

Log # R-651A



# National Transportation Safety Board

Washington, D.C. 20594

## Safety Recommendation

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**Date:** August 28, 1997

**In Reply Refer To:** R-97-22 through -25

Honorable Gordon J. Linton  
Administrator  
Federal Transit Administration  
Washington, DC 20590

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About 5:39 p.m. on February 16, 1996, Maryland Rail Commuter (MARC) train 286 collided with National Railroad Passenger Corporation (Amtrak) passenger train 29 near Silver Spring, Maryland. En route from Brunswick, Maryland, to Union Station in Washington, DC, MARC train 286 was traveling under CSX Transportation Inc. (CSXT) operation and control on CSXT tracks. MARC train 286 passed an APPROACH signal before making a station stop at Kensington, Maryland; proceeded as if the signal had been CLEAR; and, then, could not stop for the STOP signal at Georgetown Junction, where it collided with Amtrak train 29. All 3 CSXT operating crewmembers and 8 of the 20 passengers on MARC train 286 were killed in the derailment and subsequent fire. Eleven passengers on MARC train 286 and 15 of the 182 crewmembers and passengers on Amtrak train 29 were injured.<sup>1</sup>

The National Transportation Safety Board determined that the probable cause of this accident was the apparent failure of the engineer and the traincrew because of multiple distractions to operate MARC train 286 according to signal indications and the failure of the Federal Railroad Administration (FRA), the Federal Transit Administration (FTA), the Maryland Mass Transit Administration (MTA), and the CSXT to ensure that a comprehensive human factors analysis for the Brunswick Line signal modifications was conducted to identify potential sources of human error and to provide a redundant safety system that could compensate for human error.

Contributing to the accident was the lack of comprehensive safety oversight on the CSXT/MARC system to ensure the safety of the commuting public. Contributing to the severity of the accident and the loss of life was the lack of appropriate regulations to ensure adequate emergency egress features on the railroad passenger cars.

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<sup>1</sup>For more detailed information, read Railroad Accident Report--Collision and Derailment of Maryland Rail Commuter MARC Train 286 and National Railroad Passenger Corporation Amtrak Train 29, near Silver Spring, Maryland, on February 16, 1996 (NTSB/RAR-97/02).

The CSXT and MARC had operational reasons to modify the Brunswick Line signal system: improve passenger safety and freight train operations by changing the method that CSXT dispatched and monitored trains, upgrade the system capacity to operate more trains with increased peak and midday service, increase the MARC labor and equipment productivity, and reduce the CSXT operating costs. Identifiable improvements, such as total trains, traincrew use, cost savings, and centralized traffic control (CTC) operations, could be quantified and measured; however, the signal system modifications did not address the overall safety of the signal system for traincrew use. The adequacy of the system safety could only have been addressed with a total system review that included a human factors analysis of such issues as human information processing capabilities.

A total system review examining human capabilities and limitations may have resulted in the installation of a redundant system, such as an automatic train control system or automatic cab signals, which would have produced an audible indication to alert the engineer and a visible reference to identify when the cab signal display changed to a more restrictive aspect. The MTA application for FTA funding for the project indicated that the funding approval for the project would later address advanced train control systems. Yet, when MTA and MARC officials were queried about this subject, they had no current plans.

The Safety Board investigators questioned the removal of signal 100, which, located east of the Kensington station, had been the last signal on track 2 for eastbound trains traveling towards Georgetown Junction. As a result of the modification and respacing of the signals, the last signal on track 2 for trains traveling towards Georgetown Junction was now signal 1124-2, which is west of Kensington station and about 1.25 miles west of the former signal 100 location. The spacing of signals is FRA regulated under 49 Code of Federal Regulations Part 236.24, which requires signals to be adequately spaced to provide proper distances for reducing speeds or stopping by use of other than an emergency brake application before reaching the point where reduced speed or stopping is required. The FRA determined during routine signal inspections that the Brunswick Line signal system complied with the regulation for the spacing of roadway signals.

The CSXT signal system modification, however, did not adequately account for the operating characteristics of passenger trains stopping at the Kensington station, as evidenced by this accident. The removal of signal 100 relocated a source of vital information for passenger train engineers stopping at the Kensington station from a position close to where it would be acted upon to a position farther away. In this case, the physical distance the signal was moved was not the critical element; but rather, the relocation created the potential for other information and tasks to intervene and interfere with the retention of the signal indication, thus permitting it to be forgotten before it was required to be used. Of course, the potential for interference to lead to an operational error did not necessarily exist to the same degree for all trains, and the right set of circumstances had to exist. Nevertheless, the potential for an operational error to occur as a result of the relocated signal could have been foreseen. Had the design of the signal system received input from knowledgeable human factors specialists, the potential pitfall of the relocation could have been addressed and redundancy provided for an engineer forgetting a signal. The Safety Board concluded that had the FTA and the FRA required the CSXT to perform a total signal system review of the proposed signal changes that included a human factors analysis within a comprehensive failure modes and effects analyses, this accident may have been prevented.

The information obtained during the Safety Board investigation of this accident, including its public hearing, raised questions about the oversight by Federal agencies of federally funded transit projects and, specifically, the FTA grant application and approval process. Although Federal funding provided most of

the funds for the design and installation of the CTC system on the CSXT Brunswick and Camden Line signal modification, the Federal Government apparently did not perform an in-depth analysis or evaluation of this project from a safety standpoint primarily because the applying agency self-certified that it had the technical capacity to undertake the project. Furthermore, the project justification statement indicated that safety would be enhanced by the installation of this upgraded signal system; however, the available evidence indicated that the project was undertaken for economic reasons and that a total system safety review, including a human factors analysis of the upgraded signal system, was not considered at either the State or Federal Government level.

The Safety Board recognizes that the FTA may not have the necessary expertise in all project areas for which transit agencies seek funding. In this particular instance, the FTA indicated that it did not have any in-house signal expertise with which to judge the safety benefits of the proposed signal modifications. However, the FTA could have either requested assistance from other modal administrations that have the technical expertise or required a total system safety analysis by an independent contractor as a condition for grant approval. The Safety Board concluded that Federal funds granted for the signal modifications on the CSXT Brunswick Line to accommodate an increase in MARC trains did not ensure that the safety of the public was adequately addressed. Therefore, the Safety Board believes that the FTA should revise the grant application process to require a comprehensive failure modes and effects analyses, including a human factors analysis, be provided for all federally funded transit projects that are directly related to the transport of passengers.

The Safety Board has long advocated a positive train separation (PTS) control system and since 1970<sup>2</sup> has issued safety recommendations concerning train collision prevention. A PTS control system can prevent trains from colliding by automatically interceding in the operation of a train when an engineer does not comply with the requirements of the signal indication. The FRA and the railroad industry share the responsibility for the development and implementation of a PTS control system. Under its regulatory authority, the FRA can order a railroad to install a PTS control system, and the FRA can issue emergency orders, as it did following this accident, where an unsafe condition or practice causes an emergency situation involving a hazardous death or injury.

Citing the recent train accidents in Secaucus, New Jersey,<sup>3</sup> and Silver Spring, the FRA stated in emergency order (EO) 20 that it had a particular concern for operations that involve lead cars carrying passengers on track segments that have neither cab signals nor an automatic train stop or automatic train control. EO 20 required that commuter and intercity passenger railroads modify services operating above 30 mph that lack cab signals or automatic train stop or automatic train control protections and that permit passengers to occupy the lead car, either cab control cars in the forward position push-pull mode or self-propelled locomotives with passenger seating (MU [multiple-unit] locomotives). The FRA also exercised its oversight responsibility for operating rules by concluding that certain current conditions and practices on commuter and intercity passenger railroads posed an imminent and unacceptable threat to public and employee safety. The EO 20 specifically addressed the delayed-in-block rule and the exclusion granted to passenger trains under certain conditions. The FRA recognized that unacceptable threats to public and employee safety exist where protection is not provided by cab signal or automatic train stop or automatic train control systems. The FRA addressed several public safety issues that required immediate attention

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<sup>2</sup>Railroad Accident Report--*Head-on Collision between Penn Central Trains N-48 and N-49 at Darien, Connecticut, August 20, 1969* (NTSB/RAR-70/03).

<sup>3</sup>Railroad Accident Report--*Near Head-on Collision and Derailment of Two New Jersey Commuter Trains near Secaucus, New Jersey, on February 9, 1996* (NTSB/RAR-97/01).

in EO 20; however, it did not address the other critical risks posed by reliance on crew alertness in complying with operating rules.

The Safety Board has investigated numerous train collisions in which the probable cause or contributing cause was the inattention of the traincrew to wayside signals. In its investigation of the head-on collision of two freight trains near Kelso, Washington,<sup>4</sup> the Safety Board attempted to determine again why one traincrew did not comply with the signal indication of an intermediate signal. The Safety Board reported its concerns about a systemic safety issue: the adequacy of passive wayside signals to reliably capture traincrews' attention when competing sources of attention are present, and it urged the railroad industry to recognize that human vigilance has limits and that wayside signals do not ensure safe train operations. The FRA EO 20, notice no. 2, concluded that "certain current conditions and practices on commuter and intercity passenger railroads pose an imminent and unacceptable threat to public and employee safety. Of greatest concern are push-pull and MU operations lacking the protection provided by cab signal, automatic train stop, or automatic train control systems." After its investigation of the Thedford, Nebraska,<sup>5</sup> accident, the Safety Board stated that had a PTS control system been in place it could have detected that the engineer was not responding appropriately to the signal indications and could have slowed and stopped the train, thus preventing the collision.

The FRA newly required rule for calling signals has basically the same instructions as the existing CSXT operating rule 34. The signal calling that the FRA requires likely occurred in the Silver Spring accident, and at least one crewmember was in the cab control car with the engineer and is believed also to have seen the signal. The accident still happened because such a rule does not adequately compensate for human capabilities and crew interaction.

The full development of a PTS control system is still underway; however, current technology exists for cab signal, automatic train stop, or automatic train control systems. The Safety Board concurs with the FRA EO 20, notice no. 1, that:

Since most train collisions on the railroad result from human factors, the most effective preventive measure is a highly effective train control system. Cab signal systems serve an important safety purpose because they provide a constant display of the governing signal indication. This provides a corrective measure should an engineer fail to note, forget, or misread a restrictive wayside signal indication. Even greater security is provided by a train control system capable of intervening should the engineer fail to observe signals and operating rules for whatever reason...Such systems are referred to as automatic train control or automatic train stop.

Although all MARC locomotives and cab control cars have cab signal equipment, the Brunswick Line was not equipped with a train control system to implement those devices. A train control system, which would have been recognized by the MARC cab control car cab signal equipment, could have provided the engineer with a visual reminder of the 1124-2 signal aspect, required him to acknowledge and comply with the APPROACH signal indication, or enforced the requirements of the signal indication by stopping the train. The Safety Board concluded that had a train control system that could utilize the cab

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<sup>4</sup>Railroad Accident Report--*Head-on Collision and Derailment of Burlington Northern Freight Train with Union Pacific Freight Train, Kelso, Washington, on November 11, 1993* (NTSB/RAR-94/02)

<sup>5</sup>Railroad Accident Report--*Collision and Derailment Involving Three Burlington Northern Freight Trains near Thedford, Nebraska, on June 8, 1994* (NTSB/RAR-95/03)

signal equipment on the MARC cab control car been a part of the signal system on the Brunswick Line, this accident may not have occurred. Therefore, the Safety Board believes that the FTA should cooperate with the FRA for requiring, in the interim of a PTS control system being available, the installation of cab signals, automatic train stop, automatic train control, or other similar redundant systems for all trains where commuter and intercity passenger railroads operate.

The Silver Spring accident is the latest in a series of collisions that could have been prevented had a PTS control system been in place. A PTS control system could have detected that the MARC train 286 engineer was not responding appropriately to signal indications and then slowed and stopped the train, thus, preventing the collision. The Safety Board concluded that a fully implemented PTS control system would have prevented this accident by recognizing that MARC train 286 was not being operated within allowable parameters, based on other authorized train operations, and would have stopped the train before it could enter into the unauthorized track area. The Safety Board therefore believes that the FTA should cooperate with the FRA for requiring the implementation of PTS control systems for all trains where commuter and intercity passenger railroads operate.

The 1987 Maryland Department of Transportation (MDOT) grant application to the FTA for the CSXT signal system modification on the Brunswick Line stated that the improvements envisioned in this program provide the foundation for the next "generation" of train control systems: advanced train control system (ATCS). However, neither the FTA nor the MTA followed up on the MDOT pursuit of this technology. In the MTA/MARC grant application to the FTA, the future installation of an ATCS, such as cab signals, was part of the justification for awarding the grant for the signal modifications being proposed. At the time of this accident, no advanced train control had been installed.

A PTS control system is a major step for the railroad industry to provide a redundant system where an unacceptable threat to public and employee safety exists. Pending the FRA issuance of regulations that require a PTS control system installation, railroads remain responsible for a PTS control system development and installation. Consequently, the Safety Board believes that the FTA should cooperate with the CSXT in the development and installation of a PTS control system where MARC equipment operates on CSXT tracks.

Therefore, the National Transportation Safety Board recommends that the Federal Transit Administration:

Revise the grant application process to require a comprehensive failure modes and effects analyses, including a human factors analysis, be provided for all federally funded transit projects that are directly related to the transport of passengers. (R-97-22)

Cooperate with the Federal Railroad Administration for requiring, in the interim of a positive train separation control system being available, the installation of cab signals, automatic train stop, automatic train control, or other similar redundant systems for all trains where commuter and intercity passenger railroads operate. (R-97-23)

Cooperate with the Federal Railroad Administration for requiring the implementation of positive train separation control systems for all trains where commuter and intercity passenger railroads operate. (R-97-24)

Cooperate with CSX Transportation Inc. in the development and installation of a positive train separation control system where Maryland Rail Commuter equipment operates on CSX Transportation Inc. tracks. (R-97-25)

Also, the Safety Board issued Safety Recommendations R-97-9 through -21 to the FRA; R-97-26 through -31 to the CSXT; R-97-32 through -35 to the MTA; R-97-36 to the U.S. Department of Transportation; R-97-37 to the Federal Emergency Management Agency; R-97-38 to the Governor and the General Assembly of Maryland; R-97-39 through -42 to the Association of American Railroads; R-97-43 to the Montgomery County Emergency Management Agency; R-97-44 to the Baltimore County Emergency Management Agency, the Baltimore City Emergency Management Agency, the Metropolitan Washington Council of Governments, the Jefferson County Commissioners, and the Berkeley County Commissioners; and R-97-45 to the American Short Line Railroad Association, the Brotherhood of Locomotive Engineers, the United Transportation Union, the International Brotherhood of Teamsters, and the American Public Transit Association. The Safety Board also reiterated Safety Recommendations R-87-16, R-92-10, and R-93-12 to the FRA; R-92-16 to the General Electric Company; and R-92-17 to the Electro-Motive Division of General Motors. If you need additional information, you may call (202) 314-6430.

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

By:  Hall  
Jim Hall  
Chairman