National Transportation Safety Board
Washington, D.C. 20594

Railroad Accident Brief

Accident No.:	DCA-01-MR-003
Location:	Nodaway, Iowa
Date of Accident:	March 17, 2001
Time:	11:40 p.m. central standard time
Railroads:	Burlington Northern and Santa Fe Railway National Railroad Passenger Corporation (Amtrak)
Fatalities:	1
Injuries:	77
Property Damage:	$3.38 million
Type of Accident:	Derailment

The Accident

On March 17, 2001, about 11:40 p.m. central standard time, westbound Amtrak train No. 5-17, the *California Zephyr*, 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.

Amtrak train No. 5-17 had been operating over class 4 track belonging to the Burlington Northern and Santa Fe Railway (BNSF)[1] Creston Subdivision at the time of the derailment. A broken rail was discovered at the point of derailment.

The train had originated at Chicago, Illinois, at 3:35 p.m. on March 17, 2001, (30 minutes late) and was destined for Oakland, California. The train crew had boarded 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

[1] The BNSF is a subsidiary of the BNSF Corporation. The BNSF operates one of the largest railroad networks in the United States, with 33,500 route miles covering 28 States and 2 Canadian provinces. The BNSF network was created in September 1995 through the merger of the rail systems of the Burlington Northern Railroad and the Atchison, Topeka, and Santa Fe Railway.

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 use 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. The plug rail did not receive an ultrasonic inspection before or after installation. It would have been visually inspected for obvious surface damage, defects, and excessive wear before 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.

Portions of the broken plug rail were sent to the National Transportation 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.

Replacing Defective Rails

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 maintenance personnel to consider when selecting a replacement rail.[2] None of the new selection instructions would have disqualified the Nodaway plug rail segment for use as a 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 manual 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. For example, they state "Do not use 'A' rails or non-control cooled rail 112# or heavier for replacement in main track and sidings," because historical experience has shown that "A" rail and non-control cooled rail have a relatively high incidence of internal defects. All seven guidelines rely on 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.

Regulatory Requirements

Title 49 *Code of Federal Regulations* (CFR) 213.113 provides guidelines for replacing defective rail. The regulations are primarily concerned with the nature of the defect in the rail, the circumstances under which the defective rail may temporarily continue in use, and the timetables for replacing the defective rail. Nothing in the regulations provides a screening process for selecting or ensuring the quality of a replacement rail.

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[2] The new instructions were 1) If the track carries more than 20 million gross tons (mgt)/year, make every effort to use rail known to have accumulated less than 500 mgt, or rail no more than 5 years older than parent rail; 2) Use replacement rail with good surface quality, with no corrugation, head checking, shelling, or spalling; 3) Do not use rail branded "Algoma," "British," "Vilru," or "Workington"; and, 4) Do not use rail recovered from the main body of curves relayed due to defects or rail surface condition.

Title 49 CFR 213.233 provides track inspection requirements. The required inspection periods for class 4 track are twice weekly, with at least 1 calendar day between inspections. The BNSF exceeded these criteria and conducted daily inspections on the section of track where the accident took place. According to regulation, inspections must be performed either "on foot or by riding over the track in a vehicle at a speed that allows the person making the inspection to visually inspect the track structure for compliance with this part."

Title 49 CFR 213.237 requires that rail systems conduct "A continuous search for internal defects" on their tracks. For class 4 track, the minimum frequency of inspection required is "at least once every 40 mgt or once a year, whichever interval is shorter." Again, the BNSF exceeded these criteria with respect to the accident area and scanned the rail for internal defects once every 30 days.

Actions Taken Since the Accident

Since the Nodaway accident, the BNSF has required its maintenance personnel to scan some replacement rails for internal defects before the rails are inserted into existing track. However, the testing requirement applies only to main tracks over which passenger trains travel and/or which have train densities of at least 20 mgt per year.[3] The BNSF has approximately 29,043 miles of main track, of which 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.

The Safety Board is not aware of any class I railroad other than the BNSF with a procedure for checking the internal quality of rail being used to replace known defective rail. Most railroads rely on the fact that all existing rail is 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 plug rail was, in fact, defective.

[3] In 1999, the train density for the track on which the Nodaway accident occurred was approximately 104 mgt.

Probable Cause

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 Burlington Northern and Santa Fe Railway's lack of a comprehensive method for ensuring that replacement rail is free from internal defects.

Adopted: March 5, 2002

Recommendations

As a result of its investigation of the Nodaway, Iowa, railroad accident, the National Transportation Safety Board makes the following safety recommendations:

To the Federal Railroad Administration:

> Require railroads to conduct ultrasonic or other appropriate inspections to ensure that rail used to replace defective segments of existing rail is free from internal defects. (R-02-5)

To Class I and Passenger Railroads (except the Burlington Northern and Santa Fe Railway):

> Conduct ultrasonic or other appropriate inspections on all rail used to replace defective segments of existing rail to ensure that the replacement rail is free from internal defects. (R-02-6)

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)