National Transportation Safety Board

Washington, D.C. 20594

Railroad Accident Brief

Accident No.:	DCA-04-FR-006
Location:	Carrizozo, New Mexico
Date:	February 21, 2004
Time:	7:54 a.m. mountain standard time[1]
Railroad	Union Pacific Railroad
Property Damage:	$1,964,543
Fatalities:	2
Injuries:	0
Type of Accident:	Collision

Synopsis

About 7:54 a.m. on Saturday, February 21, 2004, Union Pacific Railroad (UP) eastbound freight train AMLKS-18, consisting of 2 locomotives and 78 empty multi-level cars, struck a westbound UP freight train, GLPNEP-16, consisting of 4 locomotives and 93 loaded covered hopper cars.[2] The westbound train was struck about 25 hopper cars behind its locomotives, resulting in 11 derailed cars (the 26th through the 35th). The striking train had two locomotives, and its first 11 cars derailed as a result of the collision. Both crewmembers of the striking train were killed. The crewmembers of the westbound train were unharmed. Diesel fuel released from the ruptured tanks of the striking train's locomotives caught fire, which was extinguished by the local fire department. There was no evacuation of the area. The estimated damage was $1,964,543.

The Accident

The accident occurred at milepost (MP) 825.8, at the east turnout switch to a siding from the single track mainline at Carrizozo, New Mexico. The westbound train was moving on a *diverging approach* signal into the siding from the mainline. Before the eastbound train struck the westbound train, it had traveled past a mainline *advanced approach* signal, an *approach* signal, and a *stop* signal.

[1] All times in this brief are mountain standard time.

[2] Train AMLKS-18, or the striking train, will be referred to as the eastbound train, and train GLPNEP-16, or the struck train, will be referred to as the westbound train throughout this brief.

The track in this area is owned by the UP and is part of the UP's Tucson Service Unit, Carrizozo Subdivision, which is between El Paso, Texas (MP 968.6), and Vaughn, New Mexico MP (739.6). The maximum timetable speed for freight trains operating in the vicinity of the accident was 70 miles per hour (mph). At the time of the collision, the eastbound train was traveling about 36 mph, and the westbound train was traveling about 23 mph.

Investigation

The investigation revealed that both train crews were qualified and trained to properly perform their duties and had been tested. The crewmembers of the westbound train stated that their trip up until the time of collision was routine, that they were not distracted or preoccupied, and that they had experienced no equipment or weather problems prior to the accident.

No evidence was found indicating that track conditions caused or contributed to the accident. Postaccident sight-distance tests, weather records, local witness statements, and train crew statements showed that no weather-related factors affected the performance of the trains or crewmembers. Additional testing and a records review showed that the signal and train-control systems had functioned as designed. Postaccident equipment inspections and air brake tests also showed that the locomotives and rolling stock of both trains had no defects that would have caused or contributed to the collision.

The mainline track train movements, including movements onto and off the main track and sidings, were governed by a wayside traffic control signal system, a dispatcher in Omaha, Nebraska, and several rules documents. The crewmembers were qualified; they had demonstrated their knowledge and had successfully completed tests conducted by the railroad on a periodic basis to show that they had maintained their proficiency in the knowledge and practice of rules and operating practices.

Figure 1. Overpass view of wreckage.

Eastbound Train Crew Performance

It is apparent that the eastbound engineer was suffering from the effects of fatigue at the time of the accident. According to his spouse, he had awoken at about 7:30 a.m. on the morning of February 20, the day before the accident, and had remained at home and awake all day. She also said that when he went to bed on the evening of February 20, he had been off the previous 24 hours and had retired between 6:00 p.m. and 7:00 p.m., anticipating that he would be called for work about 6:30 a.m. the following morning. However, he was called at 10:40 p.m. to report for duty at 12:20 a.m. on Saturday, February 21. She recalled that when he received the call he was tired and upset at having to go to work approximately 6 hours before he had anticipated doing so. At the time of the accident, he had been continuously awake for about 9 hours 15 minutes, and had slept only 3 ½ to 4 ½ hours in the previous 24 ½ hours.

Figure 2. Wreckage of two Union Pacific Railroad freight trains.

The eastbound conductor's work/rest history indicates that he had slept only about 5 hours in the 27 to 28 hours before the accident. At the time of the accident, he had been continuously awake for about 10 hours and had slept only between 2 ½ and 3 hours during his most recent sleep period.

The event recorder data from the lead locomotive of the eastbound train showed that at 6:08 a.m., the engineer had increased the locomotive throttle from position 7 to position 8, the highest possible position. The recording also disclosed that the train's horn was activated at 6:57 a.m., about 57 minutes and approximately 29 miles before the accident, while the train was traveling at 55 mph.[3] The investigation determined that activating the horn was the last control input by the engineer before the accident. The train then remained in throttle position 8 until the collision, approximately 1 hour 46 minutes later. During the period when the engineer had no control inputs, the speed of the train varied with the topography. Although the railroad in the accident area is not particularly demanding from a train-handling viewpoint, more control activity on the part of the engineer would have been expected than was recorded on the event recorder. The event recorder revealed that speed increased to 48 mph at 7:41 a.m., about 13 minutes before the collision. At 7:47 a.m., about 7 minutes before the collision, the speed fell to 27 mph. The speed then increased until the time of collision and was 36 mph at 7:54 a.m. The *approach signal* indication required the engineer to reduce speed to 30 mph, prepared to stop at the next signal. The investigation revealed that the *red stop* signal could clearly be observed about 7,500 feet before a train reached it. However, the crew took no action to slow the train

[3] The event recorders showed that the train had not exceeded the authorized track speed of 70 mph.

after passing the *approach signal* indication. Additionally, the investigation revealed that the horn was not blown, as required, for four grade crossings.[4]

Postaccident toxicological tests for the crewmembers of the westbound train and the conductor of the eastbound train were negative for the presence of alcohol and drugs. Toxicological test results for the eastbound engineer, however, indicated the presence of marijuana in his blood, urine, and organs. According to the report[5] of the results:

> It would appear that the deceased engineer was clearly under the influence of and/or impaired by marijuana at the time of the accident…recent use (somewhere between one and four hours before the accident) of some amount of marijuana by the deceased engineer appears certain.

After the accident, a bag containing 1.88 grams of marijuana, a hinged wooden pipe with 0.05 grams of marijuana, and a loaded .22 caliber pistol were found in the eastbound engineer's pants.[6] Marijuana affects the brain areas involved in physiological, psychomotor, and cognitive functions. Marijuana alters motor behavior, perception, cognition, memory, learning, food intake, endocrine function, and the regulation of body temperature. Potential side effects include paranoia, memory problems, lethargy, mood alterations, slurred speech, dizziness, sleepiness, and fatigue.

Studies have demonstrated the impairment of driving-related skills for up to 3 hours after an individual has used marijuana.[7] Marijuana may particularly impair a driver whose route is monotonous and long.[8] Researchers have also found that cognitive impairments resulting from marijuana use can last up to 28 days.[9]

UP rules require a conductor to record all signals other than *clear*, as well as defect detector information, in a logbook (Union Pacific Conductor Report Form 20849). Postaccident examination of the conductor's logbook revealed that he had made an entry at MP 927.4, approximately 102 miles before the collision. Pursuant to the rules, he should have recorded the status of six defect detectors (between MP 933.4 and Carrizozo), as well as the *advance approach* signal, the *approach* signal, and the *stop* signal, in his logbook as the train approached Carrizozo.

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[4] Grade crossings at MP 853, MP 851.5, MP 837, and MP 825.9.

[5] Greystone Health Sciences Corporation, La Mesa, California, letter to the Federal Railroad Administration dated February 29, 2004.

[6] Chemical Analysis for Controlled Substances. New Mexico Department of Public Safety, Southern Crime Laboratory (March 3 and 5, 2004).

[7] R.C. Baselt, *Drug Effects on Psychomotor Performance* (Foster City, CA: Biomedical Publications, 2001).

[8] Fiona J. Couper, and Barry K. Logan, *Drugs and Human Performance Fact Sheet*, National Highway Traffic Safety Administration: Final Report, August 2000 - March 2004 (Washington, DC: NHTSA, 2004).

[9] K.I. Bolla and others, "Dose-related neurocognitive effects of marijuana use," *Neurology* Vol. 59, No. 9 (2002): 1337-1343.

UP rules require that the conductor supervise the operation and administration of the train and stipulate that crewmembers in the locomotive control compartment be alert for signals and communicate clearly to each other the name or aspect requirement for any signal (other than *clear*) affecting their train movement. UP rules also state that if the engineer does not respond appropriately to signal indications, others in the cab must immediately take action to ensure safety, using the emergency brake valve to stop the train, if necessary. The conductor can put the train into emergency braking from his side of the locomotive.

The conductor's failure to enter the required information about the six defect defectors between MP 933.4 and Carrizozo and about the signal indications as the train approached the accident site suggests that he was not attentive. Further, he should have alerted the engineer to the restrictive signal indications, and that another train was on the track directly in front of them and a collision would occur if braking was not initiated. Also, his failure to place the train into emergency braking when another train was directly in front of his train and when a collision was imminent strongly suggests that he was not alert and was likely asleep.

The effects of marijuana on the engineer would thus have manifested in an environment in which the engineer was operating with few or no performance demands on him, as evidenced by no control inputs for almost 1 hour before the collision and in which the engineer had limited sleep within the previous 24 hours. Both the engineer and conductor were operating the train during one of the two periods of maximum sleepiness during a 24-hour period,[10] determined by physiological fluctuations controlled by the brain.[11] Finally, although the train's speed varied for several hours prior to the collision in accordance with changes in the track topography, the throttle was in position 8 for almost 2 continuous hours. The resulting audible and tactile sensations produced while in this throttle position would have remained constant and likely have created a monotonous environment in which the impaired engineer operated.

The combined effects of operating in a monotonous environment during a time of day associated with reduced alertness, limited sleep in the previous 24 hours, and the use of marijuana would have contributed to the engineer's falling asleep. Furthermore, the fact that the potential side effects of marijuana include sleepiness and fatigue would only decrease the engineer's ability to remain alert and focused. Finally, even though the engineer was impaired by the effects of marijuana at the time of the accident, it is unreasonable to presume he would have done nothing to try to avoid an imminent collision, including initiating an emergency braking or jumping from the train, had he at least been awake and able to observe the westbound train. The fact that a seasoned engineer failed to take any action under such circumstances further supports the likelihood that he was asleep at the time of the collision.

[10] Identified as occurring between approximately 1:00 a.m. and 7:00 a.m. and between about 1:00 p.m. and 5:00 p.m.

[11] Rosekind, M., Gander, P., Connel, L., and Co, E., "Crew Factors in Flight Operations X: Alertness Management in Flight Operations." NASA-FAA Technical Memorandum DOT/FAA/RD-93/18, 1994.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the February 21, 2004, accident was the failure of the engineer of AMLKS-18 to stop as directed by wayside signal because he was asleep, which was induced by his lack of sleep prior to the accident and his marijuana use. Contributing to the cause of the accident was the failure of the AMLKS-18 conductor to oversee the safe operation of the train because he was also asleep.

Adopted: October 31, 2006