Issued: June 9, 2023

Railroad Investigation Report: RIR-23/06

BNSF Railway Employee Fatality

Denver, Colorado
February 9, 2022

1 Factual Information

1.1 Accident Description

On February 9, 2022, about 10:57 a.m. local time, a BNSF Railway (BNSF) switchman was struck and killed by BNSF train YDEN1152-09i during a switching movement on Track 116 in the BNSF Globeville Yard in Denver, Colorado.[1] The switchman, working as a remote control operator (RCO) helper, was riding on the front center platform of the lead locomotive he was controlling remotely, BNSF 1961. The train suddenly decelerated, and the RCO helper fell forward onto Track 116, where he was struck by the locomotive he was riding. (See figure 1.) Visibility conditions at the time of the accident were daylight and clear, and the weather was 45°F with south-by-southeast winds at 15 mph.

[1] (a) Visit www.ntsb.gov to find additional information in the public docket for this NTSB accident investigation (case number RRD22FR006). Use the CAROL Query to search safety recommendations and investigations. (b) All times in this report are local time unless otherwise noted. (c) *Switching* is moving cars from one track to another track or to different positions on the same track.

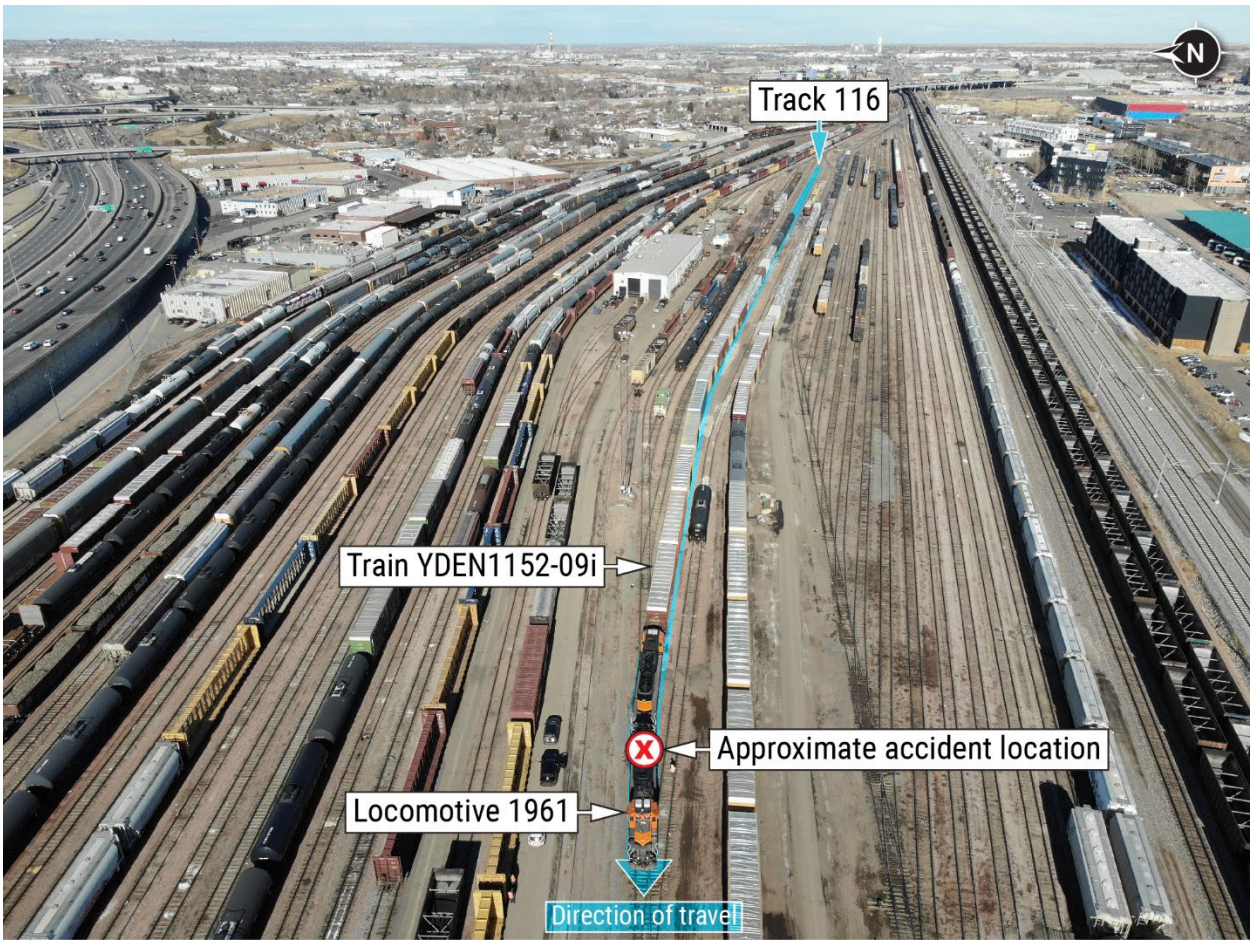

Figure 1. Overhead of accident location. (Source: BNSF Railway.)

The crew of train YDEN1152-09i consisted of an RCO foreman and the RCO helper; each had one operator control unit (OCU), a handheld device that enables a train operator to control the train remotely.[2] (See figure 2.) Train YDEN1152-09i was composed of two lead locomotives and 21 freight railcars.[3]

[2] The train operator uses the OCU to select train speed and direction, and the wireless control system on board the lead locomotive automatically modulates the train brakes and throttle to maintain that speed. Only one OCU can control the train at a time. RCO employees complete specialized classroom and hands-on training to operate remote-control systems.

[3] Train YDEN1152-09i's freight railcars included 9 empty box cars, 7 loaded covered hopper cars, and 5 loaded tank cars.

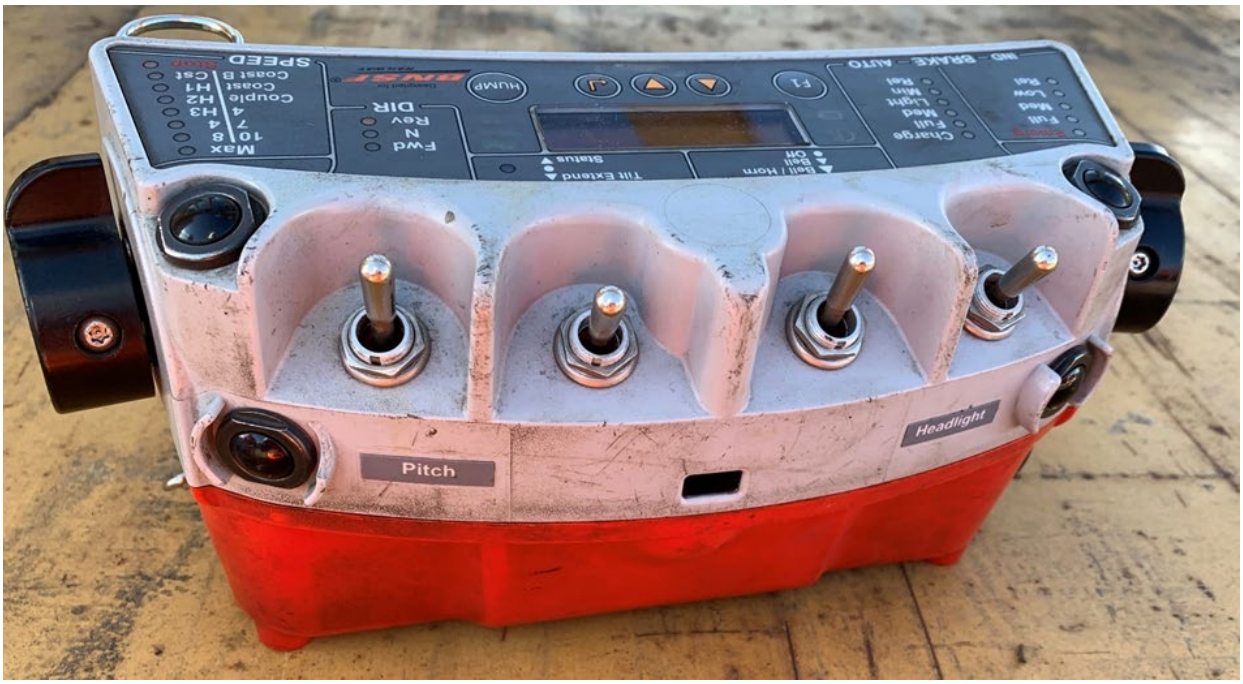

Figure 2. The accident OCU.

In an interview with National Transportation Safety Board (NTSB) investigators, the RCO foreman stated that he used his OCU to couple locomotives BNSF 1961 and BNSF 1601 to the 21 freight railcars at the east end of Track 116 in the Globeville Yard in preparation for the switching movement. The RCO foreman stated that he then used his OCU to move BNSF 1961 (the lead locomotive in the switching movement) forward about 57 feet and apply the brakes to stop the train.

About 10:56 a.m., the RCO foreman transferred control of BNSF 1961 to the RCO helper, who was located on the ground at the west end of Track 116. The RCO helper then used his OCU to move BNSF 1961 forward 33 feet before bringing the train to a very brief stop. The RCO helper selected "7 mph" on the OCU as the speed for BNSF 1961 and then mounted the stairs to the locomotive's front center platform and approached the platform.[4]

Data from BNSF 1961's event recorder reviewed by NTSB investigators indicate the locomotive had accelerated to 4 mph at 10:57:02 a.m., traveled about 20 feet, and then suddenly decelerated to 2 mph. At the time of the sudden deceleration, according to surveillance video obtained by the NTSB (see section 1.4), the RCO helper fell from the front platform of the locomotive onto the tracks. Over the next 3 seconds, BNSF 1961

[4] The maximum authorized speed in the BNSF Globeville Yard was 10 mph, as identified in BNSF's System Special Instructions No. 1, Effective August 4, 2021. The train never exceeded this speed during the switching movement.

responded to the unexpected speed reduction by accelerating to reach the 7-mph speed selected by the RCO helper, traveling another 17 feet, and striking the RCO helper on the tracks as it did so.

At 10:57:14 a.m., the tilt timeout feature on the RCO helper's OCU broadcasted the first of three radio messages indicating the tilt timeout and initiated an emergency application of the train's air brakes.[5] BNSF 1961 traveled an additional 8 feet before coming to a stop.

In his interview with NTSB investigators, the RCO foreman stated he heard the tilt timeout radio messages and walked to the scene of the accident. About 10:59 a.m., the RCO foreman called the yardmaster for emergency medical assistance. The Denver Fire Department arrived on the scene at 11:08:10 a.m., and the RCO helper was pronounced deceased.

1.2 Before the Accident

The BNSF crew arrived at the Globeville Yard about 7:00 a.m. on February 9. They were to gather assigned freight railcars in the yard and spot the railcars at various industries in the area.[6] The crew conducted a job safety briefing and began work.

1.3 Postaccident Data Evaluation, Observations, and Accident Re-creation

NTSB investigators gathered accident information and conducted on-scene observations at the Globeville Yard on February 9, 2022, immediately after the accident. On February 10, they performed an accident re-creation at that location using the same locomotive, railcars, and remote-control equipment as in the accident.

On February 9, NTSB investigators observed the air brake hoses between the locomotives and the 21 freight railcars were not connected, meaning the pneumatic

[5] (a) The *tilt timeout feature* on operator control units (OCUs) is designed to recognize any nonvertical position as a "tilt" (indicating the operator may have fallen) and automatically initiate an emergency application of the train's air brakes within 3 seconds. The NTSB investigators' review of data from the accident OCU indicated that the tilt timeout feature was activated during the accident. (b) The OCU broadcasts an emergency radio message if the tilt timeout feature is activated. The brand of OCU used in this accident is equipped with a radio-hold feature that waits for a clear radio channel before issuing an emergency broadcast, so that emergency messages do not get lost under normal yard radio chatter. In this case, the accident OCU waited 9 seconds for a clear radio channel to issue the emergency broadcast.

[6] To *spot* a railcar means to place a railcar in a specific location on a track.

brakes on the railcars were released and could not be applied using locomotive controls. This is accepted practice for switching freight railcars in the railroad industry.

During the accident re-creation on February 10, NTSB investigators observed locomotive brake system function. The locomotive brakes functioned as designed.

Also during the accident re-creation, investigators observed that the OCU units and locomotive BNSF 1961 functioned as designed. NTSB investigators also re-created the OCU tilt timeout feature; the feature functioned as designed.

1.4 Slack Action

Slack action is the free movement, or travel, of a railcar before it transmits motion and force to an adjoining coupled car. Force from acceleration or braking is applied down the train through mechanical couplers at the railcar ends. Because there is travel, or slack, between the ends of railcar couplers, and because the couplers are often combined with shock-absorbing draft gear that itself allows a certain amount of travel, each railcar experiences some free movement before it receives the force applied by the locomotive or braking system.

A train's slack is bunched when couplers and draft gear are compressed, and when couplers and draft gear are extended with no free movement between railcars, slack is stretched. When the slack condition changes rapidly from bunched to stretched, this is known as the slack running out. It can result in a jolt to equipment as the locomotive reacts to the weight of trailing cars by decelerating rapidly.

While on scene on February 9, NTSB investigators measured the amount of total slack in each railcar and observed that the accident consist had 35.5 feet of potential slack from a fully compressed to a fully extended state.[7] NTSB investigators also reviewed Globeville Yard surveillance video data, which showed slack action in the consist of train YDEN1152-09i during the accident.

During the accident re-creation on February 10, investigators used the OCU units to input the same remote control commands that were entered during the accident. During the re-creation, slack action was observed, evidenced by sudden deceleration of BNSF 1961 when the locomotive reached the accident location. The locomotive was

[7] Draft gear attached to freight railcar couplers absorb longitudinal in-train forces from such activities as switching, train handling, and coupling. Most North American railcars either use standard draft gear, made up of resilient blocks or cast wedges, or hydraulic end-of-car cushioning units. Twelve railcars in the accident train consist used standard draft gear, which has approximately 6.5 inches of travel in each device over which longitudinal in-train forces are absorbed. Nine railcars used end-of-car cushioning units, which allow approximately 15 inches of travel per device.

then observed to accelerate for 3 seconds before the OCU tilt timeout feature initiated an emergency application of the train's air brakes.

1.5 BNSF Operating Rules

BNSF's operating rules address riding equipment, operating remote control systems, and controlling in-train forces to mitigate slack action.[8] The rules state train operators using remote control equipment must change speeds gradually to let railcars adjust to one speed before moving up or down to another, adjust speed selector positions slowly to avoid erratic locomotive movements, and remain at or below the minimum speed setting when starting a remote control movement at a location that requires an automatic train brake application to prevent undesired movement. BNSF rules require RCOs to control slack action by selecting a coupling speed of 1 mph until the slack has fully run out.

BNSF operating rules at the time of the accident did not prohibit riding locomotives on the lead exterior platform, nor did the rules establish places of safety for standing on moving equipment.

1.6 Personnel and Training

The RCO foreman was hired by BNSF on May 27, 2002, and the foreman's certification was issued on October 25, 2002. The RCO foreman completed the most recent computer-based rules training on February 4, 2021, and was operationally tested 15 times in the 9 months before the accident.

The RCO helper was hired by BNSF on March 14, 2005, and received helper's certification on July 8, 2005. The RCO helper completed the most recent computer-based rules training on April 30, 2021, and was operationally tested 25 times in the 9 months before the accident.

NTSB investigators reviewed BNSF new hire and recurring training tools used for the RCO helper's training. The training covered the BNSF operating rules on controlling slack action when operating remote control equipment.

[8] BNSF Operating Rules R-2.0 and R-2.1, Remote Control Train Handling. Updated September 1, 2021.

1.7 Postaccident Toxicology Testing and Medical Conditions

Postaccident toxicological testing of the RCO helper for alcohol and other drugs identified ethanol but no other tested-for substances.[9] Further toxicological testing performed by the Federal Aviation Administration Forensic Sciences Laboratory identified ethanol, N-propanol, and ibuprofen.[10] Distribution patterns of the ethanol in body tissues and fluids were not uniform.

According to BNSF occupational health records, the RCO helper underwent a pre-employment health exam in 2005 that reported no chronic medical conditions.

1.8 Postaccident Actions

As a result of the accident, BNSF adopted a rule change, issuing a system briefing to employees about the rule change on February 22, 2022: when necessary to ride on the engine exterior, employees must not ride on platforms or walkways and must not ride on steps when coupling, and the train must not exceed 20 mph.[11]

BNSF also distributed a system briefing and safety alert on February 11, 2022, informing all employees about the circumstances of the accident in the Globeville Yard and reiterating the operating procedures and rules for remote control operation. The alert instructs employees to control in-train forces to mitigate slack action by gradually increasing the notch position, or speed setting, on the OCU and emphasizes the need to stretch the train consist using a low speed setting before commanding an increase in power.[12]

[9] (a) In accordance with Title 49 *Code of Federal Regulations* (*CFR*) Part 219 Subpart C, postaccident toxicology testing required by the Federal Railroad Administration includes testing for amphetamines, barbiturates, benzodiazepines, cannabinoids, cocaine, MDMA/MDA, methadone, opiates/opioids, phencyclidine, tramadol, ethyl alcohol, brompheniramine, chlorpheniramine, diphenhydramine, doxylamine, and pheniramine. (b) Ethanol may be produced in the body after death by microbial activity; when this occurs, the distribution patterns of the substance among the body's tissues and fluids are not uniform.

[10] (a) The Federal Aviation Administration Forensic Sciences Laboratory tests specimens for a wide variety of substances including toxins, prescription and over-the-counter medications, and illicit drugs. (b) N-propanol is a type of alcohol that may be produced in postmortem tissues and fluids. (c) Ibuprofen is an anti-inflammatory medication that treats fevers and aches and pains. It is available over the counter and is not considered impairing.

[11] BNSF Rule Change Briefing: T&Y Safety Rules S-13.1.5: Riding In or On Moving Equipment, February 22, 2022.

[12] BNSF Safety Briefing: Transportation Employee Fatally Injured in Denver Yard, February 11, 2022.

2 Analysis

In this accident, a BNSF RCO helper was struck and killed by the lead locomotive of his train, the remote-control locomotive he was riding, after falling off the front platform onto the track at the BNSF Globeville Yard in Denver, Colorado. Surveillance video data reviewed by NTSB investigators showed a sudden deceleration of the train and immediately after, the RCO helper fell from the front platform of moving locomotive. The front platform offered little, if any, protection for the RCO helper that would prevent him from falling off the front of the locomotive during a sudden change in speeds. As a result of this accident, BNSF issued a rule change prohibiting employees from riding on locomotive platforms and walkways.

Surveillance video evidence reviewed by NTSB investigators shows slack action in the train consist at the moment the RCO helper fell from the platform. Further, NTSB investigators measured 35.5 feet of potential slack in the accident train consist during postaccident observations and evaluations. The RCO foreman moved the locomotives forward 57 feet before the accident. Although theoretically 57 feet would be enough distance for 35.5 feet of slack to run out all the way, the actual accident and the NTSB's accident re-creation suggest it was not. This was likely due to a combination of factors: locomotive speed and friction in the draft gear would have allowed the locomotives to travel without fully engaging all of the draft gear systems, and the stop at 10:56 a.m. during which the RCO foreman transferred control of the locomotive to the RCO helper would have allowed the railcars to bunch, or compress, leading to slack in the train.

As the RCO helper boarded the locomotive platform, from a stopped position he selected a speed of 7 mph, which caused the locomotive to accelerate too quickly to manage the effects of slack action. Although the remote-control system functioned as designed, the RCO helper's command for a quick increase in speed likely led to uncontrolled in-train forces. After the accident, BNSF reiterated the operating procedures and rules for remote control operation to employees, emphasizing the need to use low speed to stretch a train before commanding an increase in speed.

Postaccident toxicological testing of the RCO helper identified ethanol; however, the nonuniform distribution of the substance indicated that the source of the ethanol was most likely from postmortem production rather than ingestion.

3 Probable Cause

The National Transportation Safety Board determines that the probable cause of the February 9, 2022, BNSF Railway remote control operator helper fatality was being struck by remote-control locomotive BNSF 1961 after falling from the locomotive's front platform into the tracks when slack action in the train consist caused a sudden deceleration of the locomotive.

The National Transportation Safety Board (NTSB) is an independent federal agency charged by Congress with investigating every civil aviation accident in the United States and significant events in other modes of transportation—railroad, transit, highway, marine, pipeline, and commercial space. We determine the probable cause of the accidents and events we investigate and issue safety recommendations aimed at preventing future occurrences. We also conduct safety research studies and offer information and other assistance to family members and survivors for any accident investigated by the agency. Additionally, we serve as the appellate authority for enforcement actions involving aviation and mariner certificates issued by the Federal Aviation Administration (FAA) and US Coast Guard, and we adjudicate appeals of civil penalty actions taken by the FAA.

The NTSB does not assign fault or blame for an accident or incident; rather, as specified by NTSB regulation, "accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties … and are not conducted for the purpose of determining the rights or liabilities of any person" (Title 49 Code of Federal Regulations section 831.4). Assignment of fault or legal liability is not relevant to the NTSB's statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report (Title 49 United States Code section 1154(b)).

For more detailed background information on this report, visit the NTSB investigations website and search for NTSB accident ID RRD22FR006. Recent publications are available in their entirety on the NTSB website. Other information about available publications also may be obtained from the website or by contacting—

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