National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: March 21, 2002

In reply refer to: R-02-7

Mr. Matthew K. Rose
President
Burlington Northern Santa Fe Corporation
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The National Transportation Safety Board is an independent Federal a gency 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.

This recommendation addresses the lack of ultrasonic or other appropriate inspection of replacement rail, either before or after installation, to identify any internal defects. The recommendation is derived from the Safety Board's investigation of the derailment of National Railroad Passenger Corporation (Amtrak) train No. 5-17 on the Burlington Northern and Santa Fe Railway (BNSF) Creston Subdivision, near Nodaway, Iowa, on March 17, 2001, and is consistent with the evidence we found and the analysis we performed.[1] As a result of this investigation, the Safety Board has issued three safety recommendations, one of which is addressed to the Burlington Northern Santa Fe Corporation. Information supporting this recommendation 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 recommendation.

On March 17, 2001, about 11:40 p.m. central standard time, westbound Amtrak train No. 5-17, the *California Zephyr*, en route from Chicago, Illinois, to Oakland, California, derailed near Nodaway, Iowa. Amtrak train No. 5-17 consisted of 2 locomotive units and 16 cars. All but the last five cars derailed. No fire or hazardous materials were involved in the accident. The train crew consisted of an engineer and 2 conductors with 13 on-board service personnel. In addition, 241 passengers were on the train. As a result of the derailment, 78 people were injured, including 1 fatal injury.

[1] For additional information, see Railroad Accident Brief—*Derailment of Amtrak Train No. 5-17 on Burlington Northern and Santa Fe Railway Track near Nodaway, Iowa, March 17, 2001* (NTSB/RAB-02/01).

The National Transportation Safety Board determines that the probable cause of the derailment of Amtrak train No. 5-17 was the failure of the rail beneath the train, due to undetected internal defects. Contributing to the accident was the BNSF's lack of a comprehensive method for ensuring that replacement rail is free from internal defects.

Amtrak train No. 5-17 had originated at Chicago, Illinois, at 3:35 p.m. on March 17, 2001, and was destined for Oakland, California. The train crew had originated at Chicago. The engineer on duty when the accident occurred had relieved the original engineer at Ottumwa, Iowa, milepost (MP) 280, about 9:00 p.m.

As the train progressed on its assigned route, the engineer found that the horn/whistle on the lead locomotive failed near Murray, Iowa, MP 370, around 10:21 p.m. He advised the dispatcher for the district of the problem and discussed the failure with the conductor. They decided that the conductor would ride in the second locomotive and activate the horn/whistle on the second locomotive when the train approached and passed through grade crossings. They used this procedure until, at Corning, Iowa, MP 414, the train entered a different train dispatcher's district. The new train dispatcher, upon learning of the malfunctioning horn/whistle, instructed the crew to reduce the speed of the train at the grade crossings rather than using the horn/whistle on the second unit. The conductor of train No. 5-17 came forward and rode in the lead locomotive with the engineer to assist him in observing the crossings. The engineer stated (and event recorder information confirmed) that he began reducing the train's speed at grade crossings. At MP 418.94, the train speed had been 16 mph while passing through a grade crossing. The engineer was accelerating the train during the approach to the accident site (MP 419.92). The event recorder indicated that, at MP 419.90, the train was traveling at 52 mph.

The engineer stated that near MP 419.90 he felt a "tugging" sensation in connection with the train's progress and heard a "grinding, screeching noise," so he made an emergency brake application about 11:40 p.m. When the locomotives came to a stop, the engineer and conductor looked back and realized that the train's cars had uncoupled from the locomotives, and most cars had derailed. The cars were about 1/8 mile behind the stopped locomotives. The engineer radioed the dispatcher and asked him to contact emergency responders. The conductor walked back and surveyed the damage. After reaching the cars, the conductor radioed the engineer and said, "…the wreck look[s] real bad." The conductor found the assistant conductor, and they cared for the passengers. Soon thereafter, local emergency medical service personnel began to arrive and immediately started to evacuate the injured from the train. The emergency response effort was completed by 4:00 a.m., March 18.

A broken rail was discovered at the point of derailment. The broken pieces of rail were reassembled at the scene, and it was determined that they came from a 15-foot, 6-inch section of rail that had been installed as replacement rail at this location in February 2001. The replacement had been made because, during a routine scan of the existing rail on February 13, 2001, the BNSF discovered internal defects near MP 419.92. A short section of the continuous welded rail that contained the defects was removed, and a piece of replacement rail was inserted. This rail, referred to as a "plug," was used to replace the defective rail segment. It would have been visually inspected for obvious surface damage, defects, and excessive wear before installation. The plug rail did not receive an ultrasonic inspection before or after installation.

The Safety Board could not reliably determine the source of the plug rail. Two different accounts were given concerning its origin. The local supervisor said the rail came from his inventory of rail and had been in the inventory for several years. Another engineering manager thought that the rail had come from a rail rehabilitation facility in Springfield, Missouri. In either case, the replacement rail would have been rail removed from another track location for reuse.

After the March 17, 2001, accident, portions of the broken plug rail were sent to the Safety Board laboratory for further analysis. The analysis indicated that the rail had multiple internal defects. Specifically, the laboratory found that the rail failed due to fatigue initiating from cracks associated with the precipitation of internal hydrogen. Cracks associated with the precipitation of internal hydrogen occur in steels due to excessive hydrogen content produced during processing. Therefore, the Safety Board concludes that in February 2001, the BNSF replaced an identified defective rail with a segment of replacement rail that contained undetected multiple internal defects.

Aside from the horn/whistle problem, nothing about Amtrak train No. 5-17's operation as it approached the accident site was unusual. The train was traveling at an appropriate speed for the conditions, and the engineer was operating the train in accordance with BNSF rules and existing signal indications. The "tugging" sensation that the engineer told investigators he felt just before the accident is a typical indicator of a train experiencing a track failure. When the track was examined after the accident, it was found that a rail was broken at the point at which the defective replacement plug rail had been inserted in February 2001. Therefore, the Safety Board concludes that Amtrak train No. 5-17 derailed due to a failure in the plug rail that had been used to replace a defective piece of rail at the accident location.

Title 49 *Code of Federal Regulations* (CFR) 213.113 provides guidelines that railroads use for replacing defective rail. The regulations, however, focus on operational concerns regarding the defective rail; they do not address how replacement rail should be selected or screened for defects.

At the time of the accident, the BNSF was revising the directions for replacing defective rail that appear in its *BNSF Engineering Instructions*. The revised BNSF instructions added four new items for its personnel to consider when selecting a replacement rail. None of the new selection instructions would have disqualified the Nodaway replacement rail. According to the engineering instructions, as revised March 1, 2001, the BNSF was aware that defective rail might be replaced with another piece of defective rail. The instructions stated:

> Poor quality rail used for defect removal may itself become defective. One survey found that 17 percent of defects during the month measured were in rails installed to remove previous defects.

Altogether (including the four new instructions), the *BNSF Engineering Instructions* list seven guidelines to help personnel avoid using a defective rail to replace a known defective rail. The guidelines are based on previously determined methods of identifying marginal rail. All use external indicators or previous knowledge of the rail to disqualify the replacement piece. Nothing in the instructions requires BNSF personnel to scan replacement rail for internal defects before installing it in place of a known defective rail.

Because many internal imperfections cannot be detected through visual inspection, ultrasonically scanning a rail for internal defects is the best means of determining whether a piece of rail is sound and unflawed. No Federal regulations require railroads to verify the quality of the rails used to replace defective rails, and replacement rails are not typically scanned for internal defects before they are used to replace rails that have been identified as defective. Consequently, when they are installed, the replacement rails may actually have internal flaws that have not been discovered, as was the case with the Nodaway plug rail. The Safety Board therefore concludes that using rails that have not been ultrasonically scanned for internal defects before they are installed as replacements for known defective rails may allow the flawed rails to be replaced by other flawed rails.

Most railroads rely on the fact that all existing rail must be ultrasonically scanned while in place on the track, in accordance with the requirements at 49 CFR 213.237. Therefore, if a piece of rail has been removed from a track location and stored for future use as replacement rail, a railroad may assume that the replacement rail was scanned while in its previous location and that it passed that inspection. However, this was the process used for the plug rail that failed in the Nodaway accident, and that rail segment was, in fact, defective.

Scanning performed in accordance with 49 CFR 213.237 is only required to be conducted "at least once every 40 million gross tons (mgt) or once a year, whichever interval is shorter" for class 4 track. In effect, this means that it could take as long as a year for a railroad to scan any given section of rail to detect internal flaws. Although the BNSF exceeds the regulatory criteria and scans such track for internal defects once every 30 days, this still means that defective replacement rail could be in place on BNSF class 4 track for as long as a month while rail traffic continues to travel over it. The failure of the Nodaway replacement rail took place within about a month of its being installed at MP 419.92, and the BNSF had not yet routinely scanned this section of rail for internal flaws. The Safety Board concludes that relying on scanning schedules as are required under 49 CFR 213.237 to ensure the safety of replacement rail does not provide sufficient protection against the possibility of a replacement rail being internally defective.

Since the Nodaway accident, the BNSF has required that its personnel scan some replacement rail to be inserted into existing track for internal defects before the replacement is made. However, this requirement applies only to main tracks with passenger train usage and/or train densities of at least 20 mgt per year. Replacements may be made with unscanned rail on all other types of track. Of the BNSF's 29,043 miles of main track, approximately 9,157 track miles are on passenger routes and 10,126 track miles are on nonpassenger routes that carry more than 20 mgt per year. In other words, approximately 9,760 miles, or 34 percent, of BNSF main track is not subject to pre-replacement scanning of replacement rails. The Safety Board considers that limiting the scanning requirement to main track that carries passenger trains or has 20 mgt or more traffic per year leaves a substantial amount of trackage at risk for having defective replacement rails inserted into existing track. The internal defects of such rails could cause rail failures, possibly leading to derailments or other types of accidents, before the defects are detected by the railroad through its routine rail scanning procedures, as required under 49 CFR 213.237.

Therefore, the National Transportation Safety Board makes the following safety recommendation to the Burlington Northern Santa Fe Corporation:

Implement a permanent policy of inspecting for internal defects, using ultrasonic or other appropriate means, any rail used to replace a defective segment of existing rail. (R-02-7)

The Safety Board also issued safety recommendations to the Federal Railroad Administration and to class I and passenger railroads (except the Burlington Northern and Santa Fe Railway). In your response to the recommendation in this letter, please refer to Safety Recommendation R-02-7. If you need additional information, you may call (202) 314-6607.

Chairman BLAKEY, Vice Chairman CARMODY, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

Original Signed

By: Marion C. Blakey
Chairman