National Transportation Safety Board

Washington, DC 20594

Safety Recommendation

Date: February 4, 2015

In reply refer to: R-15-4 and -5 (Urgent)

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Acting Administrator
Federal Railroad Administration
Washington, DC 20590

The National Transportation Safety Board (NTSB) urges the Federal Railroad Administration (FRA) to take action on the urgent safety recommendations issued in this letter. These recommendations address automated inputs into controlling locomotives equipped with an "electronic alertness device," commonly called an "alerter." Alerters are designed to help maintain crew member vigilance in the locomotive cab and to apply train brakes should the device fail to detect activity. The recommendations are derived from our ongoing investigation of the collision of two Union Pacific Railroad (UP) freight trains in Hoxie, Arkansas, on August 17, 2014. Facts supporting these recommendations are discussed below.

Background

On Friday, August 17, 2014, at 2:28 a.m. central daylight time, southbound UP freight train MASNL collided with northbound UP freight train QNLPI at milepost (MP) 228.6 while traversing the turnout at Control Point CP-Y 229 on the UP Hoxie Subdivision in Hoxie, Arkansas.[1] The track in the area transitions from a single main track to two main tracks. As a result of the collision, the engineer and the conductor from the southbound train were fatally injured, and the engineer and the conductor from the northbound train were transported to local hospitals on the day of the accident with serious injuries. About 500 people within a 1.5-mile radius of the derailment were evacuated.

The southbound train consisted of two leading locomotives and 86 cars. The northbound train consisted of two leading locomotives and 92 cars. The lead locomotives from both trains derailed, and the second locomotive from the northbound train released diesel fuel, resulting in a fire. In total, 55 cars derailed, including 41 cars from the southbound train and 14 cars from the northbound train.

The maximum authorized speed in the area is 70 mph for freight trains and 75 mph for passenger trains. Amtrak passenger trains operate over this segment of the UP Hoxie Subdivision. The maximum authorized speed through the turnout from main track no. 1 to main

[1] All times in this letter are central daylight time.

track no. 2 is 40 mph for both freight and passenger trains. There were no temporary speed restrictions at the point of collision on the day of the accident.

Findings

Data from the signal system and the southbound train's trailing locomotive event recorder indicate that the southbound train was travelling about 43 mph at the approach signal (MP 227.4), which was displaying a solid yellow aspect. The next signal, at the end of the two main tracks, was the turnout at Control Point CP-Y 229, which displayed a stop indication. When the southbound train passed the approach signal, the throttle was in position 7. At the time of the collision, the throttle position remained unchanged, and train speed had increased to 45 mph. Air brakes were not applied before the collision.

Data from the northbound train's event recorder indicate that just before impact the throttle was in dynamic brake, the air brakes were not applied, and train speed was 31 mph. The data further show that the subsequent emergency brake application was not induced by the engineer.

The second locomotive from the southbound train was equipped with a GE Lococam video camera that records video and audio to external storage. Data extracted from the camera covered a 10-minute period that included the accident. The data were examined by investigators in the NTSB Engineering Laboratory in Washington, DC. The extracted recording captured video images and repeated horn sounds from the lead locomotive. At 2:23:47, the train's horn became audible, and shortly thereafter the train began to pass multiple highway-rail grade crossings. The horn remained active, sounding uninterrupted grade-crossing cadences for 4 minutes 6 seconds.[2]

At 2:27:44, the train crossed the grade crossing at MP 227.84, 0.76 miles before the point of collision. Ten seconds later, at 2:27:54, the horn sounds ended, and no further horn input was audible for the duration of the recording. The collision occurred at 2:28:38.

Horn Sequencer

The lead locomotive in the southbound train, UP 9707, was equipped with a horn sequencer that is designed to sound the "long, long, short, long" highway-rail grade-crossing horn cadence. NTSB investigators asked the UP about the operating characteristics of the horn sequencer system to understand its functionality. The UP stated that the system is activated by pressing a pedal on the floor inside the cab of the locomotive on the engineer's side (the right side) under the control console.(See figure 1.) Documentation provided by the UP indicated that the pedal is pressed once and released to activate the system. The pedal is pressed again to deactivate the system.

[2] The highway-rail grade-crossing cadence consists of two long blasts from a locomotive horn followed by one short blast and one long blast. The cadence is commonly stated as "long, long, short, long."

Figure 1. Locomotive horn sequencer pedal from exemplar UP locomotive.

On December 9, 2014, NTSB investigators examined a UP locomotive similar to the accident locomotive to further evaluate the operating characteristics of UP horn sequencers and made the following observations:

- The horn sequencer was activated with a single push of the sequencer foot pedal located under the engineer's control console at several speeds ranging from 20 mph to 75 mph.
- The sequencer sounded the standard grade-crossing horn cadence (long, long, short, long) repeatedly at all speeds until the sequencer foot pedal was again depressed, which silenced the horn.

Based on examination of the Lococam data and the operating characteristics of the horn sequencer, we determined that the southbound train's horn sequencer was active for a 4-minute 6-second period before the accident.

Locomotive Alerter

The lead locomotive of the southbound train also was equipped with an "electronic alertness device," commonly called an "alerter." The alerter is designed to help crews maintain vigilance in the locomotive cab by monitoring engineer activity and to apply the train brakes should the device fail to detect activity for a predetermined period of time.

Title 49 *Code of Federal Regulations* 229.140 contains the locomotive alerter requirements. All controlling locomotives manufactured after June 10, 2013, are required to be equipped with a functioning alerter when operating at speeds in excess of 25 mph. Beginning January 1, 2017, all controlling locomotives that will operate at speeds in excess of 25 mph will be required to have a functioning alerter.

The alerter receives inputs from various locomotive systems that determine engineer activity and, after a predetermined period of time without activity, provides visual and audible alarms and a brake initiation (referred to as a penalty brake application). Any of the following control inputs and actions (engineer activity) will reset the alerter:

- Change in throttle position
- Change in generator field switch position
- Change in dynamic brake handle position
- Alerter reset switch activation (manual reset)
- Horn activation
- Locomotive independent brake bail off activation
- Change in reverser handle position
- Manual sand activation

The alerter timeout period is variable and is based on locomotive speed and the initial reset time cycle. When the alerter reset time has been exceeded without the occurrence of a reset action, the alerter alarm cycle begins. Upon system startup or after each system reset, the value of the timeout period is calculated as follows:

- When Locomotive Speed is less than Threshold Speed, Timeout = 120 seconds
- When Locomotive Speed is greater than Threshold Speed,
  Timeout = $(60 \times 40) \div \text{Locomotive Speed}$
- Threshold Speed is configured to 20 mph

The alerter alarm cycle begins with 10 seconds of visual alarms of increasing intensity followed by 10 seconds of visual and audible alarms of increasing intensity. (See figure 2.) After this sequence, if the engineer does not perform an input or action to reset the alerter (one of the control inputs and actions listed above), the alerter relay is deenergized, the alarm is silenced, and the brakes are applied.

Figure 2. Exemplar locomotive alerter indication.

As discussed above, event recorder data from the southbound train show that the horn sounded repeatedly during the 4-minute 6-second period that began at 2:23:47. During the first 1 minute 49 seconds (109 seconds) while the horn was sounding, the throttle remained in position 8. The data revealed no other actions that would have reset the alerter. During the 109 seconds, the average speed of the southbound train was 32.5 mph. Using the formula for calculating the timeout period, at this speed if the horn sequencer had not been configured to reset the alerter, the alerter would have alarmed about 74 seconds after the horn sequencer was activated.

The data show that at 2:25:36, with the horn sequencer still activated, the throttle was moved from position 8 to position 7. This action would have reset the alerter timing cycle. And for the next 2 minutes 16 seconds, the horn continued sounding the grade-crossing cadence. The data revealed no other actions that would have reset the alerter. During this time, the average speed of the southbound train was 41 mph. Again, using the formula for calculating the timeout period, at this speed, if the horn sequencer had not been configured to reset the alerter, the alerter would have alarmed about 59 seconds after the throttle moved from position 8 to position 7, requiring the engineer to reset the alerter twice during the 2 minutes 16 seconds before the horn sounds ended.

Discussion

The current configuration of the horn sequencer on the UP's locomotives prevented the alerter from activating and initiating a penalty brake application at least three times before the collision. Although the Hoxie accident investigation is ongoing, we are concerned about automatic locomotive control systems that prevent the operation of the alerter. We believe that if the alerter had not been repeatedly reset, it would have alarmed in the minutes before the collision with visual and audible alarms and a penalty brake initiation had the engineer not responded. Although we cannot determine whether an alerter activation would have prevented

the Hoxie collision, had the alerter alarmed during the minutes leading up to the collision, it would have provided an opportunity to prevent or mitigate this accident.

The NTSB has investigated dozens of railroad accidents over the decades in which crew inattentiveness was a causal factor. We have examined the role of locomotive alerter technology many times and have recognized the potential value of alerters along with their limitations.[3] Despite those limitations and the fact that some investigations have found that alerters were likely reset by reflex action with no increase in crew alertness, alerters can still prevent some train accidents.

The safety issue we have identified during this investigation involves an onboard system (in this case the horn sequencer) that, once activated, repeatedly resets the alerter cycle without any intervention by a crew member. This vulnerability needs to be immediately addressed by the FRA and the industry. Therefore, the NTSB makes the following urgent safety recommendations to the FRA:

R-15-4 (Urgent)

Review your existing regulations and your motive power and equipment compliance manual, and revise them as needed to prohibit automatic systems from resetting the locomotive alerter.

R-15-5 (Urgent)

Immediately notify railroads of the circumstances of this accident and the risks posed by automated inputs that reset alerter cycles. Urge railroads to assess all controlling locomotive alerter systems to (1) identify and document any system inputs that reset the alerter cycle without manual intervention by crewmembers and (2) determine ways to eliminate such resets.

We also issued one urgent safety recommendation to the Association of American Railroads, the American Short Line and Regional Railroad Association, and the American Public Transportation Association.

Acting Chairman HART and Members SUMWALT and WEENER concurred in these recommendations.

[3] For a recent discussion on alerters, see NTSB/RAR-12/02, *Collision of BNSF Coal Train with the Rear End of Standing BNSF Maintenance-of-Way Equipment Train, Red Oak, Iowa, April 17, 2011*.

We are vitally interested in these recommendations because they are designed to prevent accidents and save lives. We would appreciate receiving a response from you within 30 days detailing the actions you have taken or intend to take to implement them. When replying, please refer to the safety recommendations by number. We encourage you to submit your response electronically to correspondence@ntsb.gov.

[Original Signed]

By: Christopher A. Hart,
Acting Chairman