National Transportation Safety Board
Washington, D.C. 20594

Railroad Accident Brief

Accident No.:	DCA-02-FR-002
Location:	Pacific, Missouri
Date of Accident:	December 13, 2001
Time:	5:46 a.m. central standard time
Railroad:	Union Pacific Railroad Company
Trains:	Trains 2CNAAE-10, CNRBW-10, and CPAWE-13
Injuries:	4
Property Damage:	$10 million
Type of Accident:	Rear-end collision and collision with derailed equipment

Synopsis

About 5:46 a.m.[1] on December 13, 2001, three Union Pacific (UP) freight trains were involved in a collision and derailment on the Jefferson City Subdivision at Pacific, Missouri, about 35 miles southwest of St. Louis. The collision occurred in double main track territory governed by a centralized traffic control signal system. In total 6 locomotives and 74 cars were derailed.

There were two crewmembers on each of the three trains. Two crewmembers were seriously injured, and two received minor injuries. There was a release of 10,000 gallons of diesel fuel and a small fire. Damages were $10 million.

The weather was overcast with misting rain and a temperature of 36° F. It was dark at the time of the collision.

The Accident

Eastbound train 2CNAAE-10 consisted of two locomotives on the head end, 135 loaded coal cars, and an additional locomotive, operated as a distributed power unit (DPU), on the rear.[2] The rearward-facing headlight on a DPU is required to be displayed on “dim” (not at full brightness); witnesses indicated that they observed that the headlight on the rear of the DPU was illuminated. About 5:30 a.m. the engineer stopped the train at

[1] All times are central standard time.

[2] *Distributed power* is one or more locomotives at the rear of the train controlled by radio signals from the lead locomotive.

a *stop* signal at Control Point (CP) Dozier at milepost 32.6. The DPU at the rear of the stopped train was near milepost 34.2. The engineer stated that about 5:45 a.m., while stopped waiting for the signal to proceed, a westbound train (CPAWE-13) passed on the adjacent track. The engineer told investigators that an emergency brake application occurred and he thought that it might have been caused by a fault with the DPU. As he tried to reset the DPU he became aware of employees calling for help on the radio.

The engineer and conductor went toward the back of their train and saw derailed equipment and emergency personnel treating injured train crewmembers. They discovered that their train had been struck in the rear by a following eastbound train (CNRBW-10). The westbound train (CPAWE-13) that had passed them on the adjacent track had collided with cars that had been derailed because of the first collision.

Eastbound train CNRBW-10 had been following train 2CNAAE-10 on the same track. CNRBW-10 had two locomotives on the head end, 133 loaded coal cars, and a locomotive DPU at the rear. Upon impact, and as the train cars began to derail and separate, CNRBW-10 went into emergency braking. The lead locomotive unit rolled to the right (south) onto its side with the trailing locomotive and the following 54 cars derailing. The struck DPU of train 2CNAAE-10 and rear six cars derailed to the north, blocking the adjacent track. The engineer and conductor of CNBRW-10 sustained serious injuries.

The second collision occurred as westbound train CPAWE-13 was passing the stopped 2CNAAE-10. Train CPAWE-13 had three locomotives and 104 empty freight cars. The engineer of CPAWE-13 told investigators that he had a *clear* signal before passing the head-end of the stopped train while traveling about 24 mph. Shortly thereafter, while still passing the stopped train, he saw that the track ahead was obstructed by derailed equipment, made an emergency brake application, and dove to the floor. The locomotive event recorder showed that CPAWE-13 struck the derailed equipment at 17 mph. The collision resulted in the derailment of the three locomotives of CPAWE-13, the two cars immediately behind the locomotives, and three additional cars farther back in the train. In addition, 9 of 25 cars stored on an adjacent siding were derailed. The engineer and conductor of CPAWE-13 received minor injuries.

Diesel fuel was spilled from ruptured locomotive fuel tanks and fueled a small fire. Responding emergency personnel arrived within minutes of the accident, with additional personnel arriving about 10 minutes later. Emergency response personnel extinguished the fire and removed the injured crewmembers from the wreckage. The injured were transported to a St. Louis hospital.

Postaccident Information

Six crewmembers were toxicologically tested as required after a train accident by 49 *Code of Federal Regulations* Part 219. The results for tested illegal substances were negative in each case.

Examination of the wayside signal system indicated that the crew of train CNRBW-10 had a *clear* signal (green aspect) at milepost 42.0; an *advanced approach* signal (flashing yellow aspect) at milepost 40.6; an *approach* signal (yellow over red aspect) at CP Summit, milepost 37.3; and a *stop and proceed* signal (red aspect with number plate) at milepost 35.2.

Event recorder data from the lead locomotive of CNRBW-10 indicated that the locomotive horn was sounded for several grade crossings before the accident. The last recorded crewmember action was the sounding of the horn for a grade crossing at milepost 34.6. About 32 seconds later, CNRBW-10 struck the rear of the stopped 2CNAAE-10 at a speed of 48 mph. According to the event recorder data, the engineer of CNRBW-10 did not attempt an emergency brake application before the collision.

Event recorder data also indicated that CNRBW-10 was in dynamic braking and moving at 42 mph past the location of a wayside signal that was displaying an indication of *approach*. UP's special instructions require that the crew of a freight train that encounters an *approach* signal must immediately reduce speed to no more than 30 mph and be prepared to stop before passing the next signal. Event recorder data indicated that the train passed through a temporary 40-mph speed restriction[3] at 47 mph. Approximately a mile before the collision, the train passed a signal that was displaying a *stop and proceed* indication.[4] The train passed this location at 48 mph with the locomotives in dynamic braking and the train air brakes released. Although the locomotives were in dynamic braking, the braking effort was not sufficient to slow the train as it descended a grade for 5 miles between approximate milepost 40 to milepost 35. During this time the train speed was increasing.

Crew of CNRBW-10

The engineer had been off duty for 13 hours and 30 minutes, and the conductor had been off duty for 12 hours and 10 minutes, before beginning their tour of duty. They had been on duty for about 6 hours and 26 minutes at the time of the accident. The engineer was 50 years old and started with the railroad on July 24, 1976. She was a certified locomotive engineer and last attended a rules class on February 6, 2001. The

[3] The speed restriction was in place from milepost 35.0 to milepost 35.25 due to a culvert condition.

[4] An indication of *stop and proceed* requires a train to come to a complete stop before passing the signal, and then proceed at restricted speed until reaching the next signal. Restricted speed requires that the train be controlled in a manner that will enable it to be stopped within one-half the range of vision, not to exceed 20 mph. A train can only encounter a *stop and proceed* indication after it has previously passed an *approach* indication.

conductor, also 50 years old, began working for the railroad on July 1, 1996. His last rules class was on January 19, 2001.

The engineer indicated that she did not sleep well during the off-duty time before she was called to work. When asked how much sleep she had, she told investigators that she could not recall. The engineer told investigators that she remembered talking with the dispatcher and sounding the horn for grade crossings, but she did not remember any signal indications.[5]

The conductor did not recall any *approach* signals or a *stop and proceed* signal. He did not remember seeing the DPU headlight before the collision. He told investigators that he was recording the signal indications in his signal logbook. However, Safety Board investigators were unable to locate the logbook in the wreckage.

Equipment

CNRBW-10 was a 133-car coal train that weighed 18,918 tons and was 7,182 feet long. Investigators examined the locomotives and the undestroyed cars of CNRBW-10 including the rear 80 cars. Investigators found one car with inoperative brakes and one brake shoe that was missing on another car. The engineer of CNRBW-10 told investigators that, before the collision, she had stopped the train near milepost 94 and the train stopped satisfactorily.

The lead locomotive of CNRBW-10, UP 6414, was not equipped with an alerter.[6] UP has over 7,200 road locomotives in their fleet; about 68 percent are equipped with alerters. Additionally, UP representatives stated all new UP locomotives are purchased with alerters. UP officials told investigators that the railroad is in a retrofit process to complete alerter installation in 2005 and that all locomotives purchased within the last 2 years are equipped with alerters.

Fatigue

Fatigue increases during certain times of the 24-hour day and can be amplified by irregular work and sleep cycles. The engineer told investigators that she did not sleep well during her time off duty before reporting for her work assignment. Studies of circadian work-rest cycles[7] indicate that there is a greater likelihood of fatigue-related accidents in the early morning hours. This accident occurred at 5:46 a.m.

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[5] During a second interview, the engineer told investigators that she remembers searching for paperwork in the wreckage after the collision. She indicated that she might have been distracted by the paperwork falling to the floor before the collision.

[6] An *alerter* is a device that monitors the control inputs and other responses by the engineer. If no inputs are received during a preset time period, the alerter will sound an alarm. If no response is received during a preset time after the alarm, the alerter will cause the train brakes to automatically apply.

[7] *Circadian rhythms* describe the regular recurrence, in cycles of about 24 hours, of biological processes or activities, such as sensitivity to drugs or stimuli, hormone secretion, sleeping, and feeding.

The failure of the engineer and conductor to comply with three wayside signals that displayed *advanced approach, approach,* and *stop and proceed*, requiring appropriate action to be taken to safely control their train, cannot be explained if they were fully alert. The conductor was also required to be aware of the 40-mph slow order and, if alert, would have noticed that the train traversed the area at a significantly higher speed and that the speed was increasing during the time the train was passing over the area affected by the slow order. In addition, the time of day and the crewmembers' not seeing the glare of the DPU's rear headlight that was immediately ahead of them, or initiating an emergency application of the brakes in the moments before the collision, indicate that they were not sensitive to their surroundings even when faced with an imminent collision.

Positive Train Control Systems

The Safety Board has investigated numerous train collisions in which the probable cause or contributing cause was the inattention of the crewmembers to wayside signals. In its investigation of the head-on collision of two freight trains near Kelso, Washington,[8] the Safety Board reported its concerns about a systemic safety issue: the adequacy of passive wayside signals to reliably capture train crews' attention, and it urged the railroad industry to recognize that human vigilance has limits and that wayside signals do not ensure safe train operations. After its investigation of the Thedford, Nebraska;[9] Silver Spring, Maryland;[10] Delia, Kansas;[11] and Bryan, Ohio;[12] accidents the Safety Board again stated that had a positive train control system with an anti-collision component been in place at the accident locations, it could have detected that the engineers were not responding appropriately to the signal indications and could have slowed and stopped the trains.

This rhythm seems to be set by a "biological clock" that appears to be regulated by recurring daylight and darkness. Also see M. R. Rosekind, *Fatigue in Transportation: Physiological, Performance, and Safety Issues*. Prepared for the National Transportation Safety Board, Washington, D.C., April 1999.

[8]National Transportation Safety Board, *Head-on Collision and Derailment of Burlington Northern Freight Train with Union Pacific Freight Train, Kelso, Washington, November 11, 1993*. Railroad Accident Report NTSB/RAR-94/02 (Washington, D.C.; NTSB, 1994).

[9] National Transportation Safety Board, *Collision and Derailment Involving Three Burlington Northern Freight Trains near Thedford, Nebraska, June 8, 1994*. Railroad Accident Report NTSB/RAR-95/03 (Washington, D.C.: NTSB, 1995).

[10] National Transportation Safety Board, *Collision and Derailment of Maryland Rail Commuter MARC Train 286 and National Railroad Passenger Corporation AMTRAK Train 29, Silver Spring, Maryland, February 16, 1996*. Railroad Accident Report NTSB/RAR-97-02 (Washington, D.C.: NTSB, 1997).

[11] National Transportation Safety Board, *Collision Between Union Pacific Freight Trains MKSNP-01 and ZSEME-29 near Delia, Kansas, July 2, 1997*. Railroad Accident Report NTSB/RAR-99/04 (Washington, D.C.: NTSB, 1999).

[12] National Transportation Safety Board, *Collision Involving Three Consolidated Rail Corporation Freight Trains Operating in Fog on a Double Main Track Near Bryan, Ohio, January 17, 1999.* Railroad Accident Report NTSB/RAR-01/01 (Washington, D.C.: NTSB, 2001).

The Pacific accident is another of a series of collisions that could have been prevented had a positive train control system been in place. Such a system could have detected that the CNRBW-10 engineer was not responding appropriately to signal indications and then slowed and stopped the train before it collided with the 2CNAAE-10.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the rear-end collision of eastbound train CNRBW-10 with eastbound train 2CNAAE-10 and the resulting collision of westbound train CPAWE-13 was the conductor and engineer of train CNRBW-10 being in a fatigue-induced unresponsive state as their train passed several wayside signals and approached the rear of train 2CNAAE-10.

Adopted: June 17, 2004