



National Transportation Safety Board
Washington, DC 20594

Safety Recommendation Report
**Inward- and Outward-facing Audio and Image Recorders
as Investigative and Safety Tools**

Accident Number:	DCA17FR006
Operator:	Southeastern Pennsylvania Transportation Authority
Vehicle:	Light rail passenger car
Location:	Upper Darby, Pennsylvania
Date:	February 21, 2017
Recommendation Numbers:	R-17-013 through -15
Adopted:	August 24, 2017

The National Transportation Safety Board (NTSB) has investigated numerous railroad and rail transit accidents—including an on-going investigation in Upper Darby, Pennsylvania—where inward- and outward-facing audio and image recorders provided or could have provided an unequivocal record of a train operator’s actions. These types of recorders are critical to improving operational safety, accident investigations, and management oversight, particularly in accidents where the train operator is killed or suffers memory loss. Because of this, the NTSB is issuing one safety recommendation to the Federal Transit Administration (FTA) and two to the Southeastern Pennsylvania Transportation Authority (SEPTA).

Ongoing Investigation

Upper Darby, Pennsylvania

On February 21, 2017, at 8:10 a.m. eastern daylight time, SEPTA train 57 was traveling west at 10 mph when it collided with the rear of train 67, which had stopped on loop track 2 near the 69th Street station. The trains were not equipped with audio or image recorders in the operating cabs or forward-facing cameras, which would have proved invaluable in investigating this accident. Four cars derailed from train 57, and three derailed from train 67. The derailed cars from train 67 struck train 51 as it traveled in the opposite direction on loop track 1. (See figure 1.) A train operator in the control compartment of the lead car of each train operated the trains in manual mode. Each train included cars powered by an electrified third rail.

Two passengers were on board the striking train; no passengers were on trains 67 and 51. Both passengers and the operators of trains 57 and 67 were injured.

In a postaccident interview, the operator of the striking train said that he could not remember his actions immediately prior to the accident. Having inward- and outward-facing audio and image recorders that provided documentation of the operator's actions would have been invaluable to the NTSB investigators.



Figure 1. Accident site. (Photo: Upper Darby Police Department.)

Background

Past Rail Transit Investigations

In 47 of the 64 rail transit accidents the NTSB investigated between 1976 and 2015, audio and image recorders would have greatly aided investigators. In several accidents, the operator died, suffered severe injury, or could not recall the moments before the accident. Even in cases where the operator was not injured, audio and image recorders could have verified what the operator saw and heard and what actions the operator took. Because the NTSB has never issued a recommendation to transit agencies requiring audio and image recorders, in this report we detail several accident investigations where audio or image recorders helped or would have helped investigators understand what happened.

Walnut Creek, California

Following a 2008 train collision in Chatsworth, California, in which 25 people died, the state's public utility commission ordered inward-facing cameras on all rail vehicles in California. Recordings from such cameras were invaluable in the NTSB's 2013 investigation of the deaths of

two roadway workers in Walnut Creek, California.¹ A Bay Area Rapid Transit District (BART) train struck and killed employees who were working on BART's main tracks. The train, which included four passenger cars, was travelling north on the Pittsburg/Bay Point-SFO (San Francisco International Airport) Line between the Walnut Creek and Pleasant Hill stations.² It was one of two trains being operated by BART managers, because BART's union employees were on strike. Both trains were transporting management employees, who were being trained as substitute operators and system maintenance workers.

NTSB investigators reviewed the video, which showed that the train entered and quickly exited the Walnut Creek Station. Eight seconds later, the train accelerated to 44 mph. The train's speed increased to 68 mph within 28 seconds. The operator trainee repeatedly pushed the red emergency stop button and repeatedly shouted, "Look out!" and "No, no, no!" The train struck the two employees who were working within the gage of the track 4.7 seconds later.

Because of the irrefutable evidence provided by the recorders, NTSB investigators quickly confirmed the timeline of events and determined a probable cause. About 2 months after the accident, the NTSB issued urgent safety recommendations to the FTA to increase roadway worker protection.

New York City, New York

On June 5, 1995, two New York City subway trains collided on the Williamsburg Bridge.³ The operator of the striking train died; 67 passengers were injured. The train operator was controlling the train alone, and no one observed his behavior during the trip. Based on available evidence, the NTSB concluded the probable cause of the accident was the failure of the striking train's operator to stop the train because he was asleep. Inward-facing audio and image recorders would have validated this finding. Recorders could possibly have identified other actions or events that caused inattentiveness to critical operations. If audio and/or image recorders had been available, investigators would have been better able to assess the operator's actions moments before the accident.

Washington, DC

On June 22, 2009, nine people—including the train operator—died in the collision of two Washington Metropolitan Area Transit Authority (WMATA) Metrorail trains near Fort Totten Station.⁴ The train operator died, and dozens of passengers suffered injuries. An integral part of the investigation was evaluating the actions of the operators of each train. Investigators relied on

¹ National Transportation Safety Board, *Bay Area Rapid Transit Train 963 Struck Roadway Workers, Walnut Creek, California, April 13, 2015*, [RAB-15/03](#) (Washington, DC: National Transportation Safety Board, 2015).

² In this report, all train movements and track references will refer to timetable direction.

³ National Transportation Safety Board, *Collision Involving Two New York City Subway Trains on the Williamsburg Bridge in Brooklyn, New York, June 5, 1995*, [RAR-96/03](#) (Washington, DC: National Transportation Safety Board, 1996).

⁴ National Transportation Safety Board, *Collision of Two Washington Metropolitan Area Transit Authority Metrorail Trains Near Fort Totten Station, Washington, DC, June 22, 2009*, [RAR-10/02](#) (Washington, DC: National Transportation Safety Board, 2010).

a re-creation of the accident to postulate what the operator of the striking train could see ahead of the train before the collision; recordings would have provided valuable insight and greater accuracy in determining precisely what she saw and what actions she took to prevent the accident. An audio and image recorder would also have helped investigators understand why the operator of the struck train did not comply with operating procedures.

San Francisco, California

On July 18, 2009, two light rail vehicles collided in San Francisco, California.⁵ Both train operators and 46 passengers were injured. The striking train's operator told investigators the last thing he remembered was that the train was moving about 5 mph. At that point, he said he "blacked out." Audio and image recording devices could have provided information about what happened before the accident, whether the operator was unconscious, and other information the operator could not recall.

Other Transportation Systems

The need for recorded information—including audio and images—to help investigators determine the cause of an accident extends across transportation modes. The NTSB has long advocated the use of recorders to improve safety by having them on the agency's Most Wanted List of Transportation Safety Improvements. The NTSB has made recommendations for audio and image recorders for railroads regulated by the Federal Railroad Administration (FRA); helicopter emergency service and large transport aircraft operations regulated by the Federal Aviation Administration (FAA); and operational and safety oversight for heavy commercial vehicles regulated by the Federal Motor Carrier Safety Administration (FMCSA).⁶ The use of recorders in these three transportation modes are discussed in the following paragraphs.

Railroads Regulated by the FRA

The NTSB's initial recommendation for "voice recorders" came as a result of the investigation of the 1996 collision of a Maryland Rail Commuter (MARC) train—operated by CSX Transportation (CSXT)—and an Amtrak train near Silver Spring, Maryland.⁷ Eleven people died, including the three CSXT operating crewmembers. The NTSB reiterated this safety recommendation in its investigation of the 1999 Bryan, Ohio, railroad accident where there were no surviving crewmembers.⁸

⁵ National Transportation Safety Board, *Collision of Two Municipal Transportation Agency Light Rail Vehicles, San Francisco, California, July 18, 2009*, [RAB-11/04](#) (Washington, DC: National Transportation Safety Board, 2011).

⁶ For the purposes of this safety recommendation, heavy commercial vehicles are defined as those weighing more than 10,000 pounds.

⁷ National Transportation Safety Board, *Collision and Derailment of Maryland Rail Commuter MARC Train 286 and National Railroad Passenger Corporation Amtrak Train 29 Near Silver Spring, Maryland, February 16, 1996*, [RAR-97/02](#) (Washington, DC: National Transportation Safety Board, 1997).

⁸ National Transportation Safety Board, *Collision Involving Three Consolidated Rail Corporation Freight Trains Operating in Fog on a Double Main Track Near Bryan, Ohio, January 17, 1999*, [RAR-01/01](#) (Washington, DC: National Transportation Safety Board, 2001).

The NTSB has investigated additional railroad accidents in which audio recorders would have helped improve safety and determine probable cause. That was underscored by a 2005 collision in Anding, Mississippi.⁹ All four crewmembers were killed, and 15,000 gallons of diesel fuel were spilled causing a fire and the evacuation of 100 residents. Because of the postaccident fire, toxicological testing could not be performed on the remains of the northbound crewmembers, who had failed to comply with a signal to stop. This prevented NTSB investigators from determining whether the crewmembers were incapacitated before the accident, prompting us to expand our previous recommendation. As a result, the NTSB made the following recommendation to the FRA:¹⁰

Require the installation of a crash- and fire-protected locomotive cab voice recorder, or a combined voice and video recorder, (for the exclusive use in accident investigations and with appropriate limitations on the public release of such recordings) in all controlling locomotive cabs and cab car operating compartments. The recorder should have a minimum 2-hour continuous recording capability, microphones capable of capturing crewmembers' voices and sounds generated within the cab, and a channel to record all radio conversations to and from crewmembers. (R-07-03)

The benefits of recording audio and images of operating crews extend beyond investigations. These recordings could prevent accidents by helping railroad management to identify safety issues and develop training tools to address them. The Chatsworth, California, accident that killed 25 people and injured 102 demonstrates the importance of being able to observe the crew's activities in the minutes and seconds before an accident. In this accident investigation, the NTSB found that the probable cause of the accident was the failure of the Metrolink engineer to respond to a red signal because he was texting. The NTSB made the following recommendation as a result of this accident investigation, which superseded Safety Recommendation R-07-03:¹¹

Require the installation, in all controlling locomotive cabs and cab car operating compartments, of crash- and fire-protected inward- and outward-facing audio and image recorders capable of providing recordings to verify that train crew actions are in accordance with rules and procedures that are essential to safety as well as train operating conditions. The devices should have a minimum 12-hour continuous recording capability with recordings that are easily accessible for review, with appropriate limitations on public release, for the investigation of accidents or for use by management in carrying out efficiency testing and systemwide performance monitoring programs. (R-10-01)

The NTSB reiterated this important safety recommendation in its report on the collision of a BNSF coal train with the rear end of a standing BNSF maintenance-of-way equipment train near

⁹ National Transportation Safety Board, *Collision of Two CN Freight Trains, Anding, Mississippi, July 10, 2005*, [RAR-07/01](#) (Washington, DC: National Transportation Safety Board, 2007).

¹⁰ NTSB Safety Recommendation [R-07-3](#).

¹¹ NTSB Safety Recommendation [R-10-01](#).

Red Oak, Iowa, in April 2011.¹² Two crewmembers on the striking train were killed. The accident again demonstrated the need for in-cab audio and image recording devices to better understand railroad accidents that claim the lives of crewmembers, passengers, and the public.

About 14 months after the Red Oak accident, the NTSB investigated the collision of two Union Pacific freight trains near Goodwell, Oklahoma.¹³ This accident resulted in the deaths of three crewmembers and damages estimated at \$14.8 million. Again, there were questions about the operators' actions. In this accident report, the NTSB again reiterated the video recorder safety recommendation that were issued in the 2010 Chatsworth accident report. Safety Recommendation R-10-01 is classified "Open—Acceptable Response".

Aircraft Operations Regulated by the FAA

In 2008, 29 people died in crashes associated with helicopter emergency medical services (HEMS). The NTSB placed the issue of HEMS safety on its Most Wanted List of Transportation Safety Improvements in 2008 and conducted a public hearing to examine safety issues. Based on hearing testimony and findings from HEMS accident investigations, the NTSB made several recommendations to the FAA, including the following.¹⁴

Require helicopter emergency medical services operators to install flight data recording devices and establish a structured flight data monitoring program that reviews all available data sources to identify deviations from established norms and procedures and other potential safety issues. (A-09-90)

In addition, the NTSB made the following recommendation to 40 public operators of emergency medical services helicopters.¹⁵

Require helicopter emergency medical services operators to install flight data recording devices and establish a structured flight data monitoring program that reviews all available data sources to identify deviations from established norms and procedures and other potential safety issues. (A-09-99)

Heavy Commercial Vehicles Regulated by the FMCSA

The NTSB made safety recommendations involving recording devices for commercial trucks after a 2009 multivehicle crash that killed 10 people in Miami, Oklahoma.¹⁶ The chain of events began when a Ford Focus sideswiped a truck-tractor semitrailer that was parked on the right shoulder. The car's driver overcorrected to the left, lost control, and struck the concrete center

¹² National Transportation Safety Board, *Collision of BNSF Coal Train with the Rear End of Standing BNSF Maintenance-of-Way Equipment Train, Red Oak, Iowa, April 17, 2011*, [RAR-12/02](#) (Washington, DC: National Transportation Safety Board, 2012).

¹³ National Transportation Safety Board, *Head-On Collision of Two Union Pacific Railroad Freight Trains Near Goodwell, Oklahoma, June 24, 2012*, [RAR-13/02](#) (Washington, DC: National Transportation Safety Board, 2013).

¹⁴ NTSB Safety Recommendations [A-09-90](#).

¹⁵ NTSB Safety Recommendation [A-09-99](#).

¹⁶ National Transportation Safety Board, *Truck-Tractor Semitrailer Rear-End Collision Into Passenger Vehicles on Interstate 44 Near Miami, Oklahoma, June 26, 2009*, [HAR-10/02](#) (Washington, DC: National Transportation Safety Board, 2010.)

median barrier; the car came to rest in the roadway. As the traffic slowed to a stop, some motorists tried to push the automobile onto the shoulder. Meanwhile, the 76-year-old driver of a Volvo truck-tractor with an empty refrigerated semitrailer was traveling toward the slowed traffic at 69 mph. The truck driver did not react to the slowing traffic and collided with the rear of a sport utility vehicle. Both vehicles continued forward, striking other vehicles.

The data gathered during this investigation strongly indicated that a loss of driver alertness due to fatigue was the most likely cause of this accident. However, this could not be confirmed with certainty because of the limited amount of available information, so driver distraction could not be ruled out. One solution to the problem of driver distraction is the video event recorder (VER), a device designed to capture video and other parameters related to operator and vehicle performance. A VER may record forward-facing video, interior video, interior audio, lateral acceleration, and longitudinal acceleration. A VER may be configured to save the video and other data after a triggering event is detected.

As a result of the accident investigation, the NTSB made the following safety recommendations to FMCSA.¹⁷

Require all heavy commercial vehicles to be equipped with video event recorders that capture data in connection with the driver and the outside environment and roadway in the event of a crash or sudden deceleration event. The device should create recordings that are easily accessible for review when conducting efficiency testing and systemwide performance-monitoring programs. (H-10-10)

Require motor carriers to review and use video event recorder information in conjunction with other performance data to verify that driver actions are in accordance with company and regulatory rules and procedures essential to safety. (H-10-11)

These safety recommendations are classified as “Open—Acceptable Response.”

The NTSB has investigated many highway accidents where on-board video systems recorded critical accident-related information. In 2015, the NTSB released the *Commercial Vehicle Onboard Video Systems Safety Report* outlining how these systems aided investigators in the evaluation of driver and passenger behaviors in two accidents.¹⁸

Congressional Actions

The Fixing America’s Surface Transportation (FAST) Act of 2015 mandated that the FRA issue regulations requiring video recorders and gave the secretary of transportation the discretion to require audio recordings on all passenger (intercity and commuter) trains operating on the

¹⁷ NTSB Safety Recommendations [H-10-10](#) and [H-10-11](#).

¹⁸ National Transportation Safety Board, *Commercial Vehicle Onboard Video Systems Safety Report, March 3, 2015*, [SR-15/01](#) (Washington, DC: National Transportation Safety Board, 2015).

general railroad system and regulated by the FRA.¹⁹ The FRA has yet to issue rules for these devices. Regulations and requirements for transit rail vehicles do not exist despite the FTA's authorization to issue vehicle and safety standards under the FAST Act and the Moving Ahead for Progress in the 21st Century Act (MAP 21).²⁰ The FTA could issue regulations and requirements for recorders on transit rail vehicles using this authority.

Canadian Study

In a joint 2016 study, Transport Canada and the Transportation Safety Board of Canada determined that rail safety would be enhanced if locomotive voice and video recorder (LVVR) data could be collected and used for proactive safety management and accident investigation. In the final report, the president of a Canadian railroad stated the following: "By implementing LVVR as a preventative, proactive, behavior-changing tool, we will promote safe behaviors and improve safety."

Privacy Concerns

The NTSB recognizes the significant privacy concerns regarding the public disclosure of audio and image recordings, and lawmakers have also been sensitive to this issue. In 1990 and 2000, Congress enacted strict rules to protect the privacy of operators in both aviation and surface transportation. These rules govern when cockpit and surface transportation recordings and transcripts may be disclosed by the NTSB. Similar protections exist that apply to litigation.

Summary

The NTSB continues to believe inward- and outward-facing audio and image recorders improve the quality of accident investigations and provide the opportunity for proactive steps by management to improve operational safety. Therefore, the NTSB recommends that the FTA require the installation, in all controlling locomotive cabs and cab car operating compartments, of crash- and fire-protected inward- and outward-facing audio and image recorders capable of providing recordings to verify train crew actions and train operating conditions. The devices should have a minimum 12-hour continuous recording capability with recordings that are easily accessible for review, with appropriate limitations on public release, for the investigation of accidents and as a tool to improve operational safety. Furthermore, the NTSB recommends that SEPTA install crash- and fire-protected inward- and outward-facing audio and image recorders capable of recording operator actions in all rail transit vehicle operating compartments. The devices should have a minimum 12 hours of continuous recording capability with recordings that are easily accessible for review for the investigation of accidents and as a tool to improve operational safety. The NTSB also recommends that SEPTA publish a semiannual report detailing its progress in installing crash- and fire-protected inward- and outward-facing audio and image recorders until the installation is complete. The report should include the number of rail transit vehicle operating compartments with the recorders, and the number of compartments in their fleet that lack them.

¹⁹ Title 49 *United States Code (U.S.C.)* Chapter 53, as amended by the Fixing America's Surface Transportation Act and related FAST Act and Moving Ahead for Progress in the 21st Century Act (MAP-21) provisions.

²⁰ MAP-21 Pub. L. 112-141; 23 *U.S.C.* 601-609.

Recommendations

The National Transportation Safety Board makes the following recommendations to the Federal Transit Administration and the Southeastern Pennsylvania Transportation Authority:

To the Federal Transit Administration:

Require the installation, in all controlling locomotive cabs and cab car operating compartments, of crash- and fire-protected inward- and outward-facing audio and image recorders capable of providing recordings to verify train crew actions and train operating conditions. The devices should have a minimum 12-hour continuous recording capability with recordings that are easily accessible for review, with appropriate limitations on public release, for the investigation of accidents and as a tool to improve operational safety. (R-17-13)

To the Southeastern Pennsylvania Transportation Authority:

Install crash- and fire-protected inward- and outward-facing audio and image recorders capable of recording operator actions in all rail transit vehicle operating compartments. The devices should have a minimum 12-hour continuous recording capability with recordings that are easily accessible for review for the investigation of accidents and as a tool to improve operational safety. (R-17-14)

Publish a semiannual report detailing your progress in installing crash- and fire-protected inward- and outward-facing audio and image recorders until the installation is complete. The report should include the number of rail transit vehicle operating compartments with the recorders, and the number of compartments in your fleet that lack them. (R-17-15)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

ROBERT L. SUMWALT, III
Chairman

EARL F. WEENER
Member

CHRISTOPHER A. HART
Member

T. BELLA DINH-ZARR
Member

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