AVIATION HIGHWAY MARINE RAILROAD PIPELINE

Issued: December 8, 2022 Railroad Investigation Report: RIR-22/14

Canadian Pacific Railway Raking Collision and Impact with Standing Train

St. Paul, Minnesota
August 25, 2021

1. Factual Information

1.1 Accident Description

On August 25, 2021, about 5:08 p.m. local time, Canadian Pacific Railway (CP) train 296-23, traveling on the St. Paul Subdivision toward St. Paul, Minnesota, collided with standing Union Pacific Railroad (UP) freight train M-SSDM-25 on main track 2, derailing two locomotives on the CP train and one locomotive on the UP train.[1] The derailed CP lead locomotive then struck and derailed a railcar from BNSF Railway (BNSF) freight train HNTWBRC-25, which was stopped on the adjacent track, main track 1. There were no reported fatalities or injuries. At the time of the accident, it was daylight, the weather was 82°F with no precipitation, and conditions were clear. Damages were estimated to be a combined $674,300 by the three railroads involved.

CP train 296-23 consisted of four locomotives at the head end and 117 railcars (28 loaded cars and 89 empties). The National Transportation Safety Board's (NTSB's) review of locomotive event recorder data showed that as train 296-23 traveled eastbound on the St. Paul Subdivision, the train crew stopped the train for about 20 minutes at control point Seventh Street, which was displaying a red (stop) signal on a descending grade of 1.65 percent. Control point Seventh Street then displayed a red-over-yellow, or diverging approach, signal.[2] At 5:04:21 p.m., the CP train engineer

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[1] (a) For more detailed information about this investigation, see the public docket at https://data.ntsb.gov/Docket/Forms/searchdocket and search for number RRD21LR014. Use the CAROL Query to search safety recommendations and investigations. (b) All times in this report are local time unless otherwise noted. (c) On Canadian Pacific Railway (CP) train 296-23, lead locomotive CP 8737 and Union Pacific Railroad (UP) locomotive UP 5525 were derailed and damaged. On UP train M-SSDM-25, locomotive UP 5497 was derailed and damaged, and locomotives UP 8264 and UP 793 were damaged.

[2] A *diverging approach* signal indicates that a train should proceed prepared to advance on a diverging route at the next signal at the prescribed speed.

released the brakes and started to descend the grade with the throttle in the idle position, moving toward control point Division Street, which displayed a red signal.[3] (See figure 1.) The distance between the two control points was about 3,560 feet.

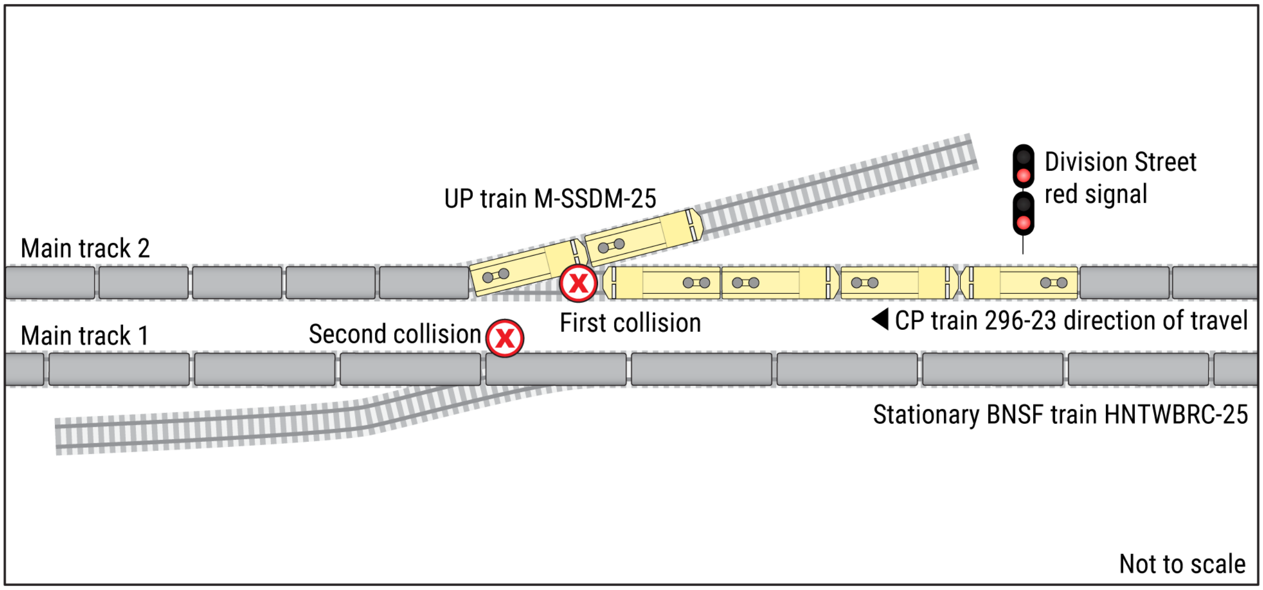

Figure 1. Diagram of collision.

Event recorder data showed that the engineer was using the dynamic brakes to control the train's descent down the hill to control point Division Street.[4] The dynamic brakes were not sufficient to hold the train on the descending grade. The data indicated that, as the CP train proceeded toward the control point, the air brakes were recovering (building air pressure) from a brake pipe reduction of 18 pounds per square inch (psi) from the recent stop at control point Seventh Street.[5] The train engineer attempted a 10-psi reduction to apply the air brakes and slow the train, but the recorded brake pipe pressure at the rear was only 81 psi, and the reduction in pressure was not enough to engage the brakes.[6] At 5:06:57 p.m., the train speed reached about 16 mph, and at 5:07:01 p.m. the engineer applied the air brakes at the

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[3] The National Transportation Safety Board's (NTSB's) postaccident review of signal and train control data logs indicated the eastbound signal at control point Division Street displayed a red (stop) signal at 4:57:55 p.m. The eastbound signal at control point Seventh Street displayed a diverging approach signal at 5:00:14 p.m.

[4] A train's *dynamic brakes* use the kinetic energy of the moving train to generate an electric current, which then dissipates through resistors in the locomotive car body.

[5] (a) The air brake system on a train is designed to slow or stop a train through the use of compressed air. (b) The air pressure within the train line is called the *brake pipe*. The train engineer applies the brakes by releasing air, thereby reducing brake pipe pressure.

[6] Normal brake pipe operating pressure, with no brakes applied, is 90 pounds per square inch.

service zone level.[7] This was the first time the air brakes engaged in the accident sequence. The train speed continued to increase.

At 5:07:54 p.m., the train reached 21 mph, its highest speed in the accident sequence.[8] At 5:08:10 p.m., the engineer applied the air brakes at the suppression level (a stronger braking application than service zone level). About 12 seconds later and at a train speed of 20 mph, the engineer placed the train into emergency braking.[9] In the 20 seconds between the emergency brake application and coming to a stop, CP train 296-23 approached control point Division Street at 19 mph, passed the stop signal, and collided with the UP and BNSF trains before coming to its final resting position at 5:08:42 p.m.

1.2 Before the Accident

The CP train originated in Calgary, Alberta, Canada, and entered the United States on August 25, 2021, with a different crew than the one involved in the accident. The positive train control (PTC) system was initialized about 5:15 a.m. as the train operated on the CP Carrington Subdivision.[10] The NTSB's review of CP PTC help desk records found that, later that morning, the train experienced a failure of the onboard PTC system that prevented the train from proceeding. About 8:59 a.m., the crew contacted the CP PTC help desk for assistance. The help desk was unable to troubleshoot the failure and about 9:17 a.m. instructed the train crew to proceed without an operating PTC system, in accordance with Federal Railroad Administration (FRA) regulations and General Code of Operating Rule 18.4.[11] (See section 1.4 for more on federal PTC regulations.)

The CP train proceeded to Glenwood, Minnesota, where a new train crew, consisting of a train engineer and conductor, boarded the train to continue toward St. Paul. The previous crew informed the new crew of the onboard PTC system failure and that the CP PTC help desk had directed the train to proceed. At 11:53 a.m., the new crew of CP train 296-23 called the CP PTC help desk to validate the failure of the onboard PTC system. The help desk informed the train crew that the PTC failure was

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[7] The *service zone level* of air braking is a brake line pressure reduction of 20 pounds per square inch.

[8] A permanent speed restriction of 25 mph was in effect for freight trains in the area of the accident.

[9] An *emergency brake application*, made by releasing air pressure very quickly from the brake pipe, is initiated when a train must be stopped in the minimum distance possible.

[10] Positive train control (PTC) is an advanced train control system that uses communication-based and processor-based technology.

[11] Under General Code of Operating Rule 18.4, the PTC system may only be cut out or disabled when authorized by rule or when proper authorization is received. See "18.4 PTC Cut Out" in *General Code of Operating Rules*, 8th ed., April 1, 2020.

still in effect. The help desk and CP dispatcher authorized the train to proceed without an operating PTC system.

As the train continued toward St. Paul, the train crew radioed the BNSF dispatcher that the onboard PTC system was disabled. The BNSF chief dispatcher authorized the CP train crew to proceed without PTC onto BNSF tracks.

1.3 Personnel Information

1.3.1 Qualifications and Testing

CP records indicate the train engineer was hired on March 14, 2011, and was qualified by CP as a locomotive engineer on March 27, 2013.[12] The records further indicate the engineer was PTC-qualified on June 8, 2019, and received his most recent vision and hearing certification on January 9, 2019.[13] CP efficiency tested the engineer 17 times between August 4, 2020, and August 8, 2021.[14]

CP records show the conductor was hired on June 23, 2014, and was qualified by CP as a train conductor on November 17, 2014. The conductor was PTC-qualified on October 10, 2018, and received his most recent vision and hearing certification on October 23, 2019.[15] CP records indicate 19 efficiency tests for the conductor between August 8, 2020, and August 10, 2021.

1.3.2 Toxicology

Postaccident toxicology testing of the engineer and conductor for alcohol and other drugs was performed, as required by FRA regulations.[16] The results were negative for all tested-for substances.

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[12] CP records also contained an engineer qualification date of January 1, 2010, for the train engineer, which CP determined to be the result of an administrative error.

[13] See Title 49 Code of Federal Regulations (*CFR*) Part 240—Qualification and certification of locomotive engineers.

[14] The Federal Railroad administration requires that locomotive engineers be given a skill performance test before certification or recertification and establishes certain criteria for the conduct of that test (see 49 *CFR* 240.127—Criteria for examining skill performance and 49 *CFR* 240.211—Procedures for making the determination on performance skills).

[15] See 49 *CFR* Part 242—Qualification and certification of conductors.

[16] Postaccident testing required by the Federal Railroad Administration screens for substances including amphetamines, barbiturates, benzodiazepines, cocaine, alcohol and cannabis metabolites, methadone, methaqualone, MDA-analogues, opiates, 6-acetylmorphine, oxycodone, opiates, phencyclidine, and propoxyphene.

1.3.3 Cellular Phones

The NTSB reviewed cellular phone records from August 23 through August 25, 2021, for two personal electronic devices, one belonging to the engineer and one belonging to the conductor. The review did not reveal usage on either device around the time of the accident or at times considered normal resting hours for the engineer and conductor on the night before the accident.

1.3.4 Work Schedules

St. Paul was the home terminal for the train engineer. He went on duty about 10:45 a.m. on August 25. The engineer described the day of the accident as "pretty standard" and recalled feeling "all right." The engineer stated that he had stayed in a nearby hotel the night before the accident and had obtained adequate rest. (See table 1 for the engineer's work schedule in the days preceding the accident.)

Table 1. Engineer Schedule

Date	Hours Worked
August 21	9 hours 50 minutes
August 22	Off duty
August 23	Off duty
August 24	10 hours 17 minutes

The train conductor, whose home terminal was Enderlin, North Dakota, reported for duty about 7:30 a.m. on August 25. (See table 2 for the conductor's work schedule in the days preceding the accident.)

Table 2. Conductor Schedule

Date	Hours Worked
August 22	11 hours 15 minutes
August 23	10 hours 25 minutes
August 24	Off duty

1.3.5 Engineer Training

The CP training materials for engineers pertaining to train handling include guidance on planning for train stops and maintaining proper brake cylinder pressure. Instructions explain that engineers should consider track grade, train weight and length, and other factors in the control of their trains. The training also addresses dynamic brakes and the use of air brakes when the available dynamic brake force cannot properly control the speed of the train.

CP training materials define an ascending grade as track with increasing elevation.[17] An ascending grade is "light" when the grade is less than 0.8 percent. "Heavy grade" is between 0.8 and 1.8 percent, and greater than 1.8 percent is "mountain grade." Regarding excessive speed on a descending grade, CP training instructs engineers to stop their train with an emergency application of the brakes if the train exceeds the maximum authorized speed by 5 mph.

1.3.6 Train Handling

During a postaccident interview with the NTSB, the train engineer explained that after stopping at the control point Seventh Street signal, he left the throttle in idle, activated the dynamic brakes, and released the air brakes. The train started moving down the descending grade and increased speed. The engineer stated he then applied the air brakes multiple times, but the train did not slow down.

The engineer recalled that as the train advanced through the curve near the control point Division Street signal, a train on the adjacent track blocked the view of the signal. The engineer further explained that when the red signal came into view, he realized the train was going too fast to stop at the signal and initiated an emergency application of the air brakes, but it was too late to stop, and the train passed the signal.

The engineer described how the track grade and weight of the train presented an operational challenge. He noted that crews "normally run on all approaches coming down the [BNSF] hill," meaning that most of the time, crews moving toward control point Division Street are met with yellow (approach) signals, not stop signals.[18]

1.4 Positive Train Control System Regulations

The postaccident NTSB review of CP PTC help desk records determined that as the train was traveling on the CP Elbow Lake Subdivision, the lead locomotive experienced a Locomotive Interface Gateway failure, which prevented the locomotive PTC system from communicating with the wayside PTC system.

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[17] A 1-percent grade is equivalent to a 1-foot rise in elevation for every 100-foot run of track.

[18] An *approach* signal indicates that a train should proceed at a prescribed speed prepared to stop before it passes the next signal.

Title 49 *Code of Federal Regulations* (*CFR*) Part 236 prescribes minimum performance-based safety standards for PTC systems.[19] The Positive Train Control Enforcement and Implementation Act of 2015 imposed a temporary prohibition on the FRA enforcing certain PTC regulations.[20] From October 29, 2015, to December 31, 2021, railroads were not subject to the operational restrictions in 49 *CFR* 236.567 and 49 *CFR* 236.1029, which applied when a controlling locomotive experienced a PTC system failure or if a PTC system otherwise failed to initialize, was cut out, or malfunctioned. This temporary prohibition only applied if the railroad operated at an equivalent or greater level of safety than that achieved immediately before PTC system implementation. CP had met this requirement at the time of the accident.

Beginning January 1, 2023, the FRA operational restrictions under 49 *CFR* 236.567 and 49 *CFR* 236.1029 will apply when any safety-critical PTC system component fails to perform its intended function or cuts out en route.[21]

1.5 CP Train 296-23 Tests and Inspections

On August 23, CP train 296-23 had a Class I air brake test and predeparture inspection by CP qualified mechanical inspectors in Calgary. In addition to the full air brake test and inspection, the train was inspected for defective conditions on the wheels, axles, bearings, and other running gear components. The CP train departed Calgary with no identified mechanical issues.

On August 25, the NTSB conducted a postaccident Class I air brake test on the cars of CP train 296-23. The air brakes applied and released as designed, and brake components showed normal wear patterns.

1.6 Postaccident Actions

As a result of this accident, the CP locomotive engineer was terminated in September 2021.

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[19] See 49 *CFR* 236.567—Restrictions imposed when device fails and/or is cut out en route and 49 *CFR* 236.1029—PTC system use and failures.

[20] Positive Train Control Enforcement and Implementation Act of 2015, 49 United States Code § 20157(j), Early Adoption.

[21] According to 49 *CFR* 236.1029, "the cause [of the PTC system failure] must be determined and the faulty component adjusted, repaired, or replaced without undue delay. Until repair of such essential components is completed, a railroad shall take appropriate action as specified in its PTC Safety Plan."

2. Analysis

CP train 296-23 was traveling to St. Paul, Minnesota, on BNSF tracks. The train passed a red (stop) signal at control point Division Street at a speed of about 19 mph and collided with a standing UP train on the same main track, derailing one CP locomotive and two UP locomotives. The derailed CP locomotive then collided with a railcar of a BNSF train that was stopped on the adjacent main track.

2.1 Positive Train Control

On August 25, about 8:59 a.m. and again about 11:53 a.m., the respective crews of CP train 296-23 alerted dispatchers that the PTC system on the train had failed. Both times, the train was permitted to continue with the PTC system disabled. FRA regulations in effect at the time of the accident and the General Code of Operating Rules provided for disabled trains to operate on PTC territory.

On January 1, 2023, enforcement of operational restrictions regarding en route failures of PTC systems will begin, prohibiting trains from departing any terminal when the PTC system fails to initialize, as occurred in this accident.

2.2 Train Handling

After ruling out employee cell phone use, toxicology, fatigue, and training, as well as signal and brake performance, the NTSB investigation analyzed the actions of the train engineer during the minutes that passed as the train proceeded between the signals at control point Seventh Street and control point Division Street. The engineer attempted to slow CP train 296-23 by initiating a 10-psi brake pipe reduction to reapply the air brakes, but this reduction was not enough to engage the air brakes because they had not built up enough air pressure from the stop at control point Seventh Street.

Data from the locomotive event recorder reviewed by the NTSB showed that, without the air brakes applied, the train began accelerating as it descended the hill. The engineer used the dynamic brakes, but they were not sufficient to hold the train on the descending grade, and the train speed continued to increase. The engineer applied the air brakes at increasingly stronger levels, eventually initiating emergency braking when the train reached its top speed of 21 mph, but the train passed the signal at control point Division Street and impacted the UP and BNSF trains before it stopped.

The actions of the engineer show that he understood that he needed to be prepared to stop at the control point Division Street signal and was actively controlling the train in the minutes before the accident. However, the engineer did not recognize that the brake pipe pressure in the rear of the train had not fully recovered from the stop at control point Seventh Street and did not reduce the brake pipe pressure enough to compensate for it during his initial brake application as he began descending the grade toward the control point Division Street signal. He also did not initiate the successive braking levels soon enough to slow the train on the descending grade, as he had been trained to do. Because of this improper train handling, the train did not stop in time.

3. Probable Cause

The National Transportation Safety Board determines that the probable cause of the August 25, 2021, train collision was improper handling of the train's air brakes by the engineer of Canadian Pacific Railway train 296-23, which resulted in his failure to bring the train to a stop at the red (stop) signal at control point Division Street.

The National Transportation Safety Board (NTSB) is an independent federal agency dedicated to promoting aviation, railroad, highway, marine, and pipeline safety. Established in 1967, the agency is mandated by Congress through the Independent Safety Board Act of 1974, to investigate transportation accidents, determine the probable causes of the accidents, issue safety recommendations, study transportation safety issues, and evaluate the safety effectiveness of government agencies involved in transportation. The NTSB makes public its actions and decisions through accident reports, safety studies, special investigation reports, safety recommendations, and statistical reviews.

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 RRD21LR014. 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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