class II, Priority Action) (R-86-60)

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 actions taken as a result of its safety recommendations and would appreciate a response from you regarding action taken or contemplated with respect to the recommendations in this letter. Please refer to Safety Recommendations R-86-58 through -60 in your reply.

BURNETT, Chairman, GOLDMAN, Vice Chairman, and LAUBER and NALL, Members, concurred in these recommendations.


By: Jim Burnett
Chairman