National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: November 23, 2007

In reply refer to: R-07-29

Mr. Charles W. Moorman
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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 recommendation in this letter. The Safety Board is vitally interested in this recommendation because it is designed to prevent accidents and save lives.

The recommendation in this letter addresses Norfolk Southern Railway Company's (NS's) signal training relating to imperfectly displayed signals. The recommendation is derived from the Safety Board's investigation of the January 18, 2006, collision and derailment of two NS freight trains near Lincoln, Alabama.[1] As a result of this investigation, the Safety Board has issued three safety recommendations, one of which is issued to the NS. Information supporting this recommendation is provided 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 recommendation.

About 4:17 p.m., central standard time, on January 18, 2006, eastbound NS freight train No. 226A117 (226), while traveling about 50 mph near Lincoln, Alabama, diverted from the main track onto a siding track where it struck the rear of eastbound NS train No. 22RA116 (22R), which was stopped in the siding. The collision derailed the three locomotives and the first seven cars of train 226 and the rear three cars of train 22R. The three crewmembers of train 226 were injured. Property damage was estimated to be about $5.2 million.

[1] For more information, see <http://www.ntsb.gov/publictn/2007/RAB0703.pdf>. National Transportation Safety Board, *Rear-end Collision of Norfolk Southern Trains near Lincoln, Alabama, January 18, 2006,* Railroad Accident Brief, NTSB/RAB-07/03 (Washington, DC: NTSB, 2007).

The National Transportation Safety Board determined that the probable cause of the January 18, 2006, collision of Norfolk Southern Railway train 226 with the rear of Norfolk Southern Railway train 22R at Lincoln, Alabama, was the failure by the crew of train 226 to recognize an extra lighted aspect (caused by reflected sunlight) as an imperfectly displayed signal and to treat it as a most restrictive indication. Contributing to the accident was Norfolk Southern Railway's inadequate illustrations and text in the rulebook and inadequate training to prepare crews to recognize a signal displaying an extra lighted aspect as an imperfectly displayed signal. Also contributing to the accident was the lack of a positive train control system that would have intervened when the crew did not respond appropriately to the signal.

Background

On the afternoon of January 18, 2006, NS train 22R was eastbound on the NS East District main line with NS train 226 following a few miles behind. Both trains had been re-crewed at Birmingham, Alabama, and were destined for Atlanta, Georgia. About 3:49 p.m., the NS dispatcher radioed the crew of train 22R and informed them that they would be taking their train into the siding at Coosa (MP 758) to allow train 226 to pass on the main line. The crew of train 226 said that they overheard this conversation and were therefore expecting to run around train 22R at Coosa.

As it followed train 22R on signal indication, train 226 passed several *clear* signals before encountering three consecutive *approach* signals. The third of these, at Pell City (MP 762.8), meant that the crew had to be prepared to stop before passing the next signal, at Riverside (MP 760.4),[2] which was the last signal before the siding at Coosa.

About 4:03 p.m., as train 226 was passing the *approach* signal at Pell City, train 22R was diverting from the main track and entering the siding at Coosa. The train 226 conductor said he had heard the train 22R crew announce (on the radio) a *diverging approach* indication at Coosa and was therefore aware that the train was entering the siding and would thus be clear of the main line before the arrival of train 226.

While train 22R was moving from the main track into the siding, the signal just west of the siding was displaying a *stop* indication to following trains. This indication triggered the signal at Riverside, about 2 miles west of Coosa, to display a *restricting* indication for train 226. Unknown to the crew of either train, when train 22R stopped in the siding, the rear of the train, though well clear of the main line, was about 84 feet within the switch circuit. As a result, the switch remained lined for the siding, and the signals continued to display *stop* and *restricting* indications.

A student engineer was at the operating controls of train 22R when it entered the siding. The student engineer did not activate the footage counter when the head of the train passed over the insulated joint at the west end of the siding. Train 22R was stopped at a familiar landmark

[2] The signal at Riverside was equipped with two signal heads, a high signal head with three aspects (green over yellow over red), and a lower, offset, signal head with two aspects (green over red).

near the east end of the siding. The crew of 22R were not aware that the rear car was occupying the circuit of the west switch.

Meanwhile, according to interviews and event recorder data, the engineer of train 226 had reduced the speed of his train to between 2 and 5 mph as the train came around the 2° curve at the approach to the signal at Riverside. Signal and dispatcher data showed that this signal, because of the switch alignment at Coosa, was displaying a *restricting* indication; that is, a single red aspect in both the high and low signal heads. The train 226 engineer, however, said he saw the signal as "green over red." He said he observed that signal for "probably a minute."

The conductor and conductor trainee, who were in the 226 locomotive cab at the time, both remembered calling the signal as *clear,* although in a postaccident interview, the conductor recalled that the signal he had observed at Riverside was "green over red."

Event recorder data indicated that train 226 passed the Riverside signal at about 18 mph. The train then proceeded toward Coosa while increasing its speed, in accordance with the *clear* indication the crew believed they had seen at Riverside. As the train exited a 3° curve west of Coosa at 53 mph, the crew were able to observe the *stop* indication at Coosa and could see the switch alignment. The engineer said he was preparing to announce the signal indication for Coosa on the radio when he saw the *stop* signal and realized that the switch was lined for the siding. He placed the train in emergency, but it was too late to prevent the collision and subsequent derailment.

After the accident, at the time of day that train 226 had passed the Riverside signal and under similar weather conditions, Safety Board investigators conducted sight distance tests at the Riverside signal. The tests revealed that, at the time when train 226 would have encountered the Riverside signal, sunlight reflecting off the signal optics caused the upper (green) aspect in the high signal head to appear to be illuminated even though it was not energized. The investigation determined that this "phantom signal"[3] persisted for about 1 hour, until the signal head was no longer in sunlight. The Safety Board concluded that reflected sunlight caused the crew of train 226 to perceive that the green aspect of the high signal head at Riverside was illuminated even though it was not actually energized. The crew thus interpreted the *restricting* signal indication as *clear*, even though the red aspects were illuminated and visible on both the high and low signal heads.

Both the engineer and conductor of train 226 recalled seeing "green over red." As shown by the postaccident sight distance tests, both the green and red aspects of the high signal head would have appeared illuminated to the crew of train 226. Because no valid NS signal in this signal mast configuration used two lighted aspects on the same signal head, the crewmembers should have treated the signal as being improperly displayed. Instead, perhaps because they were expecting to encounter a *clear* signal, they misinterpreted the green over red in the upper mast as a *clear* signal and resumed speed.

[3] The Association of American Railroads defines *phantom signal* as "an aspect displayed by a light signal, different from the aspect intended, caused by a light from an external source being reflected by the optical system of the signal."

NS Signal Training

The investigation examined whether NS signal training and operating rules adequately addressed the recognition of improperly displayed signals. Operating employees are taught to recognize and respond appropriately to signal indications. To prepare trainees to respond to improperly displayed signals, training staff set signals with signal lights out or flickering. They do not set signals to display extra lighted aspects.

NS operating rule No. 27 had instructions for employees who encountered an imperfectly displayed signal. The rule stated, in part:

> A signal imperfectly displayed, a signal functioning erratically, the absence of a light at a place where a signal is usually shown, must be regarded as the most restrictive indication that can be given by that signal and must be promptly reported to the Dispatcher, Control Station, or Yardmaster.

Neither NS operating rule No. 27 nor any of the rule book's signal illustrations or accompanying text informed employees that extra lighted aspects in a signal head indicate an anomaly in the observed signal, that such a signal should be considered an imperfectly displayed signal, and that it should be treated as if it were displaying its most restrictive indication. The Safety Board therefore concluded that the NS signal training program and operating rules did not prepare train crews to respond properly and consistently to improperly displayed signals caused by the appearance of extra illuminated aspects in the same signal head.

Therefore, the National Transportation Safety Board makes the following safety recommendation to the Norfolk Southern Railway Company:

> Modify your initial and recurrent training and operating rules to emphasize to your employees and the crews of other railroads operating on your territory that any signal that appears to display extra lighted aspects in a signal head should be treated as an imperfectly displayed signal. (R-07-29)

Please refer to Safety Recommendation R-07-29 in your reply. If you need additional information, you may call (202) 314-6177. The Safety Board is also making safety recommendations to the Class I Railroads, the Association of American Railroads, and the American Short Line and Regional Railroad Association.

Chairman ROSENKER, Vice Chairman SUMWALT, and Members HERSMAN, HIGGINS, and CHEALANDER concurred in this recommendation.

[Original Signed]

By: Mark V. Rosenker
Chairman