Collision of Two CSX Transportation Freight Trains
Carey, Ohio
August 12, 2019

Accident Report

NTSB/RAR-20/03
PB2020-101009

National
Transportation
Safety Board

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Notation 65869
Adopted September 15, 2020

Railroad Accident Report

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490 L'Enfant Plaza, S.W.
Washington, D.C. 20594

National Transportation Safety Board. 2020. ***Collision of Two CSX Transportation Freight Trains, Carey, Ohio, August 12, 2019*****. Publication Type NTSB/RAR-20/03. Washington, DC: NTSB**

Abstract: On August 12, 2019, about 5:09 a.m., local time, westbound CSX Transportation (CSX) freight train H70211 collided with the side of eastbound CSX freight train W31411 at a switch near Carey, Ohio. The trains were operating on the CSX Columbus Subdivision which extends 90.6 miles from Columbus, Ohio, to Fostoria, Ohio. Each train's crew consisted of a conductor and a train engineer. The lead locomotive of the westbound train and railcars loaded with refuse in positions 1 through 4 were derailed onto their sides from the collision. The eastbound train derailed 21 railcars, loaded with frac sand, in positions 6 through 26. As a result of the collision, the eastbound and westbound train engineers suffered minor injuries. Collision damage was estimated at $4.9 million. No placarded hazardous material railcars derailed. The National Transportation Safety Board (NTSB) identified the following safety issues: train handling and performance, CSX random drug- and alcohol-testing program, inward- and outward-facing image recorders, railroad switching operations in territory with positive train control. As a result of this investigation, the NTSB makes safety recommendations to the US Department of Transportation; the Federal Railroad Administration; the Association of American Railroads, the American Short Line and Regional Railroad Association, National Railroad Passenger Corporation, Alaska Railroad, and the American Public Transportation Association; and CSX. NTSB also classified two recommendations to the Federal Railroad Administration.

For more detailed background information on this report, visit the NTSB investigations website and search for NTSB accident ID RRD19FR010. 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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Abbreviations and Acronyms

AAR	Association of American Railroads
Amtrak	National Railroad Passenger Corporation
APTA	American Public Transportation Association
BAC	blood alcohol concentration
CFR	*Code of Federal Regulations*
CP	control point
CSX	CSX Transportation, Inc.
dL	deciliter
DOT	US Department of Transportation
DPU	distributed power unit
eastbound train	CSX Transportation freight train W31411
FRA	Federal Railroad Administration
gm	grams
GPS	global positioning system
I-ETMS	Interoperable Electronic Train Management System
ITC	interoperable train control
mL	milliliter
MP	milepost
Ng	nanograms
NPRM	notice of proposed rulemaking
NTSB	National Transportation Safety Board
OIG	Office of Inspector General
PTC	positive train control

THC	tetrahydrocannabinol
THCA	delta-9-tetrahydrocannabinol-9-carboxylic acid
westbound train	CSX Transportation freight train H70211

Executive Summary

On August 12, 2019, about 5:09 a.m., local time, westbound CSX Transportation freight train H70211 collided with the side of eastbound CSX Transportation freight train W31411 at a switch near Carey, Ohio. The trains were operating on the CSX Transportation Columbus Subdivision which extends 90.6 miles from Columbus, Ohio, to Fostoria, Ohio. Each train's crew consisted of a conductor and a train engineer. The lead locomotive of the westbound train and railcars loaded with refuse in positions 1 through 4 were derailed onto their sides from the collision. The eastbound train derailed 21 railcars, loaded with frac sand, in positions 6 through 26. As a result of the collision, the eastbound and westbound train engineers suffered minor injuries. Collision damage was estimated at $4.9 million. No placarded hazardous material railcars derailed.[1]

Probable Cause

The National Transportation Safety Board determines that the probable cause of the train collision near Carey, Ohio, was the failure of the westbound train engineer to respond to the signal indications requiring him to slow and stop the train prior to Control Point Springs because of his impairment due to the effects of alcohol. Contributing to the collision was the design of the positive train control system which allowed continued operation in restricted mode on the main track.

Safety Issues

This report focuses on the following safety issues:

- **Train handling and performance.** This investigation determined that the westbound train engineer, although trained and certified to operate the train, was not engaged in operating the train after completing work on the siding track, as indicated by the fluctuating train speed, the abnormal use of the locomotive headlight switch, and his failure to take action to stop the train at Control Point Springs.

- **CSX Transportation random drug- and alcohol-testing program.** Under the CSX Transportation random drug- and alcohol-testing program, about 25 percent of regulated employees were to have been tested for drugs per year and 10 percent of regulated employees were to have been tested for alcohol per year. However, the engineer of westbound CSX Transportation freight train H70211 had not been tested for drugs in the 10 years immediately prior to the collision.

- **Inward- and outward-facing image recorders.** Ten years ago, the National Transportation Safety Board recommended to the Federal Railroad Administration that they mandate the use of inward- and outward-facing image recorders on trains.

[1] For more information, see the factual information and analysis sections of this report. Additional information about the accident investigation can be found in the public docket for this accident (NTSB case number RRD19FR010) by accessing the Accident Dockets link for the Docket Management System at www.ntsb.gov. For more information on our safety recommendations, see the Safety Recommendation Database at www.ntsb.gov.

Although the Federal Railroad Administration has initiated efforts to require these recorders on passenger trains, no similar action has been taken to mandate recorders on freight trains.

- **Railroad switching operations in territory with positive train control.** The use of positive train control restricted mode is required during switching operations because, in certain situations, the positive train control active mode could inhibit the reverse movement of the train. While a train operates in positive train control restricted mode, train speed is limited to the upper-speed threshold of restricted speed, and signal enforcement and established work zone enforcement are no longer active.

Findings

- The following factors did not cause or contribute to the collision: train crew experience, impairment of the eastbound train crew, work schedule, train mechanical condition, track condition, traffic control signal system, disabled positive train control system on the eastbound train, and actions by the CSX Transportation Dispatch Center.

- There were no actions the eastbound train engineer or eastbound train conductor could have taken to prevent the collision with the oncoming train.

- This collision could have been prevented had the positive train control system on the westbound train been in active mode as the train approached the stop signal at Control Point Springs.

- The westbound train engineer was impaired by his use of alcohol at the time of the collision.

- Although postaccident testing showed the presence of marijuana in the westbound train engineer's system, it cannot be determined if his use of marijuana caused any further impairment.

- The westbound train engineer demonstrated performance decrements while operating the train after completing work on the Carey siding track, as illustrated by the fluctuating train speed, the abnormal use of the locomotive headlight switch, and his failure to take action to stop the westbound train at Control Point Springs.

- CSX Transportation's drug- and alcohol-testing programs failed to deter the westbound train engineer's illegal use of marijuana and consumption of alcohol which impaired his performance while on duty and operating the train.

- In light of the shortcomings in the CSX Transportation random drug- and alcohol-testing program documented in Federal Railroad Administration audits of the program, the circumstances of this collision, and the US Department of Transportation's Office of Inspector General's concerns with the Federal Railroad Administration's auditing processes an audit of CSX Transportation's testing system that is independent of the Federal Railroad Administration is warranted.

- Inward- and outward-facing recorders can improve the quality of accident and incident investigations and provide the opportunity for proactive steps by railroad management to verify that train crew actions are in accordance with safety rules and procedures.

- The administrative controls specified in Title 49 *Code of Federal Regulations* 236.1005 (f) in territories with positive train control systems that use the restricted mode feature are inadequate for preventing train-to-train collisions.

- Adequate training and managerial oversight are essential for ensuring that rules and procedures for safely operating positive train control systems in restricted mode are followed correctly.

- Based on information gathered during the course of this investigation, CSX Transportation's positive train control training program did not include particular emphasis on the use of restricted mode specific to its limitations of enforcement of restrictive signal aspects, encroachment into an established work zone, and movement through an improperly lined switch.

Recommendations

New Recommendations

To the US Department of Transportation:

- Request that the US Department of Transportation Office of Inspector General conduct an audit of CSX Transportation's drug- and alcohol-testing program to determine the circumstances that allowed a regulated employee to operate for an extended time period without being subjected to random drug testing. (R-20-15)

- Upon completion of this examination, make any needed recommendations to CSX Transportation in its implementation of its drug- and alcohol-testing program, as well as the Federal Railroad Administration in its auditing of CSX Transportation. (R-20-16)

- If necessary, apply any lessons learned to broadly implement enhancements to railroad drug- and alcohol-testing protocols to prevent a similar scenario from occurring at other railroads. (R-20-17)

To the Federal Railroad Administration:

- Review the software changes being developed by the Interoperable Train Control Application Committee regarding positive train control restricted mode and amend Title 49 *Code of Federal Regulations* Part 236 to require railroads to revise their positive train control systems to implement engineering controls that will automatically limit the use of restricted mode on main tracks. (R-20-18)

To the Association of American Railroads, the American Short Line and Regional Railroad Association, the National Railroad Passenger Corporation, the Alaska Railroad Corporation, and the American Public Transportation Association:

- Inform your members of the circumstances of this collision and request they undertake a review of their training and managerial oversight programs as they relate to restricted speed operations on territories that operate positive train control systems in restricted mode to identify opportunities for training improvement and to implement appropriate mitigating actions. (R-20-19)

To CSX Transportation:

- Review and revise your training program to ensure employees are properly qualified on positive train control, including restricted mode. (R-20-20)

Previously Issued Recommendations Classified in this Report

To the Federal Railroad Administration:

R-10-1

Require the installation, in all controlling locomotive cabs and cab car operating compartments, of crash- and fire-protected inward- and outward-facing audio and image recorders capable of providing recordings to verify that train crew actions are in accordance with rules and procedures that are essential to safety as well as train conditions. The devices should have a minimum 12-hour continuous recording capability with recordings that are easily accessible for review, with appropriate limitations on public release, for the investigation of accidents or for use by management in carrying out efficiency testing and systemwide performance monitoring programs. (R-10-1)

This recommendation was previously classified "Open—Acceptable Response" on September 16, 2019. This recommendation is now classified "Open—Unacceptable Response."

R-10-2

Require that railroads regularly review and use in-cab audio and image recordings (with appropriate limitations on public release), in conjunction with other performance data, to verify that train crew actions are in accordance with rules and procedures that are essential to safety. (R-10-2)

This recommendation was previously classified "Open—Acceptable Response" on September 16, 2009. This recommendation is now classified "Open—Unacceptable Response."

1 Factual Information

1.1 Collision Synopsis

On August 12, 2019, about 5:09 a.m., local time, westbound CSX Transportation (CSX) freight train H70211 collided with the side of eastbound CSX freight train W31411 at a switch near Carey, Ohio. Each train's crew consisted of a conductor and a train engineer.[1] The trains were operating on the CSX Transportation Columbus Subdivision which extends 90.6 miles from Columbus, Ohio, to Fostoria, Ohio. The lead locomotive of westbound train H70211 and railcars loaded with refuse in positions 1 through 4 were derailed onto their sides from the collision. The eastbound train W31411 derailed 21 railcars, loaded with frac sand, in positions 6 through 26. As a result of the collision, the eastbound and westbound train engineers suffered minor injuries. Collision damage was estimated at $4.9 million. No placarded hazardous materials railcars were derailed.[2]

[1] A train's *conductor* is the individual with overall responsibility for the train's safety; the *train engineer* is the operator of the train.

[2] For more information, see the factual information and analysis sections of this report. Additional information about the accident investigation can be found in the public docket for this accident (NTSB case number RRD19FR010) by accessing the Accident Dockets link for the Docket Management System at www.ntsb.gov. For more information on our safety recommendations, see the Safety Recommendation Database at www.ntsb.gov.

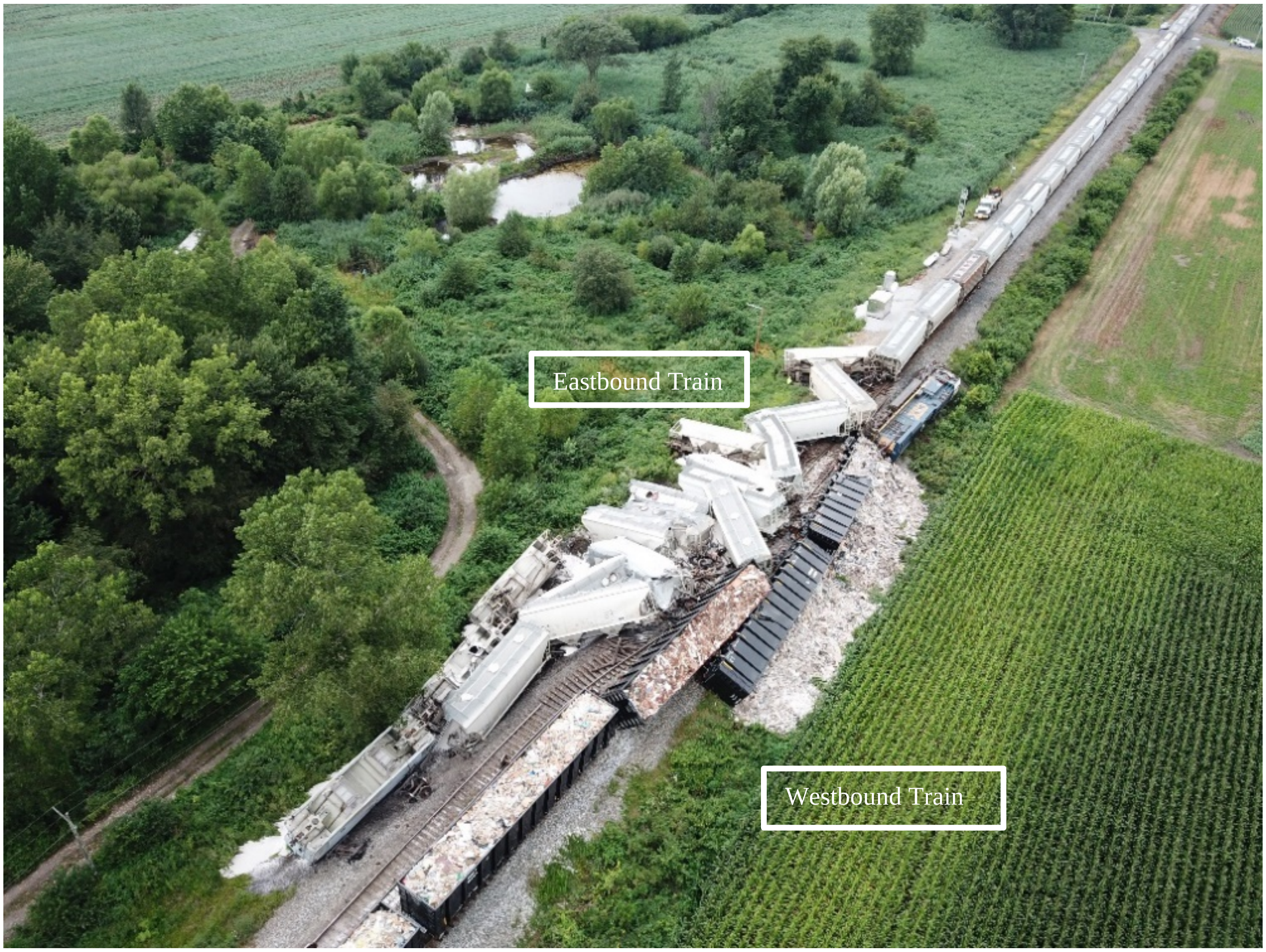

Figure 1. Aerial view of collision location. (Photograph courtesy of CSX.)

1.2 Train Information

1.2.1 Eastbound CSX Freight Train W31411

CSX freight train W31411 (eastbound train) originated in Ottawa, Illinois, and consisted of a lead locomotive, trailing locomotive, and 110 railcars loaded with frac sand.[3] The train weighed about 15,708 tons and was about 4,768 feet long.

The eastbound train's lead locomotive CSXT 477 was built in 2000 and had its last periodic inspection on March 21, 2019. The trailing locomotive, CSXT 3005, was built in 2012 and had its last periodic inspection on June 7, 2019. The train received a Federal Railroad Administration

[3] *Frac sand* is a specialized type of sand added to fracking fluids injected into unconventional oil and gas wells during hydraulic fracturing (fracking).

(FRA) Class I initial terminal air brake test and a mechanical inspection at its originating location in Ottawa, Illinois, with no defects noted.[4]

CSX maintenance records indicated that at 10:05 a.m., on August 11, 2019, while traveling to Garrett, Indiana, the eastbound train experienced a failure of the global positioning system (GPS) component in the positive train control (PTC) system, which required the train crew to disable the PTC system.

PTC is an advanced train control system designed to prevent train-to-train collisions, overspeed derailments, incursions into established work zone limits, and the movement of a train through a switch left in the wrong position. If a train does not slow for an upcoming speed restriction, PTC will alert the engineer to slow the train. If an appropriate action is not taken, PTC will apply the train brakes before it violates the speed restriction.

For over 50 years, we have investigated numerous train collisions and overspeed derailments caused by operational errors involving human performance failures. The NTSB has attributed these human performance failures to a variety of factors, including fatigue, sleep disorders, medications, loss of situational awareness, reduced visibility, and distractions in the operating cab. Many of these PTC-preventable collisions occurred after train crews failed to comply with train control signals, follow operating procedures in nonsignaled or "dark" territories, observe work zone protections, or adhere to other specific operating rules such as returning track switches to normal position after completing their work at railroad sidings. The Congressionally mandated deadline for PTC implementation was December 31, 2015. However, it was later extended to December 31, 2018, and again to December 31, 2020. Each day in which full implementation is delayed puts the public at risk. According to data reported to the FRA as of June 30, 2020, PTC is operational (including in revenue service demonstration) on 100 percent of National Railroad Passenger Corporation (Amtrak)-owned or -controlled track, 76.1 percent of commuter lines, and 100 percent of Class I and short-line railroads.[5] However, only 65.5 percent of tenants were able to communicate with the PTC systems of the host railroad (interoperable).

En route PTC failures are addressed in FRA regulations outlined in Title 49 *Code of Federal Regulations* (*CFR*) 236.1029 (b)(1) through 49 *CFR* 236.1029 (b)(6). According to this regulation, when a PTC system is disabled or cut out, a report of the failure must be made to a designated railroad officer of the host railroad as soon as safe and practicable, and the train may proceed at a speed not exceeding 49 mph. In addition, the train may continue no farther than the next forward-designated locomotive repair facility for the repair or exchange of onboard PTC apparatuses.

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[4] The FRA Class I initial terminal air brake test, commonly known as the Class I brake test, checks for brake pipe leakage. According to the regulations at Title 49 *Code of Federal Regulations* (*CFR*) 238.313, in these tests, brake pipe leakage should not exceed 5 pounds per square inch per minute or air flow should not exceed 60 cubic feet per minute.

[5] Amtrak owns or controls 898 route miles. Amtrak operates a nationwide rail network, serving more than 500 destinations in 46 states, the District of Columbia, and three Canadian provinces, on more than 21,400 miles of routes, which are primarily owned and operated by freight railroads. Freight railroads are responsible for installing PTC on their track; the systems must be interoperable to meet the deadline.

Train crews on the eastbound train reported the failure and received permission from the CSX dispatcher prior to disabling the PTC system. The train was operating within a 49-mph maximum speed restriction in accordance with federal requirements. The eastbound train was destined for Columbus, Ohio, about 180 miles away, which was the next locomotive repair facility.

1.2.2 Westbound CSX Freight Train H70211

CSX freight train H70211 (westbound train) consisted of a lead locomotive and distributed power unit (DPU) locomotive in the 94th position of the train.[6] The westbound train departed Parsons Yard in Columbus, Ohio, with 109 loads of refuse and 67 empty railcars. It weighed about 16,816 tons and was about 10,955 feet in length.

The CSX lead locomotive, CSXT 736, was built in 2007 and the DPU locomotive, CSXT 3107, was built in 2013. Locomotive CSXT 736 had a periodic inspection on July 16, 2019, and locomotive CSXT 3107 had a periodic inspection on August 9, 2019. An FRA Class I air brake test was performed on all railcars on August 11, 2019, in Columbus, Ohio. CSX mechanical records indicated that no defects were noted. The train departed with the PTC system in active mode. The first job assignment for the westbound train crew was to travel about 73 route miles and set out 30 empty railcars in a siding track in Carey, Ohio. After the railcars were dropped off at Carey, the westbound train had 109 loaded railcars and 37 empty railcars. The train was 9,497-feet long and weighed almost 16 tons.

1.3 Track and Site Information

The Columbus Subdivision extended 90.6 miles from Columbus, Ohio, to Fostoria, Ohio, in a geographic north-south direction. In this report, however, directions are referred to as running east and west based on the CSX timetable. The subdivision was mostly single main track territory with portions of multiple main track territory and passing sidings. In the collision area, the subdivision transitioned from a single main track to two main tracks at control point (CP) Springs, which is at milepost (MP) CD 76.3.[7] CP Springs is located about 2 miles northwest of the village limits of Carey, Ohio.

[6] A *DPU* locomotive is one that is capable of remote-control operation in conjunction with locomotives at the train's head end. DPU locomotives are generally added to the middle or end of heavier trains to help them climb steep grades.

[7] The Columbus Subdivision uses CD as one of its timetable designations.

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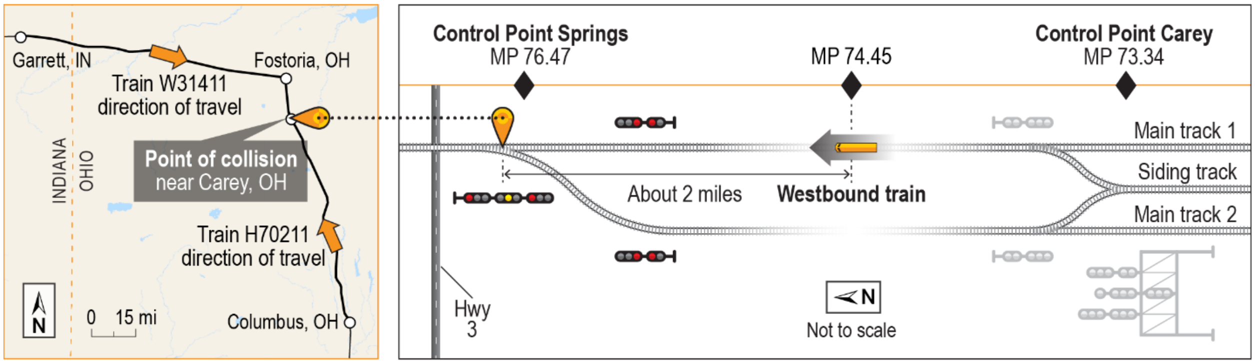

Figure 2. Map of train routes on the day of the collision.

1.4 Collision Narrative

1.4.1 The Collision

At the time of the collision, the temperature was 70°F, the sun and the moon were below the horizon, and it was dark.[8] Onboard locomotive event recorder data indicated that at 4:06:19 a.m., the westbound train stopped on main track 1 in Carey, Ohio, with the PTC system still in active mode. The crew's job assignment was to set out 30 empty railcars in a siding track. At 4:08:13 a.m., the PTC system was placed into restricted mode, allowing the train crew to make forward and reverse train movements to maneuver the empty railcars into the siding track. Once the empty railcars were placed on the siding track, the remaining railcars were reassembled. The train conductor remained at the Carey siding, assisting another train with its work, and planned to ride a railroad shuttle van to a nearby highway-railroad grade crossing to board the lead locomotive, rejoin the train engineer in the locomotive cab, and continue westbound to the next job assignment in Fostoria, Ohio. However, the westbound train conductor never rejoined the train.

At 4:45:22 a.m., with the PTC system remaining in restricted mode, the westbound train departed Carey, Ohio, to pick up the conductor with the train engineer in the locomotive control compartment. The PTC system should have been reconfigured by the westbound train engineer. The onboard locomotive event recorder showed that the train speed fluctuated, increasing up to about 10 mph, then decreasing, at times to speeds near 0 mph. At 5:03:06 a.m., the westbound train speed decreased to almost 0 mph after the train engineer initiated dynamic braking.[9] Investigators reviewed the forward-facing image recorder data showing the wayside signal at CP Springs was visible and indicating a red aspect. The headlight of the oncoming eastbound train

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[8] (a) Weather observations from the closest National Weather Service reporting location were from Findlay Airport, located about 14 miles west of the collision site. (b) Astronomical conditions from the United States Naval Observatory recorded the beginning of civil twilight at 6:10 a.m., with sunrise at 6:40 a.m. Moonset was at 3:47 a.m. and rose at 7:06 p.m.

[9] *Dynamic braking* is a feature of the locomotives in which the kinetic energy of the train is converted to electrical energy using its traction motors that cause the locomotives and the train to slow. When the dynamic brakes are activated, the traction motors on the drive axles function as generators. This provides rotational resistance to the locomotive wheels. The electrical energy from the traction motors dissipates through a bank of resistor grids. This process slows the locomotive, thus slowing the train.

was also visible. The image data showed, at 5:03:18 a.m., the westbound train engineer turned off the locomotive headlight while still moving. At 5:06:41 a.m., the westbound train engineer turned on the locomotive headlight and continued increasing speed while approaching the wayside signal at CP Springs. (See figure 3.)

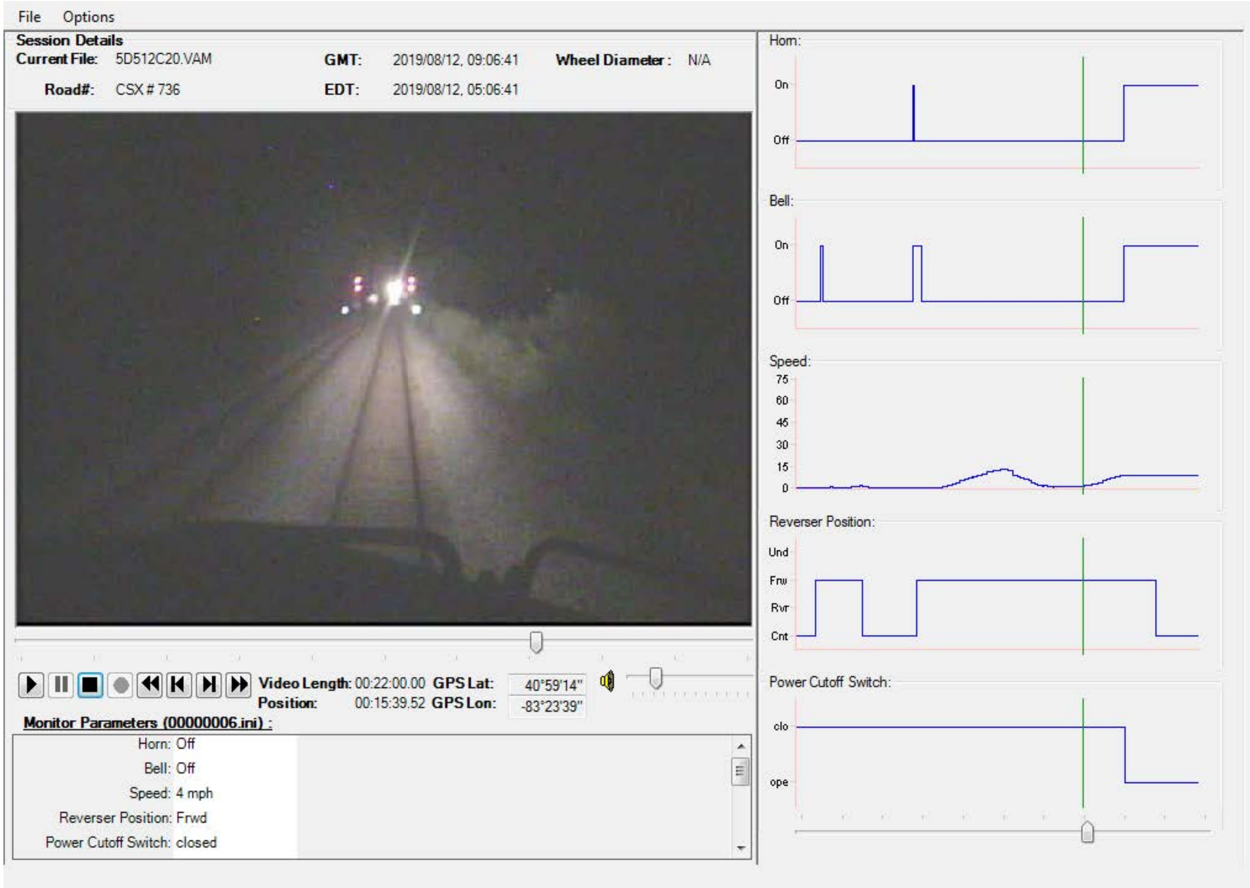

Figure 3. Data from westbound forward-facing train image recorder.

At 5:07:55 a.m., the westbound train continued increasing speed and moving toward the wayside signal. The forward-facing image recorder data indicates that at the same time, the headlight of the eastbound train became visibly brighter. The westbound train continued past the red signal at CP Springs at a speed of about 9 mph and collided with the sixth railcar of the eastbound train at 5:09 a.m. (See figure 4.) The westbound train engineer told National Transportation Safety Board (NTSB) investigators in a postaccident interview he could not remember his actions prior to the collision.

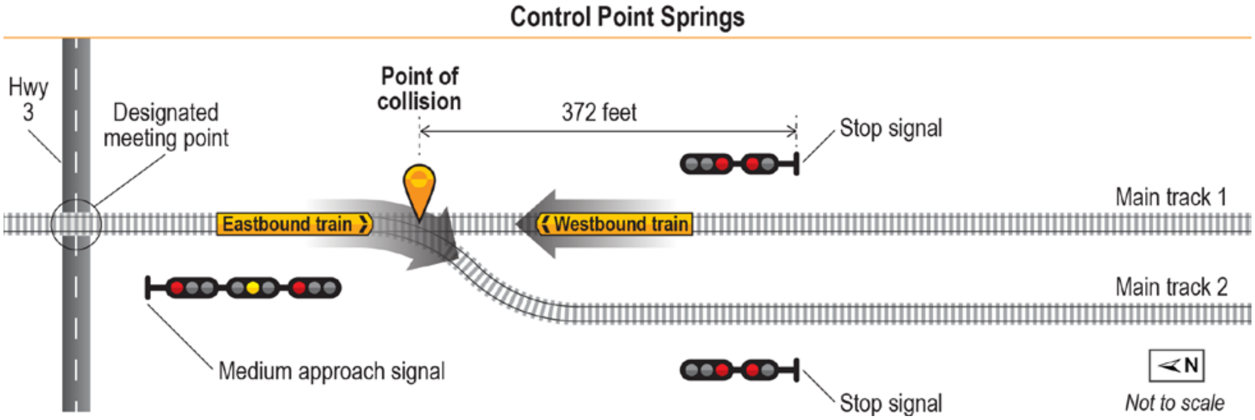

Figure 4. Illustration of the track and signal indicators at CP Springs at the time of the collision.

1.4.2 Injuries and Inspection of Wreckage

Both train engineers were transported to a local hospital by ambulance with minor injuries. While at the hospital, they were tested for drugs and alcohol. The two train conductors were driven by railroad officials to a local hospital for postaccident drug and alcohol testing.

Following the collision, FRA motive power and equipment inspectors inspected the eastbound and westbound trains. Mechanical inspections and air brake tests were performed on the railcars that did not derail from both trains. The derailed locomotives and railcars were examined. The inspectors did not identify mechanical issues with the locomotives or railcars. At CP Springs, the traffic control system was inspected, locking tests and cable insulation resistance tests were performed, electromechanical relays were tested, and checks for grounds were completed.[10] The tests and examinations did not identify issues with the traffic control or PTC systems.

1.5 Method of Operation

1.5.1 Movement of Trains on Main Track

Trains are operated on the Columbus Subdivision by centralized traffic control, in which a train dispatcher controls wayside signals to authorize or restrict the movement of trains. Trains in

[10] (a) A *traffic control system* is a block signal system under which train movements are authorized by block signals whose indications supersede the superiority of trains for both opposing and following movements on the same track. (b) *Locking* is used by the signal system to prevent a signal aspect to proceed from being displayed for any conflicting route or prevents the movement of any switch in advance of a train within the route entered or when a train is approaching a signal displaying an aspect to proceed, prevents, until the expiration of a predetermined time interval after such signal has been caused to display its most restrictive aspect, the movement of any switch in the route governed by the signal. (c) *Insulation resistance tests* are used to measure the effectiveness of wire and cable insulation used in the signal system to detect any electrical leakage between wires and cables or to the ground. (d) *Electromechanical relays* are a device operated by a variation in the conditions of one electric circuit to affect the operation of other devices in the same or another electric circuit. (e) *Grounds* are electrical connections between the positive side of an electric circuit and a conducting object such as the ground or a train underframe.

the same direction are permitted to follow one another and are spaced automatically by the wayside indications of the signal and train control systems. The train dispatcher arranges for trains operating in opposite directions to meet and pass at sidings or where main tracks converge by lining routes using the signal and train control systems.

On the Columbus Subdivision, dispatching duties were controlled by the CSX Louisville LF Dispatcher located in Jacksonville, Florida.[11] Train movements on the Columbus Subdivision were governed by operating rules, special instructions, timetable instructions, and the signal indications of a traffic control system enforced with a PTC system.

The traffic control system used coded track circuits for train occupancy detection. Wayside signals were colorlight signals with upper and lower signal heads capable of displaying green, yellow, and red aspects for train movements in either direction.[12]

CSX installed the Wabtec Interoperable Electronic Train Management System (I-ETMS) as an overlay on the traffic control system to enforce PTC functions. I-ETMS established wayside signals as targets. During normal operations, trains could operate on permissive signal indications. I-ETMS would intervene if an engineer did not take action to reduce speed and stop when the train was approaching a red absolute signal by calculating a safe braking profile for the train and automatically stopping the train short of the red absolute signal.

1.5.2 Switching Operations in PTC Territory

I-ETMS was designed in part to prevent trains from operating into occupied track blocks or traveling past a red absolute signal. Trains operating on PTC territory are unable to make reverse (shove) moves past a control point on a main track with PTC in active mode (CSX n.d.).[13] When required to perform pickups, set offs, shoving movements, or other switching activities, trains with active PTC must first bring the train/locomotive to a stop and then switch PTC from active mode to restricted mode.[14]

At the time of the collision, the westbound train was still operating in PTC restricted mode after setting out the empty railcars on the siding track in Carey. Operations in PTC restricted mode require a manual manipulation of the onboard PTC equipment. Use of PTC restricted mode is required during switching operations because, in certain situations, the PTC system active mode could inhibit the movement of the train. The onboard locomotive PTC equipment does not automatically recognize when PTC restricted mode is no longer required. The train crew must manually select options on the PTC user screen in the locomotive to return the train to PTC active mode. While a train operates in restricted mode, train speed is limited to the upper-speed threshold

[11] Louisville LF Dispatcher is the CSX desk designation for the Columbus Subdivision.

[12] *Colorlight signals* use a separate lamp to illuminate each colored lens.

[13] *Active mode* and *restricted mode* are terms used in the *CSX PTC Training Guide* to describe two of the seven possible states in the CSX PTC system.

[14] *Set off*, commonly known as set out, refers to detaching railcars from a train while between rail yards or terminals.

of restricted speed.[15] In addition, when a train operates in restricted mode, signal enforcement and established work zone enforcement are no longer affected. After completing all switching moves and updating train consist changes, the train engineer is required to switch the PTC system from restricted mode to active mode prior to commencing train movement on the main track.

According to FRA regulations found at Title 49 *Code of Federal Regulations* 236.1005 (f), a PTC system is considered to be configured to prevent train-to-train collisions if trains are required to be operated at restricted speed and if the onboard PTC equipment enforces the upper limits of the railroad's restricted speed rule. This application applies when railroads use operating rules or mandatory directives to allow trains to operate at restricted speed. Train operations with PTC in restricted mode meet the requirements of a PTC system configured to prevent train-to-train collisions.[16]

1.6 Personnel Information

1.6.1 Eastbound Train Crew

The eastbound train crew reported for duty at 1:40 a.m., on August 12, 2019, in Garrett, Indiana. Certifications and training for both employees were up to date. The train engineer was hired by CSX on July 21, 1997, and was certified through December 31, 2021. His most recent qualifications examination was November 5, 2018, and his most recent testing on PTC was on June 15, 2017. The conductor, who was also certified as a train engineer, was hired by CSX on September 25, 2005, and was certified as a conductor through December 19, 2019. His most recent engineer recertification was March 12, 2019.

In the 12 days prior to the collision, the train engineer worked six shifts on 6 days with time off between shifts that met regulatory standards. In the 12 days prior to the collision, the conductor worked eight shifts on 8 days with time off between shifts that met regulatory standards.[17]

1.6.2 Westbound Train Crew

The westbound train crew reported for duty at 9:00 p.m., on August 11, 2019, in Columbus, Ohio. Certifications and training for both employees were current. The train engineer was hired by CSX on June 19, 2000, and was certified through December 31, 2019. His most recent qualifications examination was January 25, 2019, which also included PTC testing. The conductor, who was also a train engineer, was hired on July 8, 2007, and was certified as a conductor through December 31, 2019. His most recent engineer recertification was March 7, 2019.

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[15] According to CSX's Columbus Subdivision Timetable No. 1 rules, effective December 1, 2017, CSX *restricted speed* is defined as a speed that will permit stopping within one-half the range of vision. It will also permit stopping short of a train, a railcar, an obstruction, a stop signal, a derail, or an improperly lined switch. It must permit looking out for broken rail. It will not exceed 20 mph (CSX 2017).

[16] Title 49 *CFR* 236.1005 (f).

[17] Title 49 *CFR* Part 228.

In the 12 days prior to the collision, the train engineer worked for four shifts over 4 days with time off between shifts that met regulatory standards. In the 12 days prior to the collision, the conductor worked five shifts over 5 days with time off between shifts that met regulatory standards.

1.7 Medical and Toxicology Information

An NTSB medical officer reviewed the CSX occupational health records, historical drug test results, and FRA postaccident testing toxicology reports for the westbound train engineer and conductor. The medical officer also reviewed the postaccident emergency room records for the westbound train engineer.

FRA regulations state that, except for over-the-counter drugs, no regulated employee may use or possess alcohol or any controlled substance while on duty.[18] A regulated employee cannot have an alcohol concentration of 0.02 percent or greater and continue to perform duties, nor may a regulated employee use alcohol within 4 hours of reporting for regular service. Controlled substances, which include marijuana, cannot be used at any time by a regulated employee, whether on duty or off duty. FRA postaccident toxicological testing is required after events that include an impact collision involving a reportable injury or damage to railroad property of $150,000 or more; the testing includes about 50 substances.

1.7.1 Westbound Train Conductor

At the westbound train conductor's 2007 preemployment medical exam, the conductor reported no chronic medical conditions, regular medication use, or physical abnormalities.

Hearing and vision testing were performed on CSX employees once every 2 to 3 years. CSX employee medical records indicated the westbound train conductor was medically qualified with the restriction that he must wear corrective lenses or glasses while on duty.

CSX and FRA provided NTSB with drug testing records for the westbound train conductor. The westbound train conductor underwent drug testing before employment in April 2007 and after a furlough in March 2010. Over the course of his employment at CSX until the time of the collision, the conductor had three random urine drug screens and nine random alcohol breathalyzer tests. (See table 1.) All historical drug and alcohol testing results for the westbound train conductor were negative for drugs and alcohol. The westbound train conductor also had negative blood and urine tests for drug and alcohol after the collision.

[18] (a) These FRA regulations are found at 49 *CFR* Part 219. (b) According to 49 *CFR* 219.5, a *regulated employee* is "a covered employee or maintenance-of-way employee who performs regulated service for a railroad subject to the requirements of this part." A *regulated service* means covered service or maintenance-of-way activities, the performance of which makes an employee subject to the requirements of this part.

Table 1. Westbound train conductor's drug and alcohol testing: 2008 – 2019.

Test date	Alcohol test result	Drug test result
November 7, 2008	Negative	Not performed
October 10, 2011	Negative	Negative
August 31, 2015	Negative	Negative
October 30, 2015	Negative	Not performed
June 7, 2016	Negative	Not performed
January 17, 2017	Negative	Negative
May 6, 2017	Negative	Not performed
February 19, 2019	Negative	Not performed
June 16, 2019	Negative	Not performed

1.7.2 Westbound Train Engineer

At the westbound train engineer's 2000 preemployment medical exam, he reported no chronic medical conditions, regular medication use, or physical abnormalities.

At his most recent testing on June 18, 2019, the westbound train engineer was found to be medically qualified with the restriction that he must wear corrective lenses or glasses while on duty. On this and all previous employee health questionnaires, he denied any medical treatment for conditions that could affect his ability to safely perform the essential functions of his job.

CSX and FRA provided the NTSB with drug testing records for the westbound train engineer that included preemployment testing, three random urine drug screens, and seven random alcohol tests; the most recent random urine drug test was in February 2009. (See table 2.) All historical drug and alcohol testing results for the westbound train engineer were negative for drugs or alcohol.

Table 2. Westbound train engineer's drug and alcohol testing: 2004-2015.

Test date	Alcohol test result	Drug test result
December 15, 2004	Negative	Negative
December 16, 2008	Negative	Negative
February 17, 2009	Negative	Negative
June 7, 2009	Negative	Not performed
June 18, 2009	Negative	Not performed
June 2, 2013	Negative	Not performed
August 1, 2015	Negative	Not performed

Postaccident emergency room treatment records indicated that the westbound train engineer was diagnosed with neck and lower-back strain from the collision and received nonsteroidal medications in the emergency room.[19] FRA postaccident toxicology testing of the

[19] Nonsteroidal medications are members of a drug class that are used to treat inflammation, mild to moderate pain, and fever.

westbound train engineer performed 6 hours after the collision was positive for alcohol (0.115 blood alcohol concentration (BAC)) and inactive marijuana metabolites.[20]

1.7.3 Eastbound Train Crew

The eastbound train engineer and conductor had negative blood and urine tests for drugs and alcohol after the collision.

1.7.4 Drug Testing Regulations

The US Department of Transportation (DOT) requires all regulated transportation services to maintain drug- and alcohol-testing programs, according to the general principles and practices described in 49 *CFR* Part 40. For regulated railroads, the DOT requirements have been implemented in 49 *CFR* 219, which outlines the goals and procedures established by the FRA for workplace drug- and alcohol-testing programs. Each railroad covered by these federal regulations develops, implements, and operates its own drug- and alcohol-testing program, subject to the approval and monitoring of the FRA.

To comply with 49 *CFR* 219, CSX has implemented a broad drug- and alcohol-testing program for its operations. In this program, regulated employees across its operational territories and divisions who are required to be tested are divided into pools. Train crews are grouped into nine different sampling pools, and the pools are subject to random drug and alcohol testing throughout a year. Selections for random drug and alcohol testing are not done by person under the CSX testing program. Instead, a test location is chosen randomly and the crew of the first train to arrive at that location is tested.

The FRA determines the numbers of tests to be performed based on a percentage of employees. In 2017, the requirement for CSX was 25 percent for drug testing and 10 percent for alcohol testing.

The FRA performed an audit of CSX's training program in May 2016 to check its compliance with federal drug- and alcohol-testing regulations and found defects in its random selection process. Following that audit, CSX purchased and implemented a new random selection process software program. The FRA subsequently performed a follow-up review that revealed general compliance with the program.

In May 2019, the FRA completed another audit of CSX's program. In that audit, the FRA indicated concern that overall, CSX's alcohol- and drug-testing program was not functioning at an acceptable level of compliance and efficiency. FRA auditors observed numerous instances where CSX field managers were unavailable to schedule testing or did not schedule testing to ensure that random selections were completed. The FRA Office of Technical Oversight said that CSX had not

[20] (a) According to 49 *CFR* 219.203 (d), postaccident drug and alcohol testing should be performed as soon as practicable after an accident, preferably within 4 hours. (b) The amount of alcohol detected in the westbound train engineer was 0.115 grams (gm) deciliter (dL) in blood and 0.113 gm/dL in urine and the amount of inactive marijuana metabolites detected was 6.3 nanograms (ng)/milliliter (mL) in blood and 32.6 ng/mL in urine). (c) a BAC of 0.115 is equivalent to 0.115 gm/dL.

prioritized federal drug and alcohol testing and did not sufficiently perform follow-up testing on employees returning to work after violations. The FRA discovered during the course of the audit that CSX failed to complete required testing for multiple crafts in 2017, including the engine service craft and train service craft.

The FRA 2019 audit of the CSX drug- and alcohol-testing program stated the following:

> 2017 Testing Rate Engine Service Employees: CSX failed to meet the 25 % FRA federal minimum annual random testing rate for drugs in the Engine Service craft. In accordance with the CSX Drug and Alcohol Compliance Plan Minimum monthly random test goals for HOS [hours-of-service] employees are set by the Occupational Health Testing (OHT) team, based on the FRA Administrator's determination of the random drug testing rate at the time of this policy. CSX was required to meet or exceed 25% for drugs and 10% for alcohol (Engine Service Craft). CSX's annual drug testing rate for Engine Service 2017 was only 20%. This is not in compliance with 49 *CFR* 219.625 (d) and the CSX Drug and Alcohol Compliance Plan dated June 12, 2017. A civil Penalty violation will be recommended.
>
> 2017 Testing Rate Train Service Employees: CSX failed to meet the 25% FRA federal minimum annual random testing rates for drugs in the Train Service craft. In accordance with the CSX Drug and Alcohol Compliance Plan, minimum monthly random test goals for HOS employees are set by the Occupational Health Testing (OHT) team, based on the FRA Administrator's determination of the random drug testing rate at the time of this policy. CSX was required [to] meet or exceed 25% for drugs and 10% for alcohol (Train Service craft). CSX's annual drug testing rate for Train Service 2017 was only 19%. This is not in compliance with 49 *CFR* 219.625 (d) and the CSX Drug and Alcohol Compliance Plan dated June 12, 2017.

CSX responded to the 2019 FRA Audit on August 31, 2020, and said that it had made several organizational changes, including changing vendors. While these organizational changes may address the issue going forward, they do not address the issue of how an employee was able to avoid random drug testing for over 10 years.

1.8 CSX Operating Practices

1.8.1 Efficiency Testing

Federal regulations in 49 *CFR* 217.9 require railroads to have a program to periodically conduct operational tests and inspections to determine the extent of compliance with its code of operating rules, timetables, and timetable special instructions.

In the 12 months prior to the collision, the westbound train engineer was tested by 11 supervisors on 18 separate days. He completed 29 tests on 21 rules and was in compliance with all of them. The conductor was tested by 12 supervisors on 27 separate days. He completed 55 tests on 28 rules and was in compliance with all of them.

1.8.2 PTC Training

NTSB investigators met with CSX officials on October 30, 2019, to discuss the training given to train crew personnel on PTC. CSX described the evolution of its PTC training program, from its initial program in 2016, which focused on PTC functionality and employee compliance, to its current, more encompassing program. CSX train engineers and conductors are required to complete an online/classroom PTC course called PTC Training for T&E. It is a guided course that lasts about 4 hours and gives employees an overview of the PTC system. During the course, the employees are required to answer questions along the way to test their knowledge of what they have learned, and they must score at least 90 percent on the final assessment to pass the course.

CSX currently uses 115 simulators in 76 locations for its PTC training. In addition, CSX has six mobile training trailers which contain portable simulators. The simulators include a full mockup of PTC display screens and locomotive controls, and the software uses forward-view technology, including simulations of all CSX subdivisions. The simulators are designed to allow changes to the operating conditions and complexities that may include weather, track obstructions, and other abnormal occurrences.

The simulator training is comprised of 60 miles and lasts between 3 and 4 hours. During this training, the engineer performs all of the functions of PTC including initialization, updating the consist, verifying mandatory directives, successfully maneuvering through work zones by answering prompts, complying with stop signal indications, and other required functions. CSX simulators do not include training on PTC restricted mode. All PTC simulation testing is scored and must be completed with a passing score of 80 percent. Should the train engineer fail to accomplish a passing score, the instructor will remediate the items that were failed and immediately perform another test. The westbound train engineer successfully completed simulator training on June 20, 2017, November 23, 2018, and January 25, 2019.

In addition to ongoing engineer certification and training, CSX identifies and provides additional instruction for employees who experience a PTC enforcement and/or a human factors incident.

1.8.3 Train Handling

During postaccident interviews with NTSB investigators, the westbound train engineer and westbound train conductor reported no anomalies with the operation of the locomotive, PTC system, or other equipment within the train consist. They outlined the operational steps taken to make railcar sets at the Carey, Ohio, location. These steps included conducting a job briefing, properly lining switches, switching PTC from active mode to restricted mode, making the necessary forward and reverse train moves to accurately place and uncouple the railcars, performing an air brake test, switching PTC from restricted mode back to active mode, and then moving on a proceed signal indication from the dispatcher. When asked about performing these job duties at Carey, Ohio, both the westbound train engineer and westbound train conductor told investigators that nothing was abnormal or out of the ordinary. Prior to setting out the railcars at

Carey, Ohio, the westbound train conductor left the lead locomotive to work at the rear of the train, performing tasks such as lining the switches and uncoupling the railcars that were to be dropped off the train. In a postcollision interview with NTSB investigators, the westbound train engineer said that he did not return the train to active mode because he needed the westbound train conductor to provide him with the updated train consist information. However, there were other means that could have been used to obtain this information, such as through the train manifest or by contacting the westbound train conductor by radio. After this, the westbound train conductor, working at the rear of the now 79-car train, planned to ride a railroad shuttle van to a nearby highway-railroad grade crossing to reboard the train in the lead locomotive, rather than walking a distance of about 1 mile.[21] This left the train engineer alone in the locomotive cab for 37 minutes at Carey and 24 additional minutes during the ride from Carey to CP Springs.

[21] It is common for train crews to use railroad shuttle vans during switching operations to help transport crewmembers from one end of the train to the other.

2 Analysis

2.1 Introduction

On August 12, 2019, westbound CSX freight train H70211 collided with the side of eastbound CSX freight train W31411 at a switch near Carey, Ohio. Each train's crew consisted of a conductor and an engineer. The lead locomotive of the westbound train and railcars loaded with refuse in positions 1 through 4 were derailed onto their sides from the collision. Train W31411 derailed 21 railcars, loaded with frac sand, in positions 6 through 26. As a result of the collision, the eastbound and westbound train engineers suffered minor injuries. Collision damage was estimated at $4.9 million. No placarded hazardous material railcars were derailed.

Having completed a review of the facts and circumstances that led to the collision, the NTSB established that the following did not cause or contribute to the collision:

- **Train crew experience.** Both the westbound and eastbound train crews were properly trained and certified to operate the trains.
- **Impairment of the eastbound train crew.** The results of postaccident toxicological tests performed on the eastbound train crew were negative for alcohol and common drugs of abuse.
- **Work schedule.** The work schedule suggested that the crewmembers on both trains had ample sleep opportunity prior to beginning their shifts.
- **Train mechanical condition.** The mechanical systems for both the eastbound and westbound train had been used effectively to stop and control the speed of the trains up to the time of the collision, with no reports of malfunctions. In addition, no mechanical issues on either train were identified during the postaccident inspections.
- **Eastbound train onboard PTC system.** Eastbound train operations with the PTC system disabled were accomplished following federal requirements for an en route failure of a safety-critical PTC component. Even if the PTC system on the eastbound train had been functioning correctly, it could not have prevented the collision.
- **Track condition.** Investigators did not observe any track conditions that would have contributed to this collision.
- **Traffic control signal system.** Signals were functioning as intended and no conflicting signals were displayed.
- **Westbound train onboard PTC system.** PTC was operating as designed in restricted mode and was not designed to enforce the stop signal at CP Springs.
- **CSX Dispatch Center.** Dispatching activities were appropriate regarding the use of the signal system to coordinate train movements.

The NTSB concludes that the following factors did not cause or contribute to the collision: train crew experience, impairment of the eastbound train crew, work schedule, train mechanical condition, track condition, traffic control signal system, disabled PTC system on the eastbound train, and actions by the CSX Dispatch Center.

2.2 Train Handling and Performance

The eastbound train crew operated their train with the PTC system disabled due to the failure of the vital GPS component of the PTC system. During postaccident interviews with investigators, the eastbound train crew stated the wayside signal at CP Springs indicated that the train would be diverged from the single main track onto main track 2. They stated they saw the westbound train approaching CP Springs on main track 1 and noted its locomotive headlight was on bright. The eastbound train engineer said that he flashed his headlight to indicate to the westbound train engineer to dim the locomotive headlight but received no response. Additionally, the train crew reported there were no audio communications received from the oncoming westbound train.

Although the eastbound train crew reported anomalies with the oncoming train, there was no reason for the eastbound train crew to take any action and stop the train. The eastbound train had a signal indication instructing them to proceed on the route that was lined for their train movement. Furthermore, since the collision occurred during night hours, the lighting was insufficient to determine the exact position of the oncoming train. Based on the actions of the eastbound train crew, the NTSB concludes there were no actions the eastbound train engineer or eastbound train conductor could have taken to prevent the collision with the oncoming train.

Locomotive event recorder and image recorder data indicated that the westbound train engineer departed Carey, Ohio, with the PTC system remaining in restricted mode and continued westbound to CP Springs. NTSB has advocated for PTC systems because they have the potential to prevent or significantly reduce the number of serious train collisions, overspeed derailments, incursions into established work zones, and train movement through a switch left in the wrong position by providing safety redundancy to protect against human performance errors. As designed, a PTC system in active mode intervenes if an engineer does not take action to reduce speed and stop when a train approaches a red absolute signal by calculating a safe braking distance for the train and automatically stopping the train short of the red absolute signal. Based on the sequence of this collision, the NTSB concludes that this collision could have been prevented had the PTC system on the westbound train been in active mode as the train approached the stop signal at CP Springs.

The westbound train crew's first job assignment was to set out railcars in Carey, Ohio. Locomotive event recorder data indicated the train crew worked in Carey for about 37 minutes. During those 37 minutes, the train engineer was alone in the locomotive control cab. He was also alone in the cab from the time the westbound train departed Carey to the time of the collision, an additional 24 minutes. The train engineer was, therefore, solely responsible for the safe operation of the train for over 1 hour in the time leading up to the collision.

The onboard locomotive event recorder during this hour indicated that the westbound train speed fluctuated, increasing up to about 10 mph, then decreasing, at times to speeds near 0 mph. While still moving, the westbound train engineer turned off the locomotive headlight. He later turned on the locomotive headlight and increased speed while approaching the wayside signal at

CP Springs. The westbound train continued increasing speed and moving toward the wayside signal. It continued past the red signal at CP Springs at a speed of about 9 mph and collided with the sixth railcar of the eastbound train at 5:09 a.m. These actions indicate that the westbound train engineer was experiencing a performance decrement.

FRA postaccident toxicology testing of the westbound train engineer's blood and urine, performed 6 hours after the collision, was positive for alcohol (0.115 and 0.113, respectively) and inactive marijuana metabolites. Assuming an average elimination rate of 0.015 gm/dL/hour, the calculated BAC for the westbound train engineer at the time of the collision would have been about 0.20. Because the westbound train engineer had been on duty for about 8 hours, his BAC indicated he had likely used alcohol while on duty and had operated the westbound train while impaired. The investigation, however, could not determine if the THC in the westbound train engineer's system further impaired the operation of the westbound train.

At the time of the collision (and at the time of drug testing), the westbound train engineer would legally be considered too impaired to operate a motor vehicle. Furthermore, his BAC was five times the DOT limit when he was tested 6 hours after the collision. Impairment from alcohol ingestion increases with BAC. With a BAC of 0.02, a person would experience prolonged reaction times, altered perception of the environment, slowed thinking, and worsening motor coordination. With a BAC of 0.08 or above, a person is legally considered too impaired to operate a motor vehicle in 49 states.[22] At BACs above 0.10, there is prolonged reaction time, altered perception of the environment, lack of coordination, slowed thinking, and mood and behavioral changes. At concentrations above 0.20, individuals may experience amnesia or blackouts and double vision. At his postaccident interview with NTSB investigators, the westbound train conductor stated that the westbound train engineer was behaving normally while they were together. However, the effects of alcohol can vary depending upon an individual's frequency of use and tolerance, and information about the westbound train engineer's prior alcohol use history is limited. Individuals who develop a tolerance may vary in their compensation of behavior and body function effects, and the outward and obvious signs of intoxication may not be displayed.

The westbound train engineer had many years of service and was familiar with the territory; yet, his actions were not consistent with his experience and skill level. Therefore, the NTSB concludes that the westbound train engineer was impaired by his use of alcohol at the time of the collision.

FRA postaccident toxicology tests of the westbound train engineer's blood and urine were also positive for inactive marijuana metabolites (6.3 ng/mL and 32.6 ng/mL, respectively). Under federal regulations, it is illegal for an engineer to have any amount of marijuana in his or her system. Tetrahydrocannabinol (THC) is the primary psychoactive substance in the marijuana plant. While cognitive and motor performance deficits are usually observed for at least 1 to 2 hours (and have been reported up to 24 hours) following marijuana use, the performance deficits do not correspond to peak THC levels. The inactive metabolite, THCA delta-9-tetrahydrocannabinol-9-carboxylic acid (THCA), peaks about 2 to 4 hours after dosing and can be found in urine days to weeks after the last use of the drug. Metabolism and elimination depend on the means of

[22] The NTSB, in Safety Recommendation H-13-5, has advocated states establish a per se BAC limit of 0.05 or lower for all drivers.

ingestion, potency of the product, frequency of use, and user characteristics. Given that THCA is an inactive metabolite and that urine concentration does not necessarily reflect recent use, it cannot be determined if the westbound train engineer was or was not under the influence of marijuana at any specified time. Of note, in this case, is that the westbound train engineer's toxicology report was positive for both alcohol and marijuana. The combination of alcohol and marijuana can produce effects greater than either drug individually. Even low doses of marijuana in combination with alcohol have been shown to have greater impact on driving performance. Therefore, the NTSB concludes that although postaccident testing showed the presence of marijuana in the westbound train engineer's system, it cannot be determined if his use of marijuana caused any further impairment. Furthermore, the NTSB concludes that the westbound train engineer demonstrated performance decrements while operating the train after completing work on the Carey siding track, as illustrated by the fluctuating train speed, the abnormal use of the locomotive headlight switch, and his failure to take action to stop the westbound train at CP Springs.

2.3 Drug and Alcohol Testing

A primary rationale for the implementation of random drug- and alcohol-testing programs is to deter the use of performance-degrading substances by regulated employees. In passing the Omnibus Transportation Employee Testing Act of 1991, Public Law No. 102-143, Congress specifically noted that the testing of uniformed personnel of the Armed Forces has shown that the most effective deterrent to abuse of alcohol and use of illegal drugs is increased testing, especially random testing (NTSB 2008). Indeed, research at a large railway transportation company in Portugal found random alcohol and drug testing to be associated with decreased collision risk, as well as an economic benefit (Marques and others 2014). A 2014 review of literature pointed to one study which found random alcohol testing reduced fatal collisions in the transportation industry, but also called for more methodologically rigorous research to evaluate the efficacy and utility of drug testing (Pidd and Roche 2014). It is apparent in the behavior of the westbound train engineer that he was not deterred from consuming alcohol or from using marijuana.

Indeed, in the May 2019 FRA audit of the CSX program's compliance with FRA's alcohol and drug regulations discussed in section 1.7.4, numerous deficiencies were identified. For example, the FRA discovered that CSX neglected to complete the mandatory minimum number of random alcohol and drug tests in 2017.

It is concerning that the westbound train engineer had not been subjected to drug testing for about a decade. This contrasts sharply with the westbound train conductor who received random drug testing three times in that same time frame. Though random testing protocols will result in some employees being tested more in the short term than others, in the long term, more uniformly distributed numbers of tests per employee is expected. Ten years is an unusually long time period for an employee to not be tested in a random drug-testing system. CSX's drug- and alcohol-testing program may not have been implemented in a random manner. The NTSB concludes that CSX's drug- and alcohol-testing programs failed to deter the westbound train engineer's illegal use of marijuana and consumption of alcohol which impaired his performance while on duty and operating the train.

Although FRA had completed multiple audit cycles of CSX over the past decade, ostensibly finding and addressing multiple deficiencies, the troubling finding that the westbound train engineer was not drug tested over this period remains. If the FRA was adequately auditing and following up on its audits, CSX's testing issues would have been resolved, and the westbound train engineer likely would have been tested at some point.

However, a recent report from the DOT Office of Inspector General (OIG) indicated that oversight weaknesses limited FRA's review, approval, and enforcement of railroads' drug- and alcohol-testing programs (DOT OIG 2020). OIG found that FRA reviewed and approved incomplete plans. OIG found that FRA did not meet its auditing goals and had a shortage of staff with critical expertise. Moreover, OIG found that FRA lacked a process for tracking and following up on all action items issued to railroads during compliance audits to verify that railroads take recommended actions. OIG suggested that FRA may not be positioned to identify repeat patterns that rise to the level of deficiencies at railroads as well as potential systemwide safety trends across the regions.

Indeed, when NTSB reached out to FRA to learn of the actions taken after its 2016 audit of CSX, FRA indicated, "A follow-up review, looking specifically at the random selection process…revealed general compliance of their program. Unfortunately, the follow-up was not documented in the form of an inspection report or audit report…" Thus, FRA, apparently, does not have a formal plan to track CSX's correction of its random-selection process. This is consistent with the OIG's analysis, and suggests the need for an independent review.

The DOT issues regulations to deter alcohol and illegal drug misuse in transportation systems. The NTSB concludes that in light of the shortcomings in the CSX random drug- and alcohol-testing program documented in FRA audits of the program, the circumstances of this collision, and OIG's concerns with FRA's auditing processes an audit of CSX's testing system that is independent of FRA is warranted. Therefore, the NTSB recommends that the DOT request that the US Department of Transportation Office of Inspector General conduct an audit of CSX's drug- and alcohol-testing program to determine the circumstances that allowed a regulated employee to operate for an extended time period without being subjected to random drug testing. The NTSB further recommends that upon completion of this examination, DOT make any needed recommendations to CSX in its implementation of its drug- and alcohol-testing program, as well as FRA in its auditing of CSX. Finally, the NTSB recommends that, if necessary, DOT apply any lessons learned to broadly implement enhancements to railroad drug- and alcohol-testing protocols to prevent a similar scenario from occurring at other railroads.

2.4 Inward- and Outward-Facing Image Recorders

During the postaccident interview with NTSB investigators, the westbound train engineer was unable to recall several events leading up to the collision. Inward-facing audio and image recorders in the locomotive cab would have provided important information to assist investigators in understanding what happened in this collision. Use of inward-facing audio and image recorder data by railroad management in carrying out systemwide performance monitoring programs might have also deterred train crews from using impairing substances while on duty.

Because the FRA has not required inward-facing cameras for freight locomotives, the NTSB was unable to determine the actions of the westbound train's crewmembers while operating the train from Columbus, Ohio, to Carey, Ohio, the actions of the westbound train engineer while operating alone in the locomotive cab, or the events leading up to the collision. This collision again demonstrates the need for in-cab recording devices to better understand and, thereby, prevent serious railroad collisions that have the potential to claim the lives of crewmembers, passengers, and the public.

Similar issues were found during the NTSB's investigation of the September 12, 2008, head-on collision in Chatsworth, California, between a Metrolink passenger train and a Union Pacific Railroad freight train (NTSB 2010). The NTSB was unable to determine the actions of the Metrolink engineer leading up to the collision and after discovering some illicit activities by the train engineer during previous trips, the NTSB determined that Metrolink had no way of monitoring the train engineer's activities to ensure appropriate behaviors.

The Chatsworth collision, in which 25 people were killed and 102 people were injured, underscored the importance of understanding the activities of crewmembers in the time leading up to the collision. As a result of that investigation, on February 23, 2010, the NTSB issued Safety Recommendations R-10-1 and -2 to the FRA:

> Require the installation, in all controlling locomotive cabs and cab car operating compartments, of crash- and fire-protected inward- and outward-facing audio and image recorders capable of providing recordings to verify that train crew actions are in accordance with rules and procedures that are essential to safety as well as train conditions. The devices should have a minimum 12-hour continuous recording capability with recordings that are easily accessible for review, with appropriate limitations on public release, for the investigation of accidents or for use by management in carrying out efficiency testing and systemwide performance monitoring programs. (R-10-1)
>
> Require that railroads regularly review and use in-cab audio and image recordings (with appropriate limitations on public release), in conjunction with other performance data, to verify that train crew actions are in accordance with rules and procedures that are essential to safety. (R-10-2)

In the 10 years since these recommendations were issued, the NTSB has reiterated them in the following six major railroad collision investigations:

1) September 30, 2010, collision of two Canadian National Railway freight trains near Two Harbors, Minnesota

2) April 17, 2011, collision of a BNSF coal train with the rear end of a standing BNSF maintenance-of-way train in Red Oak, Iowa

3) June 24, 2012, head-on collision of two Union Pacific Railroad freight trains near Goodwell, Oklahoma

4) May 25, 2013, collision of a Union Pacific Railroad freight train with a BNSF Railway freight train near Chaffee, Missouri

5) April 28, 2015, collision of two Southwestern Railroad freight trains near Roswell, New Mexico

6) May 12, 2015, derailment of a National Railroad Passenger Corporation (Amtrak) passenger train in Philadelphia, Pennsylvania

During the investigation for one of those collisions, the June 24, 2012, collision in Goodwell, Oklahoma, the NTSB made the following safety recommendation to all Class I railroads.

> Install in all controlling locomotive cabs and cab car operating compartments crash- and fire-protected inward- and outward-facing audio and image recorders. The devices should have a minimum 12-hour continuous recording capability. (R-13-26)

In response to Safety Recommendation R-13-26, CSX has equipped 696 out of about 1,800 locomotives with inward-facing cameras that are capable of remote-encrypted downloading. CSX's response to Safety Recommendation R-13-26 is classified *Open—Acceptable Response.* CSX reviews inward-facing recordings:

- To review incoming alerts for activities such as cell phone use while on board a moving locomotive, train engineer- or conductor-induced emergency application of the train air brakes, PTC enforcements, and any obstruction of the camera lens[23]

- For specific operational/efficiency testing of CSX crews while on board CSX locomotives

- Random reviews of inward-facing image recordings, for operational/efficiency testing purposes

- Investigation of incidents such as grade-crossing accidents involving vehicular traffic

CSX informed investigators that 312 safety/operational test reviews using inward-facing recorders were performed in 2019. As of July 2020, CSX has performed 849 safety/operational test reviews.

In response to Safety Recommendations R-10-1 and -2, the FRA announced at a May 28, 2015, meeting of the Railroad Safety Advisory Committee (RSAC) that in the absence of RSAC consensus recommendations, the FRA was proceeding with a notice of proposed rulemaking (NPRM) addressing mandatory installation of locomotive recording devices in both freight and passenger railroads. As a result, on September 29, 2015, Safety Recommendations R-10-1 and -2 were classified "Open—Acceptable Response." The FRA did not publish the NPRM for 4 years. On July 24, 2019, the FRA published an NPRM titled *Locomotive Image and Audio Recording Devices for Passenger Trains,* proposing a mandate to install inward- and outward-facing

[23] An *incoming alert* is a notification to a dispatch center.

recorders in passenger trains (*Federal Register* 2019, 35712). The NPRM was only partially responsive to the NTSB recommendations since it did not apply to freight railroads.

On September 16, 2019, the NTSB stated the following in response to the NPRM:

> Freight trains and passenger trains operate on the same railroad tracks, posing the risk of accidents that have the potential to significantly affect the public. From a safety management system perspective, it is probable that recorded information about safety problems identified in freight railroad accidents and incidents could inform, mitigate, or prevent similar safety problems that might potentially affect passenger railroad operations. As a result, we believe it would be shortsighted to limit the proposed rule to passenger railroads. The FRA should ensure one level of safety for both passenger and freight railroads. Further, we firmly believe any such devices that railroads have already voluntarily installed, whether on freight or passenger trains, should be required to meet the minimum standards in the final rule.

Of the six reiterations since these recommendations were issued, five have involved collisions of freight trains.

Although the NPRM addressed the need for inward- and outward-facing recorders on passenger railroads, it did not address freight railroads. Section 11411 of the Fixing America's Surface Transportation Act (PL 114-94), now Title 49 *United States Code* 20168 required railroads providing regularly scheduled intercity rail passenger or commuter rail passenger transportation to the public to install inward- and outward-facing image recording devices in all controlling locomotive cabs and cab car operating compartments in passenger trains. However, the law did not require freight railroads to install such devices. Title 49 *United States Code* 20103 provides the Secretary of Transportation with broad authority "to prescribe regulations and issue orders for every area of railroad safety." The NTSB concludes that inward- and outward-facing recorders can improve the quality of accident and incident investigations and provide the opportunity for proactive steps by railroad management to verify that train crew actions are in accordance with safety rules and procedures. Therefore, the NTSB reiterates Safety Recommendations R-10-1 and -2 to the FRA. Because in the 10 years since these recommendations were issued, the FRA has begun to address only passenger railroads, and not freight railroads, Safety Recommendations R-10-1 and -2 are classified "Open—Unacceptable Response."

2.5 Railroad Switching Operations in PTC Territory

CSX operating rules required the PTC system to be switched to active mode after completion of switching activities, updating train consist changes, and before commencing train movement on the main track. The hierarchy of hazard controls is a methodology used in safety management to minimize or eliminate hazards and to eliminate or reduce the risk of injury (Centers for Disease Control and Prevention 2020). It is a widely accepted methodology with applications ranging from highly hazardous processes with potential for catastrophic consequences to life, property, and the environment to preventing injuries when using portable hand tools. Within the hierarchy of control methods to mitigate identified hazards, administrative controls are less effective than other hazard mitigation activities.[24] Administrative controls are used with existing policies, work practices and other rules. CSX implemented changes to their PTC switching operations by issuing a revised bulletin. (CSX 2019).[25] Train crews are now required to conduct a safety briefing when initiating any operating mode other than PTC active mode, such as PTC restricted mode. The revised PTC bulletin was a type of administrative control to mitigate the risks associated with operating in PTC restricted mode on main tracks.

A more effective method to mitigate risks in the hierarchy of control methods is the implementation of an engineering control. Engineering controls are favored over administrative controls since they are designed to eliminate or reduce the hazard before it can cause a collision.

The Interoperable Train Control Application Committee (ITC), which is composed of four Class I railroads (CSX, BNSF Railroad, Norfolk Southern Railroad, and Union Pacific Railroad) is developing such an engineering control to address risks associated with PTC switching between active mode and restricted mode. The ITC coordinates PTC interoperability specifications and technical protocols using the Association of American Railroads (AAR) PTC design standards. Through this railroad industry committee, CSX officials are developing software changes to the PTC restricted mode. The changes will be centered around the acknowledgement of continued movement in restricted mode. The ITC is establishing a threshold based on time and/or distance before the train engineer will receive a prompt that displays "ACKNOWLEDGEMENT TO CONTINUE MOVEMENT IN RESTRICTED MODE." (See figure 5.)

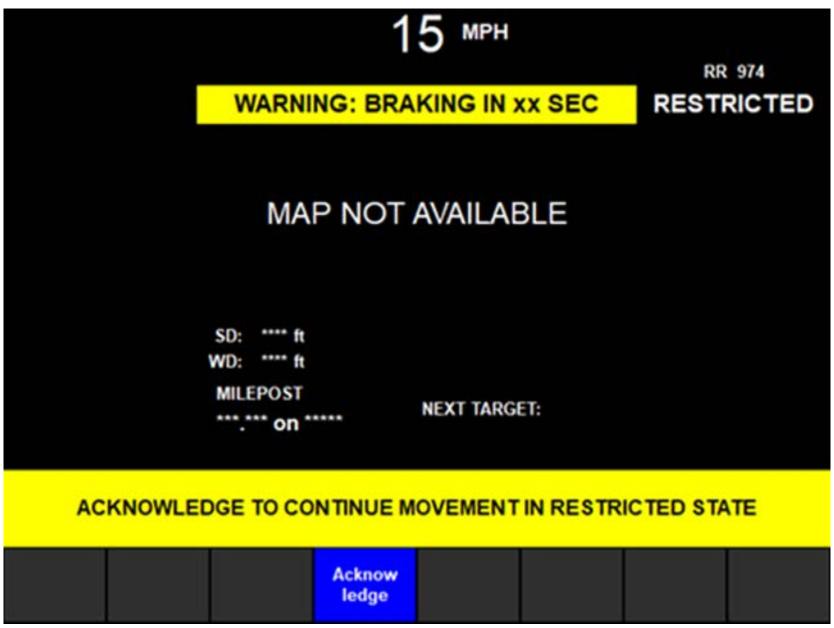

Figure 5. PTC display prototype of the proposed warning prompt. (Graphic courtesy of CSX.)

[24] *Administrative controls* are work procedures, such as written safety policies, rules, supervision, schedules, and training with the goal of reducing the duration, frequency, and severity of exposure to hazardous situations. *Engineering controls* do not require human interaction for them to perform their safety function and eliminate or reduce exposure to a physical hazard through the use or substitution of engineered safety features.

[25] According to the CSX PTC Bulletin in effect at the time of the collision, "after completing the setting off or picking up of cars or locomotives, the PTC system was required to be updated prior to departing the location."

If the train engineer does not acknowledge the prompt, the system will automatically initiate a penalty brake application. (See figure 6.)[26]

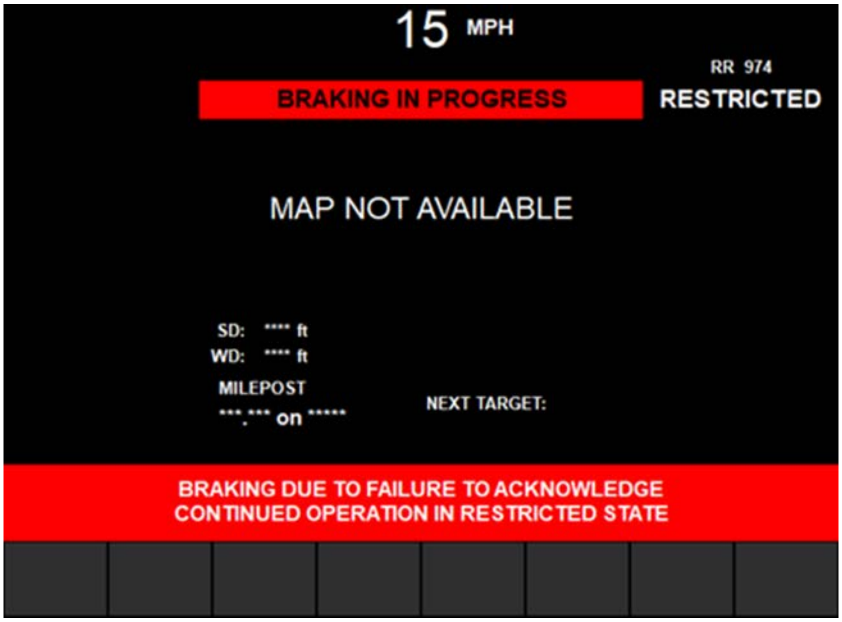

Figure 6. PTC display prototype of the proposed enforcement notification to the operator. (Graphic courtesy of CSX.)

The software change being considered by the ITC is still under development and is intended to address PTC restricted mode limitations. Operations in PTC restricted mode will be limited to a time and/or distance threshold before requiring a train engineer to acknowledge a prompt to continue operating in PTC restricted mode. CSX expects to implement the software changes to the I-ETMS by the fourth quarter of calendar year 2020.

The NTSB concludes that the administrative controls specified in 49 *CFR* 236.1005 (f) in territories with PTC systems that use the restricted mode feature are inadequate for preventing train-to-train collisions. Therefore, the NTSB recommends that FRA review the software changes being developed by the Interoperable Train Control Application Committee regarding PTC restricted mode and amend 49 *CFR* Part 236 to require railroads to revise their PTC systems to implement engineering controls that will automatically limit the use of restricted mode on main tracks.

During train operations, the signal system or train dispatcher can often provide safe train separation between trains moving in either the same direction or the opposite direction by enforcing compliance with the signal system.[27] However, there are times when trains must be authorized to operate at restricted speed, such as when trains must stop and make a reverse move on a main track or when switching cars into industry sidings and part of their train is left on the

[26] A *penalty brake application* is the automatic application of air brakes.

[27] *Safe train separation* is the distance between trains that affords enough braking distance for trains to stop plus a safety margin. Signals are spaced apart based on the braking performance of the heaviest train that operates on that segment of the track.

main track. In these cases, PTC must be switched into restricted mode. In restricted mode, safe train operation relies solely on train crew compliance with the railroad's restricted speed requirements.

The NTSB concludes that adequate training and managerial oversight are essential for ensuring that rules and procedures for safely operating PTC systems in restricted mode are followed correctly. Therefore, the NTSB recommends that the AAR, the American Short Line and Regional Railroad Association, Amtrak (National Railroad Passenger Corporation), the Alaska Railroad Corporation, and the American Public Transportation Association (APTA) inform their members of the circumstances of this collision and request they undertake a review of their training and managerial oversight programs as they relate to restricted speed operations on territories that operate PTC systems in restricted mode to identify opportunities for training improvement and to implement appropriate mitigating actions.

Additionally, the NTSB concludes that based on information gathered during the course of this investigation, CSX's PTC training program did not include particular emphasis on the use of restricted mode specific to its limitations of enforcement of restrictive signal aspects, encroachment into an established work zone, and movement through an improperly lined switch. Therefore, the NTSB recommends that CSX review and revise its training program to ensure employees are properly qualified on PTC, including restricted mode.

3 Conclusions

3.1 Findings

1. The following factors did not cause or contribute to the collision: train crew experience, impairment of the eastbound train crew, work schedule, train mechanical condition, track condition, traffic control signal system, disabled positive train control system on the eastbound train, and actions by the CSX Transportation Dispatch Center.

2. There were no actions the eastbound train engineer or eastbound train conductor could have taken to prevent the collision with the oncoming train.

3. This collision could have been prevented had the positive train control system on the westbound train been in active mode as the train approached the stop signal at Control Point Springs.

4. The westbound train engineer was impaired by his use of alcohol at the time of the collision.

5. Although postaccident testing showed the presence of marijuana in the westbound train engineer’s system, it cannot be determined if his use of marijuana caused any further impairment.

6. The westbound train engineer demonstrated performance decrements while operating the train after completing work on the Carey siding track, as illustrated by the fluctuating train speed, the abnormal use of the locomotive headlight switch, and his failure to take action to stop the westbound train at Control Point Springs.

7. CSX Transportation’s drug- and alcohol-testing programs failed to deter the westbound train engineer’s illegal use of marijuana and consumption of alcohol which impaired his performance while on duty and operating the train.

8. In light of the shortcomings in the CSX Transportation random drug- and alcohol-testing program documented in Federal Railroad Administration audits of the program, the circumstances of this collision, and the US Department of Transportation’s Office of Inspector General’s concerns with the Federal Railroad Administration’s auditing processes, an audit of CSX Transportation’s testing system that is independent of the Federal Railroad Administration is warranted.

9. Inward- and outward-facing recorders can improve the quality of accident and incident investigations and provide the opportunity for proactive steps by railroad management to verify that train crew actions are in accordance with safety rules and procedures.

10. The administrative controls specified in Title 49 *Code of Federal Regulations* 236.1005 (f) in territories with positive train control systems that use the restricted mode feature are inadequate for preventing train-to-train collisions.

11. Adequate training and managerial oversight are essential for ensuring that rules and procedures for safely operating positive train control systems in restricted mode are followed correctly.

12. Based on information gathered during the course of this investigation, CSX Transportation's positive train control training program did not include particular emphasis on the use of restricted mode specific to its limitations of enforcement of restrictive signal aspects, encroachment into an established work zone, and movement through an improperly lined switch.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of the train collision near Carey, Ohio, was the failure of the westbound train engineer to respond to the signal indications requiring him to slow and stop the train prior to Control Point Springs because of his impairment due to the effects of alcohol. Contributing to the collision was the design of the positive train control system which allowed continued operation in restricted mode on the main track.

4 Recommendations

4.1 New Recommendations

As a result of the investigation, the National Transportation Safety Board makes the following new safety recommendations:

To the US Department of Transportation:

1. Request that the US Department of Transportation Inspector General conduct an audit of CSX Transportation's drug- and alcohol-testing program to determine the circumstances that allowed a regulated employee to operate for an extended time period without being subjected to random drug testing. (R-20-15)

2. Upon completion of this examination, make any needed recommendations to CSX Transportation in its implementation of its drug- and alcohol-testing program, as well as the Federal Railroad Administration in its auditing of CSX Transportation. (R-20-16)

3. If necessary, apply any lessons learned to broadly implement enhancements to railroad drug- and alcohol-testing protocols to prevent a similar scenario from occurring at other railroads. (R-20-17)

To the Federal Railroad Administration:

4. Review the software changes being developed by the Interoperable Train Control Application Committee regarding positive train control restricted mode and amend Title 49 *Code of Federal Regulations* Part 236 to require railroads to revise their positive train control systems to implement engineering controls that will automatically limit the use of restricted mode on main tracks. (R-20-18)

To the Association of American Railroads, the American Short Line and Regional Railroad Association, the National Railroad Passenger Corporation, the Alaska Railroad Corporation, and the American Public Transportation Association:

5. Inform your members of circumstances of this collision and request they undertake a review of their training and managerial oversight programs as they relate to restricted speed operations on territories that operate positive train control systems in restricted mode to identify opportunities for training improvement and to implement appropriate mitigating actions. (R-20-19)

To CSX Transportation:

6. Review and revise your training program to ensure employees are properly qualified on positive train control, including restricted mode. (R-20-20)

4.2 Previously Issued Recommendations Reiterated and Classified in This Report

As a result of this investigation, the National Transportation Safety Board reiterates and classifies the following safety recommendations:

To the Federal Railroad Administration:

R-10-1

Require the installation, in all controlling locomotive cabs and cab car operating compartments, of crash- and fire-protected inward- and outward-facing audio and image recorders capable of providing recordings to verify that train crew actions are in accordance with rules and procedures that are essential to safety as well as train conditions. The devices should have a minimum 12-hour continuous recording capability with recordings that are easily accessible for review, with appropriate limitations on public release, for the investigation of accidents or for use by management in carrying out efficiency testing and systemwide performance monitoring programs. (R-10-1)

This recommendation is classified "Open—Unacceptable Response" in section 2.3.

R-10-2

Require that railroads regularly review and use in-cab audio and image recordings (with appropriate limitations on public release), in conjunction with other performance data, to verify that train crew actions are in accordance with rules and procedures that are essential to safety. (R-10-2)

This recommendation is classified "Open—Unacceptable Response" in section 2.3.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

ROBERT L. SUMWALT, III
Chairman

BRUCE LANDSBERG
Vice Chairman

JENNIFER HOMENDY
Member

MICHAEL GRAHAM
Member

THOMAS B. CHAPMAN
Member

Date: September 15, 2020

Appendix. The Investigation

The National Transportation Safety Board (NTSB) was notified on August 12, 2019, that westbound CSX Transportation (CSX) freight train H70211 collided with eastbound CSX freight train W31411 near Carey, Ohio. The NTSB launched an investigator-in-charge, an investigator, and a medical officer to investigate the collision.

Parties to the investigation included CSX, the Federal Railroad Administration, the Brotherhood of Locomotive Engineers and Trainmen, the Brotherhood of Railroad Signalmen, and the International Sheet Metal, Air, Rail, and Transportation Workers-Transportation Division.

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