



# National Transportation Safety Board

Washington, D.C. 20594

## Safety Recommendation

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**Date:** April 2, 2009

**In reply refer to:** R-09-1 through -3

Ms. Karen J. Rae  
Acting Administrator  
Federal Railroad Administration  
1200 New Jersey Avenue, S.E.  
Washington, D.C. 20590

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On Friday, November 30, 2007, about 11:23 a.m.,<sup>1</sup> Amtrak (National Railroad Passenger Corporation) passenger train 371, consisting of one locomotive and three passenger cars, struck the rear of standing Norfolk Southern Railway Company freight train 23M near Chicago, Illinois. The forward portion of the Amtrak locomotive came to rest on top of a container on the rear car of the freight train. Sixty-six passengers and five crewmembers were transported to hospitals; two passengers and one crewmember were subsequently admitted. The weather was clear, and the temperature was 30° F. Estimated damage was \$1,299,000.<sup>2</sup>

The National Transportation Safety Board determined that the probable cause of the November 30, 2007, collision of Amtrak train 371 with the rear of Norfolk Southern Railway Company train 23M near Chicago, Illinois, was the failure of the Amtrak engineer to correctly interpret the signal at Englewood interlocking and Amtrak's failure to ensure that the engineer had the competency to correctly interpret signals across the different territories over which he operated. Contributing to the accident was the relief engineer's failure to immediately communicate to the engineer that he had miscalled the signal at Englewood and to stop the train when he did not respond to her expressed concern. Also contributing to the accident was an absence of effective crew resource management between the relief engineer and the operating engineer which led to their failure to resolve the miscalled signal prior to the collision. Further contributing to the accident was the absence of a positive train control system that would have stopped the Amtrak train when it exceeded restricted speed.

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<sup>1</sup> All times are central standard time unless otherwise noted.

<sup>2</sup> For additional information, see <<http://www.nts.gov/publictn/2009/RAR0901.pdf>>. National Transportation Safety Board, *Collision of Amtrak Train 371 and Norfolk Southern Railway Company Freight Train 23M, Chicago, Illinois, November 30, 2007*, Railroad Accident Report NTSB RAR-09/01 (Washington, DC: NTSB, 2009).

Amtrak operating crews are often assigned to operate over multiple railroads, sometimes during a single trip, as was the case in this accident. This type of operation requires the crew to be competent in multiple signal systems. Generally, Amtrak has been successful in preparing its crewmembers for these challenges.

However, on the accident trip, the engineer appeared to have misinterpreted the meaning of a signal aspect found on different railroad properties. The signal displayed a red over yellow aspect, yet it had different meanings on different railroads. At Englewood interlocking on Norfolk Southern territory, a red over yellow aspect is a *restricting* indication. During his on-the-job training, the engineer had operated on this territory several times under the supervision of an on-board foreman. It is unknown, however, whether the engineer had been exposed to a *restricting* indication during his training.<sup>3</sup> In contrast, a red over yellow aspect in the Amtrak yard indicates a *slow approach*. Since receiving his certification, the engineer had spent most of his time working yard jobs. His experience with this Amtrak signal aspect and its associated indication would have been more recent and frequent, and as a result, more likely committed to his memory.

In the December 27, 2007, proceedings of Amtrak's internal investigation of this accident, the engineer stated, "I looked at the signal [the Norfolk Southern signal at Englewood], and I saw our signal, Amtrak's signal. And I called that signal a *slow approach*." Certain fallibilities of human memory may have contributed to his misinterpreting or forgetting the meaning of the signal at Englewood. His forgetting may have been related to *retroactive interference*,<sup>4</sup> which happens when new information affects the recall of somewhat similar material that had been previously learned. In this case, the engineer could have easily confused the red over yellow (*slow approach* indication) signal in the train yard, which was a signal indication that currently was more salient to him, with the red over yellow (*restricting* indication) signal at Englewood, which had been more relevant to him months earlier. Furthermore, the engineer's last experience of the red over yellow *restricting* signal indication may have been during his written examination, which occurred a few months before the accident. He had operated infrequently over the accident territory since then, and this lack of exposure to and rehearsal of the signals in their true context may have made it more difficult for him to accurately retrieve from his memory the meaning of signal aspects while he was operating in this territory.

The Safety Board also is concerned about the Amtrak engineer's proficiency with signal identification when he received his engineer certification. Specifically, after completing several months of training on the accident territory, he nonetheless misinterpreted the meaning of several signals on the examinations just before his certification on the Norfolk Southern territories. During his signal examination, he made the same misinterpretation for a *restricting* signal as he did on the day of the accident. He took this exam only several days before he received his engineer certification.

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<sup>3</sup> His certification was 3 months before the accident, and the engineer had operated only twice on the route from Chicago to Grand Rapids.

<sup>4</sup> This type of interference is retroactive in the sense that current tasks are interfering with the retrieval of memories of learning that took place earlier in time.

Over the years, privately owned railroads have designed and installed signal systems on their properties to control their train movements. As previously noted, in this accident the red over yellow signal aspect on Norfolk Southern's signal system had a different meaning from the red over yellow signal aspect on Amtrak's signal system within the Chicago Terminal. Currently, there are various railroad signal system configurations across the United States. Hence, the same signal aspect may have different meanings or indications, depending on which railroad a train is operating.

The Federal Railroad Administration (FRA) issued regulations in 49 *Code of Federal Regulations* (CFR) 236.23 that provide some standards for signal systems. The FRA regulations allow signal aspects to be displayed by the color of lights, the position of lights, and the flashing of lights.<sup>5</sup> Signal aspects may also be qualified by a marker plate, a number plate, a letter plate, and a marker light. Each aspect displayed by a signal must be identified by a name and must indicate the action to be taken; however, only one name and one indication can apply to each aspect, and the same aspect cannot be used with any other name and indication on the same railroad.

While these regulations apply to each railroad individually, two adjoining railroads may have signals with the same aspects and different indications, as in this accident. A signal with the same aspect and two different indications, or requirements, can be confusing. Although railroads may use the same aspect to communicate a different meaning, some fundamental conditions must apply across all railroads. These regulations address the use of four colors of lights (that is, red, green, yellow, and lunar) and their meanings. A red light or a series of horizontal lights must be used to indicate stop; a yellow light or a lunar light must be used to indicate that speed is to be restricted and that a stop may be required; and a green light or a series of vertical lights must be used to indicate proceed. The railroads combine colors in numerous arrangements to create signal aspects, such as a red light over a yellow light.

Even though the FRA requires each railroad to define each signal aspect used on its property and to provide a meaning for that aspect, the regulations do not prohibit different railroads from having different meanings for the same aspect. As seen in this accident, a red over yellow signal aspect on the Norfolk Southern's signal system was *restricting*, hence another train may be occupying the block of track beyond the signal. A red over yellow signal aspect on Amtrak's signal system within the Chicago Terminal was a *slow approach*, hence the block of track beyond the signal was not occupied.

While engineers and conductors operated predominately on the same railroad territories in the past, today's train crews may operate over several territories in a single day, and train crews must be proficient on more than one signal system. The Safety Board concludes that the lack of uniform meanings of signal aspects can lead to misinterpretation, as demonstrated in this accident. Therefore, the Safety Board believes that the FRA should establish uniform signal aspects that railroads must use to authorize a train to enter an occupied block and prohibit the use of these aspects for any other signal indication. The Safety Board also believes that the FRA

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<sup>5</sup> These regulations also allow the signal aspect to be displayed by the position of semaphore blades, which are signals equipped with a large mechanical arm that rises and lowers to provide different aspects. The use of semaphore blades has been discontinued by most railroads.

should study the different signal systems for trains, identify ways to communicate more uniformly the meaning of signal aspects across all railroad territories, and require the railroads to implement as many uniform signal meanings as possible.

The Amtrak locomotive's fuel tank was breached during the accident, and although no postaccident fire occurred, about 300 gallons of diesel fuel spilled from the tank. Due to the collision forces and structural damage, the cab compartment doors were inoperative. Additionally, because the windows were not designed to be removed by the crewmembers, the two engineers in the cab could not exit the locomotive without assistance.

The relief engineer exited the cab through a window that was removed by firefighters, about 28 minutes after the fire department's arrival. The delay occurred because the windows also were not designed to be rapidly removed by the emergency responders.<sup>6</sup> The engineer was extricated from the cab about 39 minutes after the fire department's arrival. This extended delay occurred because the firefighters had to force open a door into the structurally damaged cab. The Safety Board concludes that because all cab compartment doors were inoperable and the windows were not designed to be easily removable from either the inside or the outside, the engineers could not exit the locomotive nor could the emergency responders enter the locomotive in a timely manner.

In 49 CFR 229.206, the FRA's locomotive design requirements state,

Each locomotive used in occupied service must meet the minimum ... emergency egress ... design requirements set forth in AAR [Association of American Railroads] S-580" for locomotives manufactured or remanufactured after January 1, 2009. The AAR sets forth in its S-580 *Locomotive Crashworthiness Requirements*, subsection 6.3, *Emergency Egress* that the locomotive cab "must allow for exit through at least one opening (for example, the engineer's side door, nose door, windows) in any locomotive orientation.

After an accident, a train crew may need to quickly exit a locomotive cab, particularly in the event of a fire or a hazardous materials release, and a train crew may require assistance from emergency responders when injured or incapacitated. The need for passengers to quickly exit passenger cars and for emergency responders to be able to enter passenger cars has been previously addressed in 49 CFR Part 238. The FRA's regulations for emergency windows in passenger cars have an "ease of operability" requirement. Title 49 CFR 238.113 states that emergency window exits in passenger cars "shall be designed to permit rapid and easy removal from the inside of the car during an emergency situation without requiring the use of a tool or other implement." Title 49 CFR 238.114 states that rescue access windows in passenger cars "must be capable of being removed without unreasonable delay by an emergency responder." While the regulations for emergency egress and access in passenger cars clearly address the need for the rapid evacuation of the cars, the requirements for the emergency evacuation of locomotives do not incorporate similar "rapid and easy removal" systems. Therefore, the Safety Board believes that the FRA should require that emergency exits on new and remanufactured locomotive cabs provide for rapid egress by cab occupants and rapid entry by emergency responders.

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<sup>6</sup> This engineer was smaller, had minor injuries, and was more agile than the other engineer.

As a result of its investigation, the National Transportation Safety Board makes the following recommendations to the Federal Railroad Administration:

Establish uniform signal aspects that railroads must use to authorize a train to enter an occupied block, and prohibit the use of these aspects for any other signal indication. (R-09-1)

Study the different signal systems for trains, identify ways to communicate more uniformly the meaning of signal aspects across all railroad territories, and require the railroads to implement as many uniform signal meanings as possible. (R-09-2)

Require that emergency exits on new and remanufactured locomotive cabs provide for rapid egress by cab occupants and rapid entry by emergency responders. (R-09-3)

The Safety Board also issued safety recommendations to Amtrak, the Association of American Railroads, the American Short Line and Regional Railroad Association, the American Public Transportation Association, the United Transportation Union, and the Brotherhood of Locomotive Engineers and Trainmen.

In response to the recommendations in this letter, please refer to Safety Recommendations R-09-1, -2, and -3. If you would like to submit your response electronically rather than in hard copy, you may send it to the following e-mail address: [correspondence@ntsb.gov](mailto:correspondence@ntsb.gov). If your response includes attachments that exceed 5 megabytes, please e-mail us asking for instructions on how to use our Tumbleweed secure mailbox procedures. To avoid confusion, please use only one method of submission (that is, do not submit both an electronic copy and a hard copy of the same response letter).

Acting Chairman ROSENKER and Members HERSMAN, HIGGINS, and SUMWALT concurred in these recommendations.

*[Original Signed]*

By: Mark V. Rosenker  
Acting Chairman