National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: May 10, 2012

In reply refer to: R-12-23 and -24 (New)
R-11-8 (Reclassification)

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The National Transportation Safety Board (NTSB) 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 NTSB is vitally interested in these recommendations because they are designed to prevent accidents and save lives.

These recommendations address crashworthiness of modular locomotive cabs and survivability of electronic data. The recommendations are derived from the NTSB's investigation of the April 17, 2011, collision of BNSF Railway (BNSF) coal train C-BTMCNM0-26, BNSF 9159 East, with the rear end of standing BNSF maintenance-of-way (MOW) equipment train U-BRGCRI-15, BNSF 9470 East, near Red Oak, Iowa, and is consistent with the evidence we found and the analysis we performed.

As a result of this investigation, the NTSB has reclassified 4 safety recommendations, reiterated 5 safety recommendations, and issued 11 new safety recommendations, 2 of which are addressed to the Association of American Railroads (AAR). Information supporting these recommendations is discussed below. The NTSB would appreciate a response from you within 90 days addressing the actions you have taken or intend to take to implement our recommendations.

On April 17, 2011, about 6:55 a.m. central daylight time, eastbound BNSF coal train C-BTMCNM0-26, BNSF 9159 East, travelling about 23 mph, collided with the rear end of standing BNSF MOW equipment train U-BRGCRI-15, BNSF 9470 East, near Red Oak, Iowa. The accident occurred near milepost (MP) 448.3 on main track number two on the Creston Subdivision of the BNSF Nebraska Division. The collision resulted in the derailment of 2 locomotives and 12 cars. As a result of collision forces, the lead locomotive's modular crew

cab was detached, partially crushed, and involved in a subsequent diesel fuel fire. Both crewmembers on the striking train were fatally injured. Damage was in excess of $8.7 million.[1]

The NTSB determined that the probable cause of the accident was the failure of the crew of the striking train to comply with the signal indication requiring them to operate in accordance with restricted speed requirements and stop short of the standing train because they had fallen asleep due to fatigue resulting from their irregular work schedules and their medical conditions. Contributing to the accident was the absence of a positive train control system that identifies the rear of a train and stops a following train if a safe braking profile is exceeded. Contributing to the severity of collision damage to the locomotive cab of the striking coal train was the absence of crashworthiness standards for modular locomotive crew cabs.

Crash Performance of BNSF Locomotive 9159

The lead locomotive of the striking train, BNSF 9159, was an Electro-Motive Diesel SD70ACe manufactured in March 2008. The design incorporates a modular operator's cab at the front end of the unit and has a fabricated steel underframe that extends the length of the unit, upon which the diesel engine and alternator components are mounted (aft of the operator's cab). Investigators examined the crash performance of BNSF 9159 to understand how the substantial damage occurred. They also evaluated the adequacy of existing locomotive crashworthiness standards in light of the locomotive damage seen in the Red Oak collision.

During the collision sequence, the clip car at the rear end of the struck train immediately folded, derailed, and was displaced north of the track. A powered axle and truck from that car along with other train equipment became lodged in front of the snow plow of BNSF 9159, forming a ramp in front of the locomotive. The next car in the struck train, an 89-foot flatcar outfitted with a specialized loading ramp (scorpion car), rode up and over the trapped equipment in front of BNSF 9159 overriding the locomotive anti-climber and collided with the modular operating cab. The collision forces lifted and rotated the modular operating cab toward the rear, shearing and separating it from its attachment points. When the modular operating cab separated and rolled rearward, the short hood and collision posts no longer provided the protection intended by the crashworthiness design standards. The cab was then crushed at the rooftop as it rolled into the electrical locker, and the forward-facing window frame was folded forward over the top of the cab. The side walls remained relatively intact below the window line. Diesel fuel from the scorpion car leaked onto the front end of BNSF 9159 and caught fire. Several other flatcars overrode the scorpion car before the striking train came to a stop. The detachment and upending of the cab module and subsequent crushing action exerted forces on the cab occupants that would not have been present had the cab remained fixed to the deck. Because the operating cab rotated into the electrical locker, the rear door was crushed. The NTSB concludes that because the isolated locomotive cab module detached from the deck of the locomotive and was subsequently rotated and crushed, the crew could not have survived.

[1] See *Collision of BNSF Coal Train With the Rear End of Standing BNSF Maintenance-of-Way Equipment Train, Red Oak, Iowa, April 17, 2011*, Railroad Accident Report NTSB/RAR-12/02 (Washington, D.C.: National Transportation Safety Board, 2012) on the NTSB website at <http://www.ntsb.gov>.

BNSF 9159 was constructed to meet the crashworthiness standards in AAR Standard S-580, "Locomotive Crashworthiness Requirements." This standard is incorporated by reference in Title 49 *Code of Federal Regulations* 229.205 and is applicable to all locomotives built after January 2009. Electro-Motive Diesel supplied documentation on the structural design and analysis of this model locomotive that confirmed BNSF 9159 was in compliance with these regulatory requirements. However, AAR Standard S-580 does not specifically address modular (isolated) wide-nose locomotive operating cabs like the cab on BNSF 9159.

Current crashworthiness requirements are design standards. Design standards fix requirements under prescribed conditions, which are not necessarily related to the variety of conditions that could occur in a collision. They were based on specific accident scenarios and on locomotive designs in use at the time of their development. In comparison, performance standards attempt to define equipment performance requirements. For example, maintaining survivable space in a control compartment following a collision is a performance standard; prescribing the strength of a collision post in front of the control compartment is a design standard.

Modular cabs are very effective at reducing crew noise and vibration exposure, which can have a safety benefit. There are about 562 isolated cab locomotives operating in North America. Cab integrity is vital to crew safety in a variety of accident scenarios including train-train collisions, train-motor vehicle collisions, and train derailments in which a locomotive overturns. There are no crashworthiness criteria for modular cabs in the existing standards. The NTSB concludes that although the current locomotive crashworthiness standards include a procedure to validate alternative locomotive crashworthiness designs that are not consistent with any Federal Railroad Administration (FRA)-approved locomotive crashworthiness design standard, this requirement was not effective in identifying the modular operating cab as an alternate design. Consequently, the NTSB recommends that the AAR revise its Standard S-580 to provide protection for the occupants of isolated operating cabs in the event of a collision, and make the revision applicable to all locomotives, including those newly constructed, rebuilt, refurbished, and overhauled.

Safeguarding Electronic Data for Accident Investigations

The NTSB has long advocated the capture and preservation of on-board locomotive operational data to assist in accident investigations. After the derailment of a Louisville and Nashville freight train in Pensacola, Florida, on November 9, 1977, the NTSB recommended that the FRA

> Promulgate regulations to require locomotives used in trains on main tracks outside of yard limits to be equipped with operating event recorders. (R-78-44)

The FRA responded that "such regulations are not appropriate" and, in a subsequent communication, that "any safety benefit … is significantly exceeded by the cost of installation and maintenance." The FRA wrote to the NTSB in 1985 that it believed that the intent of the recommendation was being accomplished without regulation and that "Federal involvement is neither justified or necessary." Based on this response, the NTSB classified Safety Recommendation R-78-044 "Closed—Unacceptable Action" on November 29, 1985.

In its investigation of the rear-end collision between two Union Pacific Railroad freight trains in Hermosa, Wyoming, on October 16, 1980, the NTSB made the following safety recommendation to the AAR:

> Encourage member railroads to install or relocate event recorders so as to lessen the likelihood of their becoming damaged in an accident. (R-81-50)

The NTSB classified Safety Recommendation R-81-50 "Closed—Acceptable Action" on December 30, 1982.

After the NTSB's first recommendation on event recorders in 1978, recorder and data storage technology improved and railroads began to install locomotive event recorders in much greater numbers. By the 1990s, most railroads were installing event recorders on their locomotives.

In 1988 Congress passed legislation requiring the FRA to promulgate event recorder regulations, and the requirement for event recorders on all lead locomotives of trains operating above 30 mph became effective in 1995. However, recorder data remained susceptible to damage during accidents, and their value in accident investigation was compromised in many cases.

In its investigation of a head-on collision between two Union Pacific freight trains in Devine, Texas, that occurred on June 22, 1997, the NTSB found that the event recorders on both lead locomotives were destroyed and that critical operational data were lost. The NTSB made the following safety recommendation to the FRA:

> Working with the industry, develop and implement event recorder crashworthiness standards for all new or rebuilt locomotives by January 1, 2000. (R-98-30)

The FRA utilized the Rail Safety Advisory Committee to help develop language for a Notice of Proposed Rulemaking. Eventually, a regulation requiring crashworthy event recorder memory modules was promulgated and became effective October 1, 2005. In correspondence dated October 26, 2005, the NTSB stated its preference for stricter recorder survivability standards that would meet the European Organization for Civil Aviation Equipment standard.[2] The NTSB noted that the regulatory standards issued by the FRA are less stringent. Nonetheless, the NTSB classified safety recommendation R-98-30 "Closed—Acceptable Action." In a letter dated October 26, 2005, the NTSB further noted that

> … it will continue to monitor this situation and offer recommendations as a result of its (future) accident investigations to improve the effectiveness of crashworthiness standards and survivability of event recorders.

[2] While this is an aviation standard, it is based on fire temperatures more consistent with diesel fuel fires than the 750° C (1400° F) contained in 49 CFR 229.135(b). For example, the locomotive diesel fire following a collision in Anding, Mississippi, was estimated to have reached well over 1000° C. See *Collision of Two CN Freight Trains, Anding, Mississippi, July 10, 2005*, Railroad Accident Report NTSB/RAR-07/01 (Washington, D.C.: National Transportation Safety Board, 2007) at <http://www.ntsb.gov>.

In the Red Oak accident, data from the forward-facing video recorder on the BNSF 9159 did not survive the collision and subsequent fire because it was not housed in a crashworthy memory module. However, on the same locomotive, event recorder data stored in a certified U.S. Department of Transportation crashworthy memory module did survive and was available to investigators, allowing them to better understand the circumstances of the accident. The NTSB concludes that because the FRA developed standards and regulations for certified U.S. Department of Transportation crashworthy event recorder memory modules in response to the NTSB's prior recommendations, and a crashworthy event recorder was installed on the accident locomotive, information about this accident was available that otherwise would have been destroyed.

Forward-facing video cameras are not required by regulation. The BNSF and many other railroads are voluntarily installing forward-facing video cameras as a good safety practice that allows railroads to obtain factual information and to verify conditions related to incidents involving trespassers, highway-rail grade crossings at grade, and other accidents. These cameras have obvious value for accident investigation and prevention. In the Red Oak accident, this type of video data was not available because the recorder data was not stored in a crashworthy memory module and was lost to collision and fire damage. The NTSB believes that it would be a good safety practice for railroads to ensure that data from these voluntarily installed cameras be safeguarded. The NTSB concludes that because data from voluntarily installed locomotive video cameras are typically not stored in crashworthy memory modules, important operational and safety data are at risk of being lost following an accident. Addressing this risk provides an opportunity for the industry to revisit the best methods to preserve electronic data. As the NTSB has noted, the current regulatory standards allow enclosures to be designed to withstand temperatures as low as 750° C (1400° F), while diesel fires can burn at much higher temperatures. Therefore, the NTSB recommends that the AAR develop a standard that specifies the use of suitable crash-protected memory modules for all new and existing installations of on-board video and audio recorders. The memory modules should meet or exceed the survivability criteria specified in 49 *Code of Federal Regulations* 229.135 Appendix D, Table 2.

Therefore, the NTSB makes the following safety recommendations to the Association of American Railroads:

> Revise Association of American Railroads Standard S-580 to provide protection for the occupants of isolated operating cabs in the event of a collision, and make the revision applicable to all locomotives, including those newly constructed, rebuilt, refurbished, and overhauled. (R-12-23)

> Develop a standard that specifies the use of suitable crash-protected memory modules for all new and existing installations of on-board video and audio recorders. The memory modules should meet or exceed the survivability criteria specified in Title 49 *Code of Federal Regulations* 229.135 Appendix D, Table 2. (R-12-24)

As discussed in the Red Oak accident report, the NTSB reclassifies the following previously issued recommendation to the Association of American Railroads:

> Through appropriate and expeditious means, such as issuing and posting advisory bulletins on your website, use the occurrences of five recent rear-end collisions of freight trains—(1) Red Oak, Iowa, on April 17, 2011, (2) Low Moor, Virginia, on May 21, 2011, (3) Mineral Springs, North Carolina, on May 24, 2011, (4) DeWitt, New York, on July 6, 2011, and (5) DeKalb, Indiana, on August 19, 2011—to urge your members to undertake a review of their operations to identify the potential for similar occurrences and to take appropriate mitigating actions. (R-11-8)

Safety Recommendation R-11-8 is classified "Closed—Acceptable Action."

The NTSB also issued safety recommendations to the Federal Railroad Administration and the BNSF Railway. In response to the recommendations in this letter, please refer to Safety Recommendations R-12-23 and -24. We encourage you to submit updates electronically at the following e-mail address: correspondence@ntsb.gov. If your response includes attachments that exceed 5 megabytes, please e-mail us at the same address for instructions. To avoid confusion, please do not submit both an electronic copy and a hard copy of the same response.

Chairman HERSMAN, Vice Chairman HART, and Members SUMWALT, ROSEKIND, and WEENER concurred in these recommendations.

[Original Signed]

By: Deborah A.P. Hersman
Chairman