



# National Transportation Safety Board

Washington, D.C. 20594

## Safety Recommendation

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**Date:** January 23, 2002

**In reply refer to:** R-01-26 through -28

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The National Transportation Safety Board is an independent Federal agency charged by Congress with investigating transportation accidents, determining their probable cause, and making recommendations to prevent similar accidents from occurring. We are providing the following information to urge your organization to take action on the safety recommendations in this letter. The Safety Board is vitally interested in these recommendations because they are designed to prevent accidents and save lives.

These recommendations address the following safety issues: the adequacy of requirements governing the use of prescription and over-the-counter medications by light rail vehicle (LRV) operators, the effect of sleeping disorders on the performance of LRV operators, and the adequacy of the event recorders on the LRVs involved in these accidents. The recommendations are derived from the Safety Board's investigation of the Maryland Transit Administration (MTA) LRV accidents at the Baltimore-Washington International Airport transit station near Baltimore, Maryland, on February 13 and August 15, 2000, and are consistent with the evidence we found and the analysis we performed. As a result of this investigation, the Safety Board has issued four safety recommendations, one of which (Safety Recommendation R-01-28) is addressed specifically to the MTA. Two additional recommendations (Safety Recommendations R-01-26 and -27) are being sent to rail transit systems, including the MTA. Information supporting the recommendations is discussed below. The Safety Board would appreciate a response from you within 90 days addressing the actions you have taken or intend to take to implement our recommendations.

In 2000, the MTA experienced two similar accidents in the same location just 6 months apart. Both accidents involved the failure of an MTA LRV train to stop at the designated stopping point at the Baltimore-Washington International Airport Light Rail Station (BWI Airport Station). In both cases, the train struck a hydraulic bumping post apparatus at the end of the track. The Safety Board's investigation of the two accidents indicated that, although the direct cause of each accident was different, aspects of the MTA rail transit operation common to

the two accidents influenced both their outcomes. Consequently, the Safety Board developed a special investigation report to address the safety factors affecting both accidents.<sup>1</sup>

The first accident occurred about 2:37 p.m. (eastern standard time) on February 13, 2000, when MTA train 24 (composed of a single LRV), en route from Baltimore to the BWI Airport, struck the hydraulic bumping post at the terminus of track No. 1 at the BWI Airport Station and derailed. The force of the collision detached the bumping post from the track, and the front of the train, which was lodged against the bumping post, was elevated about 3 1/2 feet into the air. Train 24 carried 26 people (25 passengers and 1 operator), 18 of whom were injured. Five of those injured had serious injuries. The MTA estimated the cost of the accident at \$924,000.

The Safety Board determined that the probable cause of the February 13, 2000, accident at the Baltimore-Washington International Airport rail transit station was the train 24 operator's impairment by illicit and/or prescription drugs, which caused the operator to fail to stop the train before it struck the bumping post at the terminus.

The second accident occurred about 7:14 a.m. (eastern daylight time) on August 15, 2000, when MTA train 22 (composed of two LRVs), en route from Baltimore to the BWI Airport, struck the hydraulic bumping post at the terminus of track No. 2 at the BWI Airport Station and derailed. The bumping post separated from its attachment to the track and came to rest in an inverted position. The leading LRV of the train came to rest on top of the overturned bumping post and about 4 1/4 feet up in the air. The roof of this LRV was partially embedded into the ceiling structure of the terminal building. Train 22 carried 22 people (21 passengers and 1 operator), 17 of whom were injured. None had life-threatening injuries. The MTA estimated the cost of the accident at \$935,000.

The Safety Board determined that the probable cause of the August 15, 2000, accident at the Baltimore-Washington International Airport rail transit station was the train 22 operator's severe fatigue, resulting from undiagnosed obstructive sleep apnea, which caused the operator to fall asleep so that he could not brake the train before it struck the bumping post at the terminus.

Among the safety issues considered by the Safety Board in the course of these investigations was the adequacy of requirements governing the use of prescription and over-the-counter medications by LRV operators. During these investigations, the Safety Board learned that, although the MTA had substance abuse requirements addressing the use of alcohol and illicit drugs, it did not specifically require that safety-sensitive employees report their use of prescription and over-the-counter medications before operating equipment. Rule 1.6.2 of the MTA *Interim Rules and Instructions for Employees* prohibited employees from reporting for duty or being, while on duty, under the influence of "intoxicants, including alcohol, or Controlled Substances, or any other substance which may impair job performance." (Italics added.) The MTA, however, did not define "any other substance which may impair job performance" as including prescription or over-the-counter medications, many of which have side effects that can impair alertness and other job performance factors.

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<sup>1</sup> For additional information, see forthcoming Railroad Special Investigation Report NTSB/SIR-01/02: *Maryland Transit Administration Light Rail Vehicle Accidents at the Baltimore-Washington International Airport Transit Station near Baltimore, Maryland, February 13 and August 15, 2000.*

Both operators in the BWI 2000 accidents had been on medical leave for extended periods shortly before their respective accidents. Both had been prescribed medications that had possible side effects that included fatigue and drowsiness. Regarding the MTA's policy about employees who had been on medical leave, the MTA light rail superintendent stated in a June 12, 2000, letter to the Safety Board that the MTA does "not positively know whether a safety-sensitive employee is on medication when they return to work."

Prescription and over-the-counter medications can significantly affect the performance of people taking them. Many such medications can make the patient drowsy or dizzy, affect vision or hearing, or bring about other physical conditions that could reduce the effectiveness of a safety-sensitive employee. It appears that the MTA's policy regarding prescription and over-the-counter medications was to allow the employee to make the final determination whether he or she was fit for duty while taking a medication. But the MTA itself had no mechanism by which it could review the appropriateness of the employee's decision.

The physical condition of an employee who carries out safety-sensitive duties should be of vital interest to any rail transit system management. Management is responsible not only for the well-being of that employee but of the passengers and coworkers the employee's actions affect. Some medications, even when they are taken as prescribed or recommended, may have the effect of degrading employee performance. In some cases, legal substances such as over-the-counter and prescription drugs can impair the condition of an employee nearly as readily as illegal drugs. Consequently, the Safety Board concluded that because the MTA did not require safety-sensitive employees to report their use of prescription and over-the-counter medications, it lacked information that could have had a bearing on the condition and performance of such employees.

Safety-conscious rail transit agencies must consider an employee's use of substances, whether legal or illegal, that could negatively affect the employee's performance and put passengers and coworkers at risk. If use of a prescription or over-the-counter medication brings into question the performance of an employee responsible for safety-sensitive duties, the employee can be temporarily reassigned to non-safety-sensitive duties while taking the medication. But management cannot reassign its employees if it does not know that they are using prescription or over-the-counter medications that might cause impairment. Through postaccident interviews, the Safety Board found that the two operators involved in the BWI accidents each had a different perception about the MTA's policy concerning an operator's responsibility for reporting medication use. The train 24 operator was taking the pain-relievers oxycodone and Tylenol 3 when he returned to work. He did not tell anyone at the MTA that he was taking the medications, but he was under the impression that he was supposed to inform someone. The train 22 operator had been prescribed and was taking pain medications to deal with chronic back and neck pain, and at least one of the medications may have carried a safety warning about operating machinery. The train 22 operator stated that he did not believe he was obligated to show these medications to his MTA supervisors but that he had done so on two occasions.

Thus, the operator in the February 2000 accident believed he was supposed to report his medication use but failed to do so, while the operator in the August 2000 accident did not think he was obligated to report medication use, although he said he tried to report it. At the same

time, the chief of the MTA benefits section told the Safety Board that the MTA did not require employees to inform the MTA about their using prescription medications, while the MTA's contract physician told the Safety Board that employees were expected to report medication use in at least some cases. On the basis of the inconsistency evident at all levels within the organization about what was required for an employee to fulfill the policy, the Safety Board concluded that MTA managers and employees were confused about the requirements for reporting medication use to the MTA.

The chief of the MTA benefits section told the Safety Board that the MTA followed applicable Federal Transit Administration (FTA) regulations pertaining to substance abuse and that, consistent with those regulations, the MTA had no specific requirement that employees in safety-sensitive positions inform the MTA about their use of prescription and/or over-the-counter medications. The Safety Board reviewed the FTA drug regulations at 49 *Code of Federal Regulations* (CFR) Part 653 and found no explicit reference to the use of prescription and/or over-the-counter medications by safety-sensitive employees.<sup>2</sup> Other rail transit organizations may also infer from the lack of FTA regulations concerning the use of prescription and/or over-the-counter medications that they do not need to require their employees to report their use of prescription and over-the-counter drugs. Therefore, because the MTA may be only one of a number of rail transit organizations that do not require their safety-sensitive employees to report their use of prescription and over-the-counter medications, the Safety Board believes that rail transit systems should require employees in safety-sensitive positions to inform their supervisors when they are using prescription or over-the-counter medications so that qualified medical personnel may determine the medication's potential effects on employee performance, and train the employees about their responsibilities under the policy.

The BWI investigations also raised questions about the effect of sleeping disorders on the performance of LRV operators. After the August 15, 2000, accident, the train 22 operator's physician became concerned that the operator's unexplained loss of consciousness on the day of the accident might have been caused by a sleeping disorder. On September 5, 2000, on the advice of his physician, the operator underwent an evaluation by a sleep medicine specialist. The evaluation results indicated that the operator suffered from severe obstructive sleep apnea.

During the assessment, the operator told the examining sleep specialist physician that he had "excessive daytime sleepiness sometimes." The evaluation indicated that the operator had a self-reported Epworth Sleepiness Scale value of 14, while an Epworth Sleepiness Scale value for a person without excessive sleepiness would be 10 or lower.<sup>3</sup> In addition, the medical testing determined that the operator demonstrated a respiratory disturbance index of 106 episodes per hour. A normal index would be less than 5 episodes of disturbance per hour, while an index indicating "severe" disturbance would be anything above 30 episodes per hour. Therefore, the operator had more than 21 times the number of breathing pauses per hour than is considered

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<sup>2</sup> At the time of the accidents in 2000, 49 CFR Part 653, "Prevention of Prohibited Drug Use in Transit Operations," was in effect. Effective August 2001, Part 653 was superseded by 49 CFR Part 655, "Prevention of Alcohol Misuse and Prohibited Drug Use in Transit Operations." The Safety Board's review of the new FTA regulations at 49 CFR Part 655 found that they are also silent on the use of prescription and over-the-counter medications by safety-sensitive employees.

<sup>3</sup> The Epworth Sleepiness Scale has a range of 0 to 24. Epworth Scale values for a person without excessive sleepiness would be 10 or less, while values 11 through 24 indicate significant sleepiness.

normal and more than 3 times the number of breathing pauses per hour than is considered severely disturbed. In addition, the evaluation showed that the operator's sleep latency period (the time it took for him to fall asleep under optimum conditions) was shorter than that of an individual who is not sleep-deprived.

The Safety Board sent the full results of the operator's medical sleep evaluation to the director of the Center for Sleep and Respiratory Neurobiology at the University of Pennsylvania Medical Center for assessment. This expert strongly supported the diagnosis of severe obstructive sleep apnea and considered the operator at risk for falling asleep inappropriately. Based on its review of the sleep evaluation evidence and the verification of the evaluation findings by an independent expert, the Safety Board concluded that the train 22 operator was suffering from severe obstructive sleep apnea at the time of the August 15, 2000, accident.

Obstructive sleep apnea is a medical condition that chronically prevents those affected by it from obtaining restful sleep, creating circumstances that result in persistent fatigue no matter how much sleep is obtained during any period. Medical authorities agree that excessive daytime sleepiness is almost uniformly present in people who suffer from obstructive sleep apnea, and constant fatigue is one of the symptoms of the disorder. Because he had severe obstructive sleep apnea, the operator almost certainly had severe and persistent fatigue. He likely was so accustomed to his habitual condition of tiredness that he did not even clearly recognize that he was fatigued. On the morning of the accident, this unrelieved fatigue appears to have caused the operator to fall asleep while he was operating the train during the approach to the BWI Airport Station. Consequently, the Safety Board concluded that the chronic fatigue he was experiencing due to undiagnosed obstructive sleep apnea likely caused the train 22 operator to fall asleep as the LRV approached the BWI Airport Station on August 15, 2000.

An estimated 10 million people in the United States have undiagnosed obstructive sleep apnea.<sup>4</sup> This is due in large part to a lack of awareness about and appreciation of the symptoms of the disease. Its hallmarks, such as snoring and persistent fatigue, are often considered mere annoyances rather than possible symptoms of a medical condition. Consequently, people with sleep apnea frequently dismiss the indicators as insignificant. A person educated about the disease, however, might recognize them as symptoms of the condition and seek appropriate medical treatment. Similarly, if transit agencies were better educated about and focused more attention on such disorders, they might be more aware of those employees likely to have sleeping disorders and be better equipped to help employees with sleeping disorders treat the conditions safely and effectively. Consequently, the Safety Board concluded that better education about the risks posed by sleeping disorders, the indicators and symptoms of such disorders, and the available means of detecting and treating the conditions could help transit agencies and their employees reduce the risk of safety-sensitive employees being impaired by chronic fatigue.

Before the BWI accidents took place in 2000, the MTA did not attempt to educate its employees or managers about how sleeping disorders could negatively affect the safety of the transit environment and about how such problems could be identified and addressed. Following the accidents, in 2001, some MTA personnel participated in fatigue awareness training, including

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<sup>4</sup> Information obtained in early 2001 from the Home page of the American Sleep Apnea Association <<http://sleepapnea.org>>.

the Transportation Safety Institute's fatigue awareness training, which includes modules addressing the major types of sleeping disorders, including sleep apnea. In addition, the MTA began developing its own fatigue awareness training program and policy.

The Safety Board is pleased with these MTA efforts in the area of fatigue awareness and encourages the MTA to develop a systematic and comprehensive program that will ensure that MTA employees are kept aware of the various safety issues involving fatigue, particularly fatigue caused by sleeping disorders. As indicated by the August 2000 accident at the BWI Airport Station, such disorders can have significant system safety consequences. Given that a sleeping disorder may affect the performance of an operator employed by any rail transit system, all such systems would benefit from including a sleeping disorder component in their fatigue programs. Therefore, the Safety Board believes that rail transit systems should ensure that their fatigue educational awareness programs include the risks posed by sleeping disorders, the indicators and symptoms of such disorders, and the available means of detecting and treating them.

Finally, the BWI investigations indicated that the MTA may have problems concerning the adequacy of its event recorders. The two BWI investigations showed that each MTA light rail car contains a system for preserving a limited amount of train performance data in the event of an incident that meets a specific triggering requirement (in this case, an application of the track brakes at a train speed of at least 10 mph). The system consists of a software package that modifies the LRV's central computer system so that performance data may be stored within the car computer's memory. The data saved cover from 30 seconds before until 30 seconds after the triggering event.

When investigators first examined the available event data for the February 2000 accident, they determined that the event recorder had recorded a triggering event that occurred about the time of the accident. Further analysis, however, showed that the data recorded were inconsistent with the known facts of the accident event (that an LRV had collided with a bumping post).

A day after the initial examination of the recorder and its data, investigators found that the recorder had in the meantime documented another triggering event, which occurred after the postaccident data download. The time that the recorder showed as the occasion of this second triggering event preceded any postaccident movement of the LRV; the car was at rest throughout this period. Consequently, investigators determined that the LRV did not, in fact, experience a valid triggering event at this time. The data from the second triggering event overwrote the data from the event that had occurred on the day of the accident, even though the MTA had requested that the system be set to allow two separate triggering events to be saved before overwriting. The manufacturer was unable to explain exactly why and how these problems occurred.

In addition to the problems encountered while attempting to access the February 2000 accident data, the Safety Board identified several other specific weaknesses in the MTA's event recorder system. One significant deficiency is the dependence of the system on a trigger to begin recording. The accident scenarios presented by the two accidents at BWI, as well as many other potential accident scenarios, would not necessarily provide the triggering event necessary to activate the recording system. Also, the amount of time captured by this system (30 seconds

before the trigger and 30 seconds after the trigger, for a 1-minute total) does not provide enough information to determine how the train was being operated before the accident. Sometimes trending data are helpful to determine unsafe operating practices, and no such data are available on this system. Installing a system that continually monitors and records data can eliminate this deficiency. FRA regulations at 49 CFR 229.5(g) state that an event recorder should monitor and record data “over the most recent 48 hours of operation of the electrical system of the locomotive on which it is installed.” Having the previous 48 hours of operational data available increases the likelihood that trend data will be available if needed for the investigation.

Another major deficiency of the current MTA recording system is its reliance on the functionality of the car’s computer system. In an accident, the car’s computer system could be compromised. Installing a recording system as an integral part of the computer system leaves the recording vulnerable not only to the trauma associated with the accident itself, but also to any electronic anomalies present in the computer. Having a separate, self-contained recording system would eliminate the possibility of the computer system compromising the recorded data.

A final weakness in the current recording system is its reliance on the car’s central power source. The possibility exists for the car to lose power during an accident sequence. Under such a circumstance, the unpowered recording system could fail to receive and record significant operational and performance data during the accident’s progression. Providing nominal battery back-up power to the recording system for several moments after power is lost would eliminate this deficiency and ensure that all relevant operational data are stored and kept ready for analysis.

Given the irregularities in the data recording and retention encountered following the February 2000 accident and the deficiencies of the system detailed above, the Safety Board concluded that the event recording system in place on the MTA light rail cars is inadequate to serve as a reliable accident investigation tool. The Safety Board believes that the MTA should install, on all its LRVs, independent event recorders that record and retain the most recent 48 hours of data, store data in nonvolatile memory, and have a back-up power source that would enable the entire recording system to function if electric power is lost to the car.

Therefore, the National Transportation Safety Board makes the following safety recommendations to the Maryland Transit Administration:

Require employees in safety-sensitive positions to inform their supervisors when they are using prescription or over-the-counter medications so that qualified medical personnel may determine the medication’s potential effects on employee performance, and train the employees about their responsibilities under the policy. (R-01-26)

Ensure that your fatigue educational awareness program includes the risks posed by sleeping disorders, the indicators and symptoms of such disorders, and the available means of detecting and treating them. (R-01-27)

Install, on all your light rail vehicles, independent event recorders that record and retain the most recent 48 hours of data, store data in nonvolatile memory, and have a back-up power source that would enable the entire recording system to function if electric power is lost to the car. (R-01-28)

Safety Recommendations R-01-26 and -27 were also issued to other rail transit agencies. The Safety Board also issued a safety recommendation to the Federal Transit Administration. In your response to the recommendations in this letter, please refer to Safety Recommendations R-01-26 through -28. If you need additional information, you may call (202) 314-6607.

Chairman BLAKEY, Vice Chairman CARMODY, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

By: Marion C. Blakey  
Chairman