National Transportation Safety Board

Railroad Accident Brief

Angels Flight Railway Derailment

Accident No.:	DCA13FR011
Location:	Los Angeles, California
Date:	September 5, 2013
Time:	11:30 a.m. pacific daylight time
Railroad:	Angels Flight Railway Foundation
Property Damage:	$6,000
Injuries:	None
Fatalities:	None
Type of Accident:	Derailment

On September 5, 2013, about 11:30 a.m. pacific daylight time, an Angels Flight Railway (Angels Flight) car that was moving down the incline derailed near the middle of the guideway.[1] One passenger was on board the derailed car, and five passengers were on board the stalled car that had been moving up the incline. The temperature was 93°F, and the weather was clear. No passengers were injured.

When the operator of the Angels Flight cars recognized that a car had stopped on the incline, he initiated a command to return each car to its respective destination gate. The operator told an NTSB investigator that he was unaware of the derailment. Both cars moved about 100 feet and stopped; neither car reached a gate. Then, the operator reversed the direction of the cars in an attempt to reposition each car at its starting gate. The derailed car moved uphill and stopped. At this time, the operator recognized that the car had derailed. (See figure 1.)

Figure 1. Derailed Angels Flight car.

[1] All times in this report are in Pacific daylight time.

Angels Flight Railway Derailment

Angels Flight is a two-car funicular railway in downtown Los Angeles, California, that is operated and managed by the nonprofit Angles Flight Railway Foundation. The cars are moved about 300 feet by means of a wire rope on an inclined guideway. The power for the wire rope is supplied by the station house at the top of the guideway. An operator controls the car movement (and collects fares from passengers) from a booth at the station house. The operator can operate the cars in either an automatic mode or a manual mode. The maximum car speed is 3 1/2 miles per hour.

The NTSB conducted a prior accident investigation at Angels Flight. This accident involved a collision and a passenger fatality on February 1, 2001.[2] The NTSB determined that the probable cause of that accident was the improper design and construction of the Angels Flight funicular drive and the failure of various organizations involved in that design and construction to ensure that the railway system conformed to initial safety design specifications and known funicular safety standards. As a result of that investigation, the NTSB issued two safety recommendations to the California Public Utilities Commission (CPUC).

Angels Flight reopened on March 15, 2010. At that time, a safety redesign had been implemented: a track brake was mounted on each car. Electrical power to the track brake system was provided from a third-rail parallel to the guideway, and a set of batteries was installed on each car to provide backup power. Electrical grounding for the track brake system was provided by a car-mounted wire brush that contacted a wheel. The track brakes were designed to be tested only when the cars were stopped. (See figure 2.)

During periodic inspections, the CPUC inspectors found abnormal wheel and rail wear. The car body and the wheel-axle assembly are not articulated. The car moving downhill was pulled through the curve by gravity, and the uphill car was pulled through the curve by the rope. This nonarticulated movement caused steel-on-steel contact for the wheels, the running rail, and the guard rail. When the thickness on the wheels decreased to nearly 0.25 inches, the CPUC ordered Angels Flight to close on June 10, 2011. No direct applicable wheel standard addressed the unique diameter of the Angels Flight car wheels—including standards published by the Federal Railroad Administration (FRA), the Association of American Railroad (AAR), and the Association of Mechanical Engineers (ASME). The CPUC and Angels Flight jointly developed proportional standards for the car wheels. Angels Flight agreed to adhere to these standards. The CPUC allowed Angels Flight to resume revenue operation on July 5, 2011. To lessen the effects of steel-on-steel contact, Angels Flight personnel applied grease to the entire rail head.

[2] *Uncontrolled Movement, Collision and Passenger Fatality, Angles Flight Railway in Los Angeles, California, February 1, 2001,* Railroad Accident Report NTSB/RAR-03/03 (Washington, D.C.: National Transportation Safety Board, 2003). <http://www.ntsb.gov>

Figure 2. Track brake ram head in contact with the rail head.

The days before the September 5, 2013, accident were unseasonably warm. On September 4, 2013, the director of maintenance applied what he called a "liberal" coat of grease to the rail to offset the heat effect of the high temperature (92°F). During the investigation, NTSB investigators found that grease had fouled the wire brush head and that the batteries were discharged.

Angels Flight personnel said that the cars had experienced undesired stops for some time. When these undesired stops occurred, the operator was required to depress and hold the start (that is, the run) button on the control panel. This action allowed the operator to move the cars in a manual operation. Typically, each car was moved by operator to its destination gate. The frequency of the undesired stops had increased over time. During the days prior to the accident, the stops could occur multiple times on a single trip. The operators used a small stick (that is, a branch from a nearby tree) to constantly depress the start button. (See figures 3 and 4.) The operator said that he was using the stick at the time of the derailment. The operator also said that Angels Flight management was aware of the stick, which could be readily seen in the station house controls.

When the operator saw the cars stop because of the derailment, he mistakenly believed it was just another undesired stop. Consequently, he started to manually move each car to its destination gate. The operator was able to move the cars until the force on the rope surpassed the threshold of the drive-system limiting switch. With the stick wedged in place, the safety systems were negated.

After the derailment, passengers had to either self-evacuate or be evacuated with the assistance of a firefighter. Video from the Angels Flight cameras showed that one passenger crawled from a stranded car to the upper platform. The passengers had to evacuate across open ties. Angels Flight does not have a suitable evacuation route—walkways, railings, or guide ropes—to prevent passengers or emergency rescue personnel from falling onto the sidewalk 25 feet below.

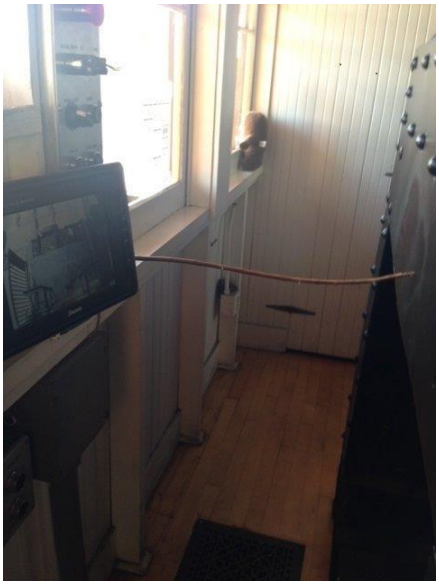

Figure 3. Wedged tree limb.

Figure 4. Start button with wedged tree limb.

Postaccident Actions

The CPUC ordered the railway to cease operations until all identified issues and concerns were corrected. The railway is to remain out of operation until the CPUC authorizes the resumption of service.[3]

During the postaccident investigation it was apparent that the existing track brakes were not an efficient method of redundant braking. The ram heads on both cars that contact their respective rails showed evidence of prolonged wear. According to the brake design engineer, this situation should not have occurred since the track brake should have only deployed in a static mode during routine testing and dynamically during an actual emergency. Angels Flight managers repeatedly stated they were unaware that track brakes had been deployed prior to the September 5, 2013, accident.

On November 22, 2013, Angels Flight management reported that the apparent cause for the recurring unintentional stops had been discovered by an electrical engineering contractor. The electrical conduit beneath the guideway and near the top of the railway had been contaminated by pigeon droppings. Over time, the uric acid from the bird droppings had corroded the conduit and damaged the insulation surrounding the electrical control wires, which resulted in intermittent circuitry failure. The conduit was replaced, and a guard wire designed to discourage bird roosting was installed.

[3] Letter dated September 6, 2013, from Mr. Paul W. King, Deputy Director, Office of Rail Safety, Safety and Enforcement Division, CPUC, to Mr. John Welborne, President, Angels Flight Railway Company.

NTSB Recommendations

On October 10, 2013, the NTSB issued the following urgent safety recommendation to the CPUC:

> Before authorizing it to resume passenger service, independently verify that the Angels Flight Railway meets all applicable accepted industry standards and engineering practices including: (1) preventing excessive wheel and track wear; (2) providing emergency stopping under all foreseeable failure modes; (3) ensuring safety systems are not bypassed; (4) preventing passenger ejection in the event of a collision; and, (5) providing a suitable means of emergency egress for passengers and ingress for emergency responders. (Urgent) (R-13-037)

This safety recommendation is classified "Open—Initial Response Received."

Probable Cause

The National Transportation Safety Board determines the probable cause of the September 5, 2013, accident was the intentional bypass of the funicular safety system with Angels Flight management knowledge; and Angels Flight management continuation of revenue operations despite prolonged, and repeated, unidentified system safety shutdowns.

For more details about this accident, visit www.ntsb.gov/investigations/dms.html and search for NTSB accident ID DCA13FR011.

Adopted: June 23, 2014

The NTSB has authority to investigate and establish the facts, circumstances, and cause or probable cause of a railroad accident in which there is a fatality or substantial property damage, or that involves a passenger train. (49 U.S. Code § 1131 - *General authority*)
