Transportation Safety Board of Canada
Bureau de la sécurité des transports du Canada

RAIL TRANSPORTATION SAFETY INVESTIGATION REPORT R24C0020

MAIN-TRACK TRAIN COLLISION

Canadian Pacific Railway Company, doing business as CPKC
Freight trains 805-339 and 301-230
Mile 116.8, Mountain Subdivision
Near Greely, British Columbia
16 February 2024

Canada

ABOUT THIS INVESTIGATION REPORT

This report is the result of an investigation into a class 3 occurrence. For more information, see the Policy on Occurrence Classification at www.tsb.gc.ca

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

TERMS OF USE

Citation

Transportation Safety Board of Canada, *Rail Transportation Safety Investigation Report* R24C0020 (released 31 March 2025).

Transportation Safety Board of Canada
200 Promenade du Portage, 4th floor
Gatineau QC K1A 1K8
819-994-3741; 1-800-387-3557
www.tsb.gc.ca
communications@tsb.gc.ca

Rail transportation safety investigation report R24C0020

Cat. No. TU3-11/24-0020E-PDF
ISBN 978-0-660-76350-7

This report is available on the website of the Transportation Safety Board of Canada at www.tsb.gc.ca

Le présent rapport est également disponible en français.

Table of contents

RAIL TRANSPORTATION SAFETY INVESTIGATION REPORT R24C0020

MAIN-TRACK TRAIN COLLISION

Canadian Pacific Railway Company, doing business as CPKC
Freight trains 805-339 and 301-230
Mile 116.8, Mountain Subdivision
Near Greely, British Columbia
16 February 2024

Summary

On 16 February 2024, at about 2200 Pacific Standard Time, the loaded unit coal train 805-339 of the Canadian Pacific Railway Company, doing business as CPKC, was proceeding westward at 22.3 mph on the north main track of the Mountain Subdivision when it collided with the trailing car of stationary unit grain train 301-230 at Mile 116.8 near Greely, British Columbia. The 4 head-end locomotives on train 805-339 derailed, 1 of which caught fire. Four cars on train 301-230 derailed, 1 of which also caught fire. Both crew members of train 805-339 were taken to a local hospital, 1 with serious injuries; there were no injuries to the crew of train 301-230. Approximately 17 500 litres of diesel fuel leaked from the derailed locomotives, of which an undetermined amount burned. Approximately 400 tons of grain spilled from train 301-230.

1.0 FACTUAL INFORMATION

On 16 February 2024, a train crew of the Canadian Pacific Railway Company, doing business as CPKC, was ordered for 1020[1] at Field[2] to operate freight train 301-230 (train 301) westward from Field to Revelstoke via the CPKC Mountain Subdivision. Train 301 consisted of 3 locomotives in a distributed power configuration (2 at the head end and 1 about mid-train) and 122 loaded grain cars. It measured 7087 feet and weighed 17 923 tons.

On the same day, another CPKC train crew was ordered for 1600 at Golden to operate unit coal train 805-339 (train 805) from Golden to Revelstoke via the CPKC Mountain Subdivision. Train 805 consisted of 4 locomotives in a distributed power configuration (2 at

1 All times are Pacific Standard Time.

2 All locations are in the province of British Columbia, unless otherwise indicated.

the head end, 1 about mid-train, and 1 at the tail end), 2 dead-in-tow locomotives behind the 2 head-end locomotives, and 152 loaded coal cars. It measured 8508 feet and weighed 22 235 tons.

1.1 The occurrence

Under section 28 of the *Canadian Transportation Accident Investigation and Safety Board Act*, every on-board recording is privileged. However, the TSB may make use of any on-board recording where it is necessary in the interests of transportation safety. For this reason, while the Board may refer to an on-board recording where required to support a finding and identify a substantive safety deficiency, other parties may not access or use privileged on-board recordings.

The reason for protecting on-board recordings lies in the premise that the privilege of a recording respects the privacy of operating personnel whose words and actions are captured on the recording and will also help ensure that this essential material is available for the benefit of safety investigations.

This report references content from a Locomotive Voice and Video Recorder (LVVR), which is a form of on-board recording in the rail transportation sector. For each of these references, the TSB is using the LVVR recording to substantiate some of its findings and to identify certain substantive safety deficiencies. In each case, the material has been carefully examined to ensure that the extracts used are necessary to identify causes or contributing factors of this occurrence or to identify safety deficiencies.

Train 805 left Golden at about 1630 and proceeded westward on the north main track of the Mountain Subdivision. Train 301 had already passed by Golden on its way to Revelstoke and was further ahead of train 805, also on the north main track of the Mountain Subdivision.

At about 2049, the rail traffic controller (RTC) contacted the crew on train 301 to inform them of a delay at Greely, indicating that their train would have to wait for and meet several eastbound trains. Just as the RTC was ending this conversation with the crew on train 301, he received a call from the crew on train 805. The crew on train 805 did not hear the conversation between train 301 and the RTC, nor the RTC's conversations with other approaching eastbound trains. The RTC did not mention train 301's delay to train 805, nor was there a requirement to do so.

At about 2150, the conductor on train 805 communicated the Clear indication at signal 1131N approaching Twin Butte and made a radio broadcast indicating that the train was cleared to Greely.

At about 2153,[3] the RTC called train 805 to report cold wheel information[4] as required by company procedures.[5] The conductor copied the car numbers, and there was some back and forth between him and the RTC to repeat and clarify some of them. The conversation about the cold wheel report lasted 2 minutes and 50 seconds, during which time the train travelled about 8800 feet.

While the RTC was providing the cold wheel report, train 805 was approaching the next signal (1149N) and passed an eastbound train. As the opposing train was approaching, approximately 0.75 miles from signal 1149N, the locomotive engineer (LE) made a minimum application of the air brakes (8 psi brake pipe pressure reduction) and momentarily dimmed the headlights. During this time, the LE overheard the conversation between the conductor and the RTC and recognized that car DTTX 767871, reported in position 2, could not be on the train.[6] He then consulted his copy of the train consist listing to verify and reconcile the car numbers provided by the RTC. In particular, he was trying to reconcile the RTC's report of car DTTX 767871 in position 2 with the train consist listing that showed position 2 was occupied by the 2nd head-end locomotive.[7]

At 2154:24, signal 1149N came into view. It was displaying a Clear to Stop indication.[8] The conductor, still copying the numbers communicated by the RTC, did not see the indication. The LE saw the Clear to Stop indication but did not call it as he did not want to interrupt the communication between the conductor and the RTC. After passing the signal, the LE continued to review the train documentation and made a further 2 psi brake pipe pressure reduction (for a total of 10 psi).

---

3 The call from the RTC came less than 10 minutes before the RTC's shift change, which occurs at the same time every day. Shift changes are especially busy periods for RTCs.

4 Cold wheels on a rail car can be an indication that the car's air brake system is ineffective.

5 When a rail traffic controller (RTC) receives a cold wheel report from a wheel temperature detector on the Mountain Subdivision, the RTC must provide the train crew with the rail car number for each car with cold wheels. [Source: CPKC, *Summary Bulletin 002/23* for the Pacific Subdivision, Section H: Additional Operating Bulletins in Effect, Operating Bulletin BCO-056/12 (Crew Responsibilities for ATBE Trains), pp. 42 and 43].

6 The investigation later determined that car DTTX 767871 was on eastbound train 148-15. This train was travelling on the south track by Mile 104.8 within a couple of minutes of train 805, which was on the north track. The DTTX car was erroneously reported by the wheel temperature detector as a car with cold wheels on train 805.

7 The DTTX reporting mark is used for intermodal cars. Since train 805 was a unit coal train, there would not have been a DTTX car in the train consist.

8 A Clear to Stop indication allows a train to proceed, but the train crew must prepare to stop at the next signal. Movements must reduce to a speed not exceeding 30 mph (40 mph for passenger trains). Reduction in speed must begin before passing the signal. [Source: Canadian Pacific Railway Company, *Rule Book for T&E Employees* (28 October 2021), section 19.3: Aspects, Names and Indications, Rule 411, p. 52.]

At 2156:21, as the RTC was ending the call with the conductor, the LE picked up his handset[9] and asked the RTC to confirm car number DTTX 767871, but the radio transmission had already been disconnected and the RTC did not reply.

At 2156:44, around Mile 116.0, the train was travelling 29.3 mph and the LE released the air brakes. About 30 seconds later, the speed had increased to 30.4 mph and the LE reapplied the brakes (10 psi brake pipe pressure reduction);[10,11] however, the train speed continued to gradually increase.

At 2157:52, while train 805 was travelling at 32.7 mph, signal 1167N came into view, about 523 feet ahead. Upon seeing this signal, the conductor called out the Restricting indication[12] to the LE. At about the same time, the flashing light of the end-of-train marker on a stationary train ahead came into view; it was train 301, which was stopped around a curve waiting to cross over to the south track, with its air brakes applied, about 439 feet beyond the signal. The LE made an emergency application of the train brakes at 2157:55. At this time, the train was travelling at 32.7 mph with the dynamic brakes in position 5 and was about 818 feet away from the tail end of train 301. The LE increased the dynamic brake application to the maximum available.

At 2158:14, about 11 seconds after train 805 had passed signal 1167N, it collided with the tail-end car of train 301 at a speed of 22.3 mph. The collision occurred at Mile 116.8 near Greely (Figure 1). The movement came to a stop 155 feet beyond the point of collision.

---

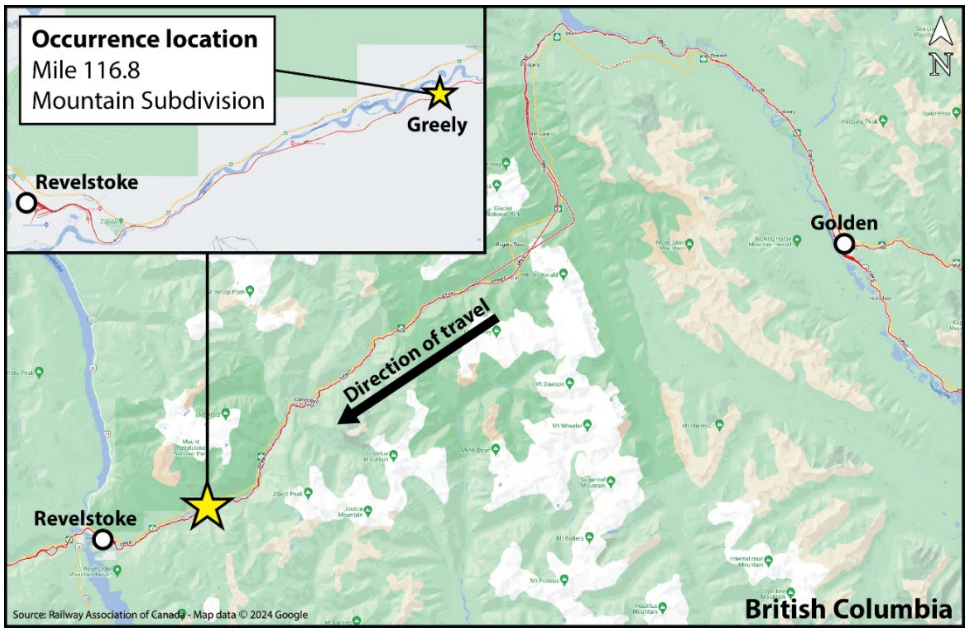
9 In a locomotive cab, the locomotive engineer (LE) and the conductor each have a radio handset.

10 The LE reapplied the brakes before the air brake system was fully recharged; in such cases, less brake retarding force is developed.

11 When making a service brake application on distributed power trains equipped with a tail-end remote locomotive, if the train air brake system is not fully charged, LEs must use the equalizing reservoir gauge to measure a brake pipe pressure reduction of at least 7 psi from the point where the service exhaust starts to blow, or determine the amount of false gradient (if any) and reduce the equalizing reservoir pressure by 7 psi plus the amount of false gradient. [Source: Canadian Pacific Railway Company, *General Operation Instructions*, (last updated 28 October 2021), section 1, item 34.2, p. 18.]

12 A signal displaying a Restricting indication authorizes a train to proceed beyond the signal at restricted speed. Restricted speed is defined as a speed that will permit stopping within one-half the range of vision of equipment (train crews must also be prepared to stop the train short of a switch not properly lined and be on the lookout for broken rails) and in no case exceed 15 mph. [Source: Canadian Pacific Railway Company, *Rule Book for T&E Employees* (28 October 2021), section 19.3: Aspects, Names and Indications, Rule 436, p. 54, and Definitions, p. 8.]

Figure 1. Map of the occurrence location, with inset map showing the location's proximity to Greely (Source: Railway Association of Canada, *Canadian Rail Atlas*, with TSB annotations)

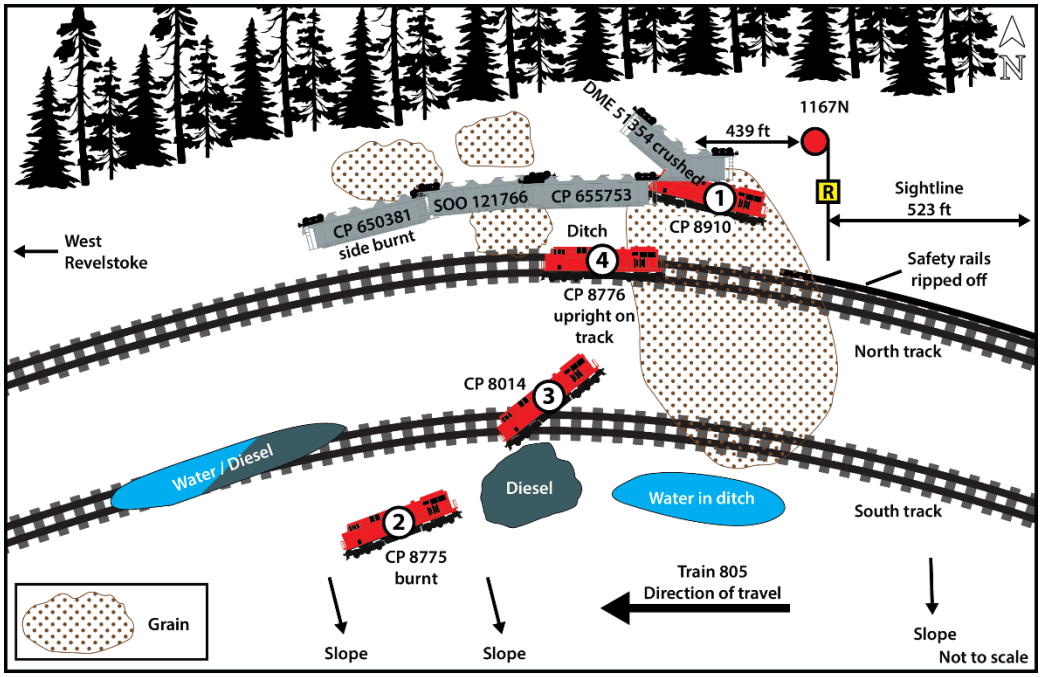


As a result of the collision, the 4 head-end locomotives on train 805 derailed (locomotives CP 8910, CP 8775, CP 8014, and CP 8776), 1 of which (CP 8775) caught fire. About 17 500 litres of diesel fuel leaked from the derailed locomotives. On train 301, 4 cars derailed, 1 of which (CP 650381) caught fire, and about 400 tons of grain spilled from the train (Figure 2).

There is no indication that the crew on train 805 made the required *Canadian Rail Operating Rules* (CROR) emergency broadcast on the train standby channel, however, they contacted the crew on train 301, who, in turn, informed the RTC of the situation. They indicated to the RTC that the tail end of their train had been hit by train 805, and that some locomotives on train 805 had derailed and were on fire. They requested that the RTC send ambulance and fire services as soon as possible. Both crew members of train 805 were taken to a local hospital, 1 with serious injuries; there were no injuries to the crew of train 301.

The local fire service, upon receiving details on the rolling stock fires and being told that their assistance would not be necessary to extract anyone from the area, opted not to attend, indicating that they would reassess this decision if needed. The fires eventually burnt themselves out.

Figure 2. Schematic of the occurrence site showing the derailed rolling stock after the collision, including the derailed locomotives and their order in the train consist (Source: TSB)



At the time of the occurrence, the temperature was –9 °C, the sky was cloudy, and the visibility was clear.

1.2 Crew information

The crew on train 301 consisted of an LE and a conductor. The LE had qualified for his position 7 months before the occurrence, after having worked as a conductor on the Mountain Subdivision for 4 years. The conductor had about 1 year experience in his position, also on the Mountain Subdivision.

The crew on train 805 consisted of an LE and a conductor. The LE had about 8 years of experience, of which 5 were on the Mountain Subdivision. The conductor had about 1.5 years experience in his position, also on the Mountain Subdivision.

All crew members were qualified for their respective positions and met fitness and rest requirements.

1.3 Subdivision and track information

The Mountain Subdivision extends westward from Field (Mile 0.0) to Revelstoke (Mile 125.7).

Train movements are governed by the centralized traffic control system (CTC) as authorized by the CROR and are dispatched by an RTC located in Calgary, Alberta.

The track in the vicinity of the occurrence consists of double main tracks. It is designated as a Class 3 track according to the *Rules Respecting Track Safety*. The maximum authorized speed is 35 mph for freight trains.

Signal 1167N is at Mile 116.8 on the subdivision within a 5.92° right-hand curve. It is a high masted, single aspect signal equipped with a letter plate depicting the letter "R."[13] It is positioned to the right of the north track as seen from an approaching westward train. The track gradient for westward trains approaching this location is undulating with a 1% descending grade for 0.216 miles before the signal. The sightline distance to the signal is 523 feet (about 0.1 mile).

1.4 Recorded information

The sequence of events was established from a review of available information, including forward-facing video camera recordings, radio communication records, wayside track signal logs, data from the locomotive event recorder and the locomotive video and voice recorder, and interviews. Select events are provided in Appendix A.

1.5 Signal indications

1.5.1 Centralized traffic control system

The CTC system provides for safety during the operation of trains, and during track work, on one or more main tracks. It uses track circuits interconnected with signals displayed in the field to control train movements.

Signal indications are used to control train movements by visually conveying advance information to train crews about the status of the track ahead, authorized speed within the track block, and the immediate limits within which the train may operate, i.e., usually 1 or 2 consecutive blocks in the direction of travel.

Signal indications also identify if the block ahead is occupied by another movement and provide protection against some conditions, such as a broken rail or a switch left open. Signal indications are progressive: the preceding signal indicates what the next signal will potentially display.

1.5.2 Signal indications and associated rules in this occurrence

Rules 405 to 439 of the CROR govern the signals used in CTC territory. At CPKC, the rules are also contained in the company's instructions for its train and engine [T&E] employees, the *Rule Book for T&E Employees*, and may stipulate more restrictive requirements for some of the rules.

---

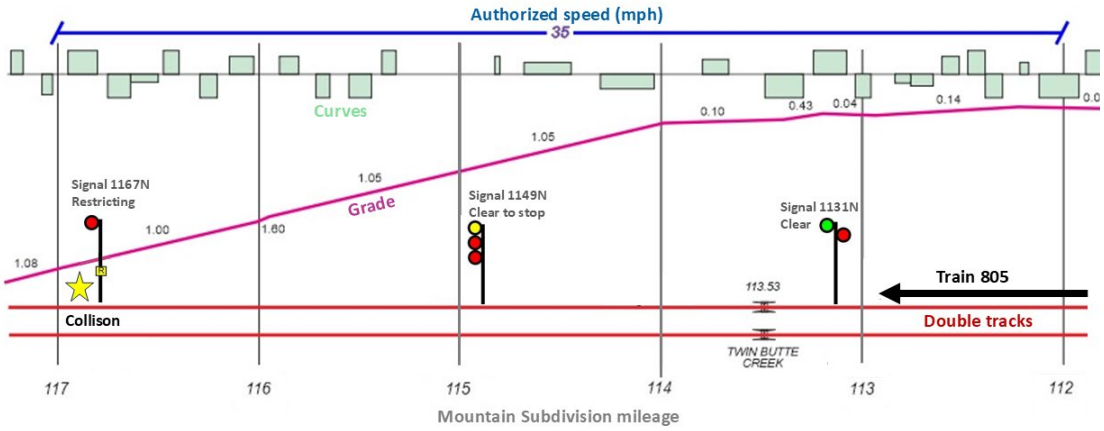
[13] The letter plate depicting the letter "R" modifies the indication of this signal from Stop and Proceed (Rule 437 of the *Canadian Rail Operating Rules*-CROR) to Restricting (CROR Rule 436) when the colour light is displaying red. The use of arrows or plates on signals is authorized by CROR Rule 403 (b).

Train crews must comply with all signal indications and are required to control their trains in accordance with these rules.

In this occurrence, westbound train 805 encountered a progression of signal indications that governed the approach to Greely (Figure 3):

- The 1st signal, 1131N, displayed a Clear indication, which identified that the train could proceed.
- The following signal, 1149N, displayed a Clear to Stop indication, which identified that the train could proceed but must be prepared to stop at the next signal. CPKC's *Rule Book for T&E Employees* also stipulates that, on a Clear to Stop indication, movements must reduce to a speed not exceeding 30 mph (40 mph for passenger trains).[14]
- The 3rd signal, 1167N, displayed a Restricting indication, which identified that the train could proceed at restricted speed.

Figure 3. Schematic of the signal progression in this occurrence (Source: CPKC, with TSB annotations)



1.5.3 Signal recognition and compliance

Signal recognition and compliance is governed by CROR Rule 34 (Fixed Signal Recognition and Compliance). Section 6.5 of CPKC's *Rule Book for T&E Employees* also contains provisions related to signal recognition and compliance. Rule 34 and section 6.5 both state that crew members within physical hearing range must clearly communicate the indication

[14] Canadian Pacific Railway Company, *Rule Book for T&E Employees* (effective 28 October 2021), section 19.3: Aspects, Names and Indications, p. 51.

by name of each fixed signal they are required to identify.[15,16] These instructions are followed by a list of signals that must be communicated, which includes block signals,[17] interlocking signals,[18] and Stop signals.

In addition to calling signals to each other within the locomotive cab, train crews are also required to broadcast some signals over the radio. Section 4.5 of CPKC's *Rule Book for T&E Employees* states, in part:

> […]
>
> Unless otherwise indicated in special instructions, radio broadcasts must be made on the designated standby channel:
>
> (a) for each controlled location/point, and the advance signal to such or to the next interlocking, stating:
>
> (i) designation;
>
> (ii) name of signal indication displayed; and
>
> (iii) name of the controlled location/point or location of interlocking […][19]

Train crew awareness of signal indications displayed in the field relies on visual detection and perception. Accurate and timely perception of signals is essential for compliance. Signal perception, when there is clear visibility and unobstructed sightlines, can be accomplished rapidly from relatively long distances. However, a crew's fitness for duty, distractions, mental models, and expectations can affect perception and reaction time.

In this occurrence:

- The crew members on train 805 communicated the Clear indication at signal 1131N to each other, and the conductor made a corresponding broadcast on the radio.
- The LE saw the Clear to Stop indication at signal 1149N, but did not communicate it, nor did he broadcast it over the radio; the LE picked up his handset but did not call the indication to avoid distracting the conductor and broadcasting over the ongoing RTC-conductor conversation.
- The conductor did not see the signal because he was copying car numbers given by the RTC and comparing it with the train consist.

---

15 *Canadian Rail Operating Rules* (effective 01 October 2022, approved by Transport Canada on 09 May 2022), Rule 34, pp. 27-28.

16 Canadian Pacific Railway Company, *Rule Book for T&E Employees* (effective 28 October 2021), section 6.5: Fixed Signal Recognition and Compliance, p. 20.

17 A block signal is a fixed signal at the entrance to a block (i.e., a length of track of defined limits, the use of which by a movement is governed by block signals) to govern a movement entering or using that block. [Source: Ibid., section 1 – Definitions, p. 6]

18 An interlocking signal is "a fixed signal at the entrance to or within interlocking limits to govern the use of the routes." (Source: Ibid., section 1 – Definitions, p. 7)

19 Ibid., section 4.5: CTC Broadcast Requirements, p. 17.

- In the final seconds, both crew members on train 805 saw the Restricting indication at signal 1167N, and the conductor called the indication in the cab. At this point, the train was operating at 32.7 mph.

1.6 Stopping distance calculations

The investigation sought to determine the theoretical distance required to stop train 805 after the LE made an emergency application of the train brakes, but in the absence of any stationary equipment in its path.

Based on calculations using locomotive event recorder data, such as the deceleration rate during the emergency application of the train brakes, it was determined that the theoretical stopping distance was about 1426 feet (about 608 feet beyond the point of collision).

The calculations took into account the following:

- At 21:57:55, when the LE applied the brakes in emergency, the train was travelling at 32.7 mph. At the time, the train was at Mile 116.57, on a 1% descending grade.
- At 21:58:14, just before the collision, train speed had come down to 22.3 mph as a result of the emergency application of the train brakes. At the time, the train was at Mile 116.73, the dynamic brakes on the head-end locomotive were set to position 8, and the brake cylinder pressure on the remote locomotives was at 45 psi.

1.7 Situational awareness and mental models

Situational awareness is the perception of the elements in the environment, the comprehension of their meaning, and the projection of their status in the future.[20] In a dynamic environment, situational awareness requires individuals to continuously extract information from the environment, integrate this information with relevant internal knowledge to create a coherent mental model of the current situation, and use this model to anticipate future events. Problems can occur in any of the 3 steps of situational awareness where critical elements are either not detected, their importance is not perceived, or their consequences are not anticipated. Communications are critical for a team to establish a shared situational awareness.

A mental model is an internal construct that enables people to describe, explain, and predict events and situations in their environment.[21] When a mental model is adopted, it is resistant to change. New convincing information must be assimilated to change the mental model. An

---

20 M. R. Endsley, "Toward a Theory of Situation Awareness in Dynamic Systems," in *Human Factors*, Volume 37, Issue 1 (1995), pp. 32-64.

21 E. Salas, F. Jentsch and D. Maurino, *Human Factors in Aviation*, 2nd Edition (Academic Press, 2010), p. 66.

inaccurate mental model will interfere with situational awareness, notably in the perception of critical elements or the comprehension of their importance.[22]

1.8 Attention and human performance

Attention is a state in which cognitive resources of a person are concentrated on certain aspects of the working environment instead of others. Divided attention is when a person's attention is simultaneously focused on 2 or more information channels to attend to 2 or more tasks.[23] The U. S. Federal Railroad Administration describes attention as a person's behaviour to concentrate on the critical information inside and outside the locomotive cab.

People have limited attentional resources; therefore, attention on information that is not critical at a given time becomes a distraction. Distractions can compete with other tasks, increase attentional demands, and divert attention from higher-priority tasks. However, when attention is divided on 2 or more aspects of the working environment, it can result in a reduction of performance, which can then lead to an incident or accident.[24]

Since 2005, the TSB has made 16 findings related to distractions or divided attention of railway employees in 13 investigation reports.[25]

1.9 Prospective memory

Prospective memory is a form of memory that enables an individual to remember to perform a planned action or to recall an intended task in the future. It requires that an individual first form an intention to perform a task and then to retain that intention while performing other tasks. Because these other tasks can occupy one's limited short-term attention capacity, the intention to perform the task is stored in long-term memory. Memory encoding is a process by which the sensory information is modified and stored in the brain. Memory encoding is notably achieved through visual, acoustic, and/or semantic encoding. A combination of these can reinforce encoding and timely retrieval. Some key parameters for prospective memory are that the execution of the intended task is not immediate and is embedded in ongoing activity. Increasing attentional demands for tasks

---

22 M. R. Endsley, "Situation Awareness in Aviation Systems," in J. A. Wise, V. D. Hopkin and D. J. Garland, *Handbook of Aviation Human Factors*, 2nd Edition (Boca Raton, FL: CRC Press, 2010), Part II: Human Capabilities and Performance, Chapter 12, p. 12.

23 American Psychological Association, *APA Dictionary of Psychology*, "Attention," at https://dictionary.apa.org/attention (last accessed on 13 March 2025).

24 Federal Railroad Administration, "Attention: Definition and Examples," at https://railroads.dot.gov/human-factors/elearning-attention/attention-definition-and-examples (last accessed on 13 March 2025).

25 TSB rail transportation safety investigation reports R23H0006, R22D0106, R18H0105, R15V0183, R14D0011, R12T0038, R12D0063, R10E0080, R10V0038, R09V0230, R07C0040, R07W0042, and R06H0013.

other than monitoring the ongoing task can compromise the retrieval and execution of the intended prospective memory task.[26]

1.10 Wheel temperature detection and reporting

Rail car wheels that do not contribute to a car's braking effort remain cold when the train brakes are applied; conversely, wheels that have elevated temperature readings when the brakes are not applied are usually indicative of a brake issue, such as a stuck air brake or a hand brake that is not released. The wheel temperature on a car can therefore be used to evaluate brake effectiveness on a train.

1.10.1 Using wheel temperature detectors for automated train brake effectiveness reporting

In 2008, CPKC began a study to explore the possibility of using wheel temperature detector (WTD) data to identify cars with air brake issues, an initiative that was referred to as automated train brake effectiveness (ATBE). The approach was novel in the industry at the time.

As part of the ATBE study, CPKC adapted several WTDs on the Mountain Subdivision so that they could generate cold wheel reports. The detectors proved successful at providing automated brake effectiveness reports, including information about cold wheels on rail cars. In 2011, TC granted CPKC an exemption[27] waiving the requirement for conducting No. 1 air brake tests[28] on coal trains at Golden, but the exemption required that exempted trains receive a WTD inspection en route. Since then, reports submitted from CPKC to TC, as required by the exemption, indicate that the process of using WTDs for reporting cars with cold wheels as a substitution for air brake tests on exempted trains is performing as expected.[29] CPKC continues to analyze the data and enhance the process as needed.

WTDs use infrared sensor technology to assess the wheel temperatures of passing trains. Sites equipped with WTDs are connected to a communication network, to allow the inspection data from a passing train to be automatically transmitted and stored electronically at a centralized location, where the data can be analyzed using automated

---

26 M. A. McDaniel and G. O. Einstein, *Prospective Memory: An Overview and Synthesis of an Emerging Field* (Sage Publications Inc, 2007), pp. 1–29.

27 Minister of Transport, Notice of exemption pursuant to section 22 of the *Railway Safety Act*, chapter R-42 [R.S., 1985, ch. 32 (4th Supp.)] (17 June 2011).

28 A No. 1 brake test, conducted by a certified car inspector, verifies brake pipe integrity and continuity, brake rigging condition, air brake application and release, and piston travel on each car. After receiving a No. 1 brake test, a train may depart from a safety inspection location with 95% of the train brakes operative.

29 In 2023, a total of 1508 coal trains passed through the wheel temperature detectors, of which 99.6% had effective brakes. In rare situations where the effectiveness of the air brakes cannot be determined through a cold wheel report (usually when circumstances prevent the brakes from being applied long enough to generate sufficient heat to meet the required train average wheel temperature), the train must undergo a No. 1 air brake test before departing from the next designated safety inspection location.

algorithms. On the Mountain Subdivision, the cold wheel summary report is generated after westbound trains go past the WTD at Mile 104.8.

The WTDs are calibrated every 180 days, as per manufacturer specifications, and are visually inspected every month. Data are reviewed every month by CPKC signal maintainers.

1.10.2 Requirements for cars with inoperative brakes

According to the exemption for coal trains, if a WTD equipped for automated brake effectiveness reporting determines that there are cold wheels on a coal car, this car must be considered to have an inoperative brake.

Requirements concerning cars with inoperative brakes are provided in the *Railway Freight and Passenger Train Inspections and Safety Rules*. Section 7 stipulates that freight trains may not operate with less than 85% operative brakes.[30] (The exemption for coal trains stipulates stricter requirements specifically for westbound trains departing Revelstoke; these trains may not depart with less than 95% operative brakes).

With respect to cars found to have inoperative brakes while en route, section 8 indicates that these cars may continue to destination on a freight train provided that:

- there are no more than 2 consecutive inoperative control valves on the train, and
- there are at least 3 cars with operative brakes at the rear of the train.[31]

If the train has less than 85% operative brakes, or if either of the 2 conditions above is not met, corrective action must be taken.

In this occurrence, the cold wheel report transmitted by the RTC to the crew on train 805 was necessary for the train crew to determine if the train could continue to destination. The information provided by the RTC allowed the crew to determine that the train met these minimum operative brake requirements and could continue to operate to Revelstoke.

1.10.3 Cold wheel reporting on the Mountain Subdivision

The exemption for coal trains stipulates how cold wheel information from the WTDs must be treated; in particular:

- The RTC must inform the westbound train crew after the train has passed by the WTD location, and the train crew must record the information, which must be kept on the train until its arrival at Golden on the return trip.
- The westward train crew must be informed of the results of automated brake effectiveness tests before departing Revelstoke.

---

30 *Railway Freight and Passenger Train Brake Inspection and Safety Rules* (01 May 2023, approved by Transport Canada on 30 January 2023), section 7: Operating Requirements, p. 7.

31 Ibid., section 8: Exceptions, p. 10.

CPKC has no specific instructions regarding how soon after the train has passed by the WTD location that the RTC must communicate the cold wheel information to the train crew. However, according to the terms of the exemption, this information must be communicated to the train crew in a timely manner.

RTC communications with train crews regarding wheel temperature issues identified by the ATBE process are frequent. For instance, over the 4 quarters preceding the occurrence, of the 1508 coal trains that passed over a WTD, wheel temperature issues were identified on 987 cars.

1.10.4 Cold wheel information for train 805

At 2131, train 805 travelled over the WTD at Mile 104.8. The alert that appeared on the RTC monitor indicated that there were 5 cars with cold wheels: CP 963963 (position 28), CEFX 41349 (position 80), CP 965420 (position 82), TIMX 40520 (position 130), and DTTX 767871 (position 2). In fact, there was only 1 car with cold wheels, TIMX 40520.[32]

Cars with a DTTX reporting mark are not used for the transportation of coal, and hence car DTTX 767871 could not have been on train 805. However, some RTCs are not familiar with all car reporting marks and the associated car types; the RTC in this occurrence did not recognize that the report from the WTD contained an error. After receiving the report, the RTC contacted the crew on train 805 and provided the 5 car numbers to the conductor. The RTC conveyed the information to the crew immediately after receiving the report from the WTD, 22 minutes after the train had cleared the detector at Mile 104.8. The LE recognized that a car with a DTTX reporting mark could not be on a coal train and referred to the train consist listing in an effort to reconcile the information provided by the RTC.

To determine the frequency of erroneous reports from WTDs on the Mountain Subdivision, the data for the 30 days before the occurrence were reviewed as part of the investigation. Results indicate that, during this period, 1% of all coal, sulfur, potash, and grain trains operating under the exemptions travelled past a WTD at the same location but on the other track within minutes of another train; in these cases, the WTD can report incorrect car numbers. In this occurrence, car DTTX 767871 was on eastbound train 148-15; this train had travelled by Mile 104.8 within minutes of train 805, but on the south track.

---

32 Based on a post-occurrence TSB review of the data from the WTD at Mile 104.8 for train 805, only 4 out of the 5 cars were in train 805's consist: CP 963963, CEFX 41349, CP 965420, and TIMX 40520 (the only car with cold wheels). The investigation could not determine why some cars were reported as having cold wheels when in fact they were not.

Finding: Other

Cold wheel information transmitted to RTCs from WTDs on the Mountain Subdivision can contain errors when 2 trains have passed the same WTD within minutes of each other on adjacent tracks.

1.11 Crew responsibility

The safe operation of train movements is the direct responsibility of train crews. CROR Rule 106 states in part:

> All crew members are responsible for the safe operation of movements and equipment in their charge and for the observance of the rules. Under conditions not provided for by the rules, they must take every precaution for protection. [...][33]

1.12 Radio communications

Radio communication instructions provide guidance on standard terms to use and protocols to follow when communicating over the radio. For instance:

- Rule 120 of the CROR defines some radio terms. In particular, it indicates that the term "stand by" can be used to denote that the caller should monitor the channel for the next transmission.[34] There are no instructions or examples that clarify when the term should be used. CPKC's *Rule Book for T&E Employees* does not contain a definition of the term stand by, nor instructions on the appropriate use of this term.
- Rule 122 of the CROR indicates that radio communications must be brief and to the point and contain only essential instructions or information.[35]

Neither CPKC's *Rule Book for T&E Employees* nor the CROR provide guidance to train crews on deferring radio communications at safety-critical times.

1.13 Cab red zone and critical focus zone

To minimize the risk of train crew distraction, both VIA Rail Canada Inc. (VIA) and Canadian National Railway Company (CN) have implemented an additional administrative defence: the cab red zone (CRZ) and critical focus zone (CFZ), respectively. The CRZ and CFZ are to be applied at times when train crew concentration is most important, and to prevent diverted attention at safety-critical times.

---

33 *Canadian Rail Operating Rules* (01 October 2022, approved by Transport Canada on 09 May 2022), Rule 106: Crew Responsibilities, p. 46.

34 Ibid., Rule 120: Radio Terms, p. 54.

35 Ibid., Rule 122: Content of Radio Communications, p. 55.

1.13.1 Cab red zone

Following the investigation into the March 2012 derailment and collision of VIA 92 near Burlington, Ontario, on the CN Oakville Subdivision, where the 3 operating crew members were fatally injured and 45 people sustained various injuries,[36] VIA implemented a set of special instructions called the CRZ. CRZ is described as "the environment in the locomotive cab during critical periods, especially when multitasking is required by members of the train crew. Its purpose is to maintain optimal situational awareness to ensure the safety of the movement."[37] It is considered to be a critical time within the cab when there are simultaneous task requirements (e.g., copying an authority while approaching a slow order, or operating on signals that require the train to be prepared to stop at the next signal). When travelling at a time when a CRZ is in effect, communications within the cab, including the use of the radio, are restricted to immediate responsibilities for train operation. Furthermore, when stopped at a station or within a controlled block, the in-charge LE will record the indication of the last signal received before stopping.[38] Before commencing movement, all employees in the cab must confirm with each other the indication of the last signal in their direction of travel. When movement has commenced, CRZ must be applied until the next signal is reached. These instructions are in addition to the requirements of CROR Rule 34.

VIA's special instructions relating to CRZ indicate that not every possible situation can be covered by the CRZ. Consequently, it becomes part of the operating crew's responsibility to apply the CRZ for any conditions warranted as critical to the movement.

1.13.2 Critical focus zone

On 23 August 2022, CN issued System Operating Bulletin 007 that introduced a new special instruction under CROR Rule 34 for the implementation of the CFZ.

CFZ refers to special procedures to be applied at times when crew concentration is most important. For instance, when a CFZ is in effect, employees in the cab of a controlling locomotive must cease communicating and other duties unrelated to the train's immediate operation. If train crew members are contacted by other employees concerning a matter unrelated to the safe operation of their movement, they must respond by indicating that they are in a CFZ and tell the other employee to stand by.

A CFZ begins 3 miles from a Stop signal or the moment that the advance signal is observed (if it is within 3 miles) and remains in effect until the movement has stopped for the Stop

---

36 TSB Railway Investigation Report R12T0038.

37 VIA Rail Canada Inc., *Passenger Train Instructions*, section 8: VIA Special Instructions, sub-section 8.8: Cab Red Zone (CRZ) (01 May 2019), p. 8-5.

38 As per cab red zone special instructions, before stopping at any VIA Rail Canada Inc. station, the in-charge locomotive engineer records in writing the indication of the last signal received.

signal or the next signal has been identified to be permissive. While a CFZ is in effect, all crew members in the cab must confirm any approaching restrictions such as Stop signals.

1.13.3 Procedures at CPKC

CPKC has not implemented instructions similar to CFZ or CRZ. The company relies strictly on adherence to its *Rule Book for T&E Employees*, which is reinforced under its training program. In terms of preventing diverted attention at safety-critical times, the following, in particular, apply; these procedures meet or exceed the requirements of the CROR:

- Section 2.2(a), which states that "safety and a willingness to obey the rules are of the first importance in the performance of duty. If in doubt, the safe course must be taken".[39]
- Section 2.2(c)(vi), which states that train crews must "provide every possible assistance to ensure every rule or instruction is complied with, contact the proper authority for clarification if in doubt, and promptly report any violation."[40]
- Section 4.5, which states, in part, that "radio broadcasts must be made on the designated standby channel […] for each controlled location/point, and the advance signal to such […]."[41]
- Section 6.5, which states, in part, that "[c]rew members within physical hearing range must clearly communicate the indication by name of each fixed signal they are required to identify as soon as it is positively identified".[42]

1.14 Physical fail-safe defences for trains in signalled territory

The absence of physical fail-safe defences capable of intervening by slowing or stopping a train when operating in CTC territory and the absence of a passive warning system to alert crew members when they approach their limits of authority have been raised by the TSB in its investigation reports since 1995. Inadequate defences against misapplied or misinterpreted signal indications have been cited as a cause or contributing factor in numerous investigations conducted by the TSB,[43] and this issue has been on the TSB Watchlist since 2012.[44]

---

39 Canadian Pacific Railway Company, *Rule Book for T&E Employees* (effective 28 October 2021), section 2.2: While on Duty, subsection (a), p. 10.

40 Ibid., section 2.2: While on Duty, subsection (c), item (vi), p. 10.

41 Ibid., section 4.5: CTC Broadcast Requirements, p. 17.

42 Ibid., section 6.5: Fixed Signal Recognition and Compliance, p. 20.

43 TSB rail transportation safety investigation reports R23Q0022, R23H0006, R19W0002, R18D0096, R16T0162, R16E0051, R15D0118, R15V0183, R14T0294, R13C0049, R12T0038, R11E0063, R10Q0011, R10V0038, R09V0230, R07E0129, R99T0017, R98V0148, and R95V0174.

44 TSB Watchlist, "Following railway signal indications", at https://www.tsb.gc.ca/eng/surveillance-watchlist/rail/2022/rail-01.html (last accessed on 17 March 2025).

While the introduction of additional administrative defences such as CRZ and CFZ can support existing defences, to be effective, crews must recognize that they are in a CRZ or CFZ. Therefore, they are subject to the same limitations as the other administrative defences that are in place. One recent example of this limitation is the near-miss collision between a CN freight train proceeding eastward on the south track of the Kingston Subdivision and a VIA passenger train proceeding westward on the south track, where it was lined to cross over to the north track, approaching Wesco, Ontario.[45] The CN crew missed a Clear to Stop indication while operating in a CFZ as they were focused on preparing for a future task not related to the train's immediate operation. The crew were therefore not prepared to stop at the next signal displaying a Stop indication. The CN train came to a stop approximately 1786 feet past the Stop signal and about 1100 feet from the stopped VIA passenger train.

1.14.1 Positive train control in the United States

After a head-on collision in 2008 between a freight train and a passenger train in Chatsworth, California, that resulted in mass casualties, U. S. lawmakers mandated the development and implementation of physical fail-safe train controls (i.e., positive train control or PTC). Since 29 December 2020, PTC technology has been in operation on all 57 536 required freight and passenger railroad route miles in the United States.[46]

PTC is designed to prevent train-to-train collisions, overspeed derailments, incursions into work zones, and movement of a train through a switch left in the wrong position.

PTC addresses the risk of crews going past a Stop signal. Stopping distance is automatically calculated based on actual train speed and braking force algorithms. If a train has proceeded beyond the calculated stopping distance and no action or insufficient action has been taken, the system initiates a penalty brake application[47] to bring the train to a controlled stop before the point of restriction. The train's penalty brake stop distance is monitored and, if calculated to be insufficient to stop short of the point of restriction, then an emergency application of the train brakes is initiated. Emergency braking can generate about 20% more brake cylinder pressure at each car in the train.

While physical fail-safe train controls in the form of PTC have been implemented in the United States, the infrastructure required to fully support a system similar to PTC has not yet been implemented in Canada. Furthermore, its implementation is not yet mandated under the *Railway Safety Act*.

---

45 TSB Rail Transportation Safety Investigation Report R23H0006.

46 U. S. Department of Transportation, Federal Railroad Administration, *Information Guide on Positive Train Control in 49 CFR Part 236, Subpart I* (12 December 2022), at https://railroads.dot.gov/sites/fra.dot.gov/files/2022-12/2022_12%20PTC%20FAQs_final.pdf [last accessed on 17 March 2025].

47 On a PTC-equipped locomotive, when a penalty brake application is automatically triggered, the electronic air brake system will reduce brake pipe pressure to between 55 to 62 psi; this allows brake pipe pressure to be further reduced to 0 psi in the event of an emergency application of the train brakes.

1.14.2 TSB recommendations related to physical fail-safe train controls

The TSB has issued 3 recommendations calling for additional backup safety defences (i.e., physical fail-safe train controls) in signalled territory:

- In February 2001, following a rear-end collision between 2 Canadian Pacific Railway Company trains that occurred on 11 August 1998 near Notch Hill, British Columbia,[48] the TSB issued Recommendation R00-04 to the Department of Transport, calling for the implementation of additional backup safety defences to help ensure that signal indications are consistently recognized and followed. The latest response from Transport Canada (TC) was assessed as **Satisfactory in Part** in March 2021 and the recommendation was assigned a Dormant status. It is linked to TSB Recommendation R13-01 and will be reassessed in accordance with this recommendation.
- In June 2013, following a main-track derailment involving a VIA passenger train that occurred on 26 February 2012 at Aldershot, Ontario,[49] and in which the operating crew members were fatally injured and 45 people sustained various injuries, the TSB issued Recommendation R13-01 to the Department of Transport, calling for the implementation of physical fail-safe train controls for major Canadian passenger and freight railways, beginning with Canada's high-speed rail corridors. The response from TC was most recently assessed in March 2023 to be **Satisfactory in Part** and the recommendation was assigned a Dormant status. This recommendation is linked to Recommendation R22-04 and will be reassessed in accordance with this recommendation.
- In August 2022, following a main-track train collision and derailment involving 2 CN trains on 03 January 2019, at Portage la Prairie, Manitoba,[50] the TSB issued Recommendation R22-04 to the Department of Transport, which calls for major Canadian railways to expedite the implementation of physical fail-safe train controls on Canada's high-speed rail corridors and all key routes. In its December 2024 response to Recommendation R22-04, TC indicated that it continues to engage with industry and other stakeholders to progress in developing its corridor risk assessment methodology for the implementation of physical train controls; the term enhanced train control (ETC) has been adopted to describe such systems.[51] TC also plans to draft regulations in 2025, with an anticipated publishing in the *Canada*

48 TSB Railway Investigation Report R98V0148.

49 TSB Rail Transportation Safety Investigation Report R12T0038.

50 TSB Rail Transportation Safety Investigation Report R19W0002.

51 Enhanced train control, as envisioned by Transport Canada, includes 2 levels. The top level is expected to be equivalent to positive train control in the United States. The second level is expected to be a passive warning system to alert the crew but is not expected to provide automated enforcement to prevent train-to-train collisions, overspeed derailments, incursions into work zones, and movement of a train through a switch left in the wrong position.

Gazette, Part I in 2026. The timelines for implementation will be determined when the regulations are developed. The response from TC was most recently assessed in March 2025. Although the Board considers the response to show **Satisfactory Intent**, continued delay to expeditiously address the recommendation may result in a reduced rating in the future.

1.14.3 Letter to the Minister of Transport

On 17 April 2024, as a result of 3 other investigations that were ongoing at the time,[52] the TSB sent a letter to the Minister of Transport concerning the absence of physical fail-safe defences for trains operating in Canada. The letter stated that, despite the calls from the TSB for additional physical fail-safe defences in signalled territory since 2000 and the implementation of such a solution in the form of PTC in the United States in 2020, the Canadian railway system continues to rely on administrative defences centred on compliance with rules by train crews. TC and the railway industry have been discussing the framework needed to address the issue since 2013 and, while TC has taken positive steps toward identifying a solution for physical fail-safe defences in the form of ETC, the pace of development has remained slow. Without physical fail-safe defences to protect train crews and the public, there is a significant risk of collisions and a potential mass casualty event on Canadian railways. Given the risk to train crews and the travelling public, the TSB strongly urged the Department of Transport and the railway industry to accelerate the implementation of physical fail-safe train controls on Canada's high-speed rail corridors and all key routes in Canada. At the time of writing, the TSB had not received a response.

1.14.4 Proximity detection device system

In Canada, the Quebec North Shore and Labrador Railway (QNS&L) implemented a physical defence known as the proximity detection device (PDD) system in 1997. The PDD system is equipped with a GPS that can determine the position, direction, and speed of any rail vehicle fitted with the device. PDDs are installed in all QNS&L's locomotives and track units and enable alarms to be received from closely approaching movements within a certain range of distance. When an alarm is received, it must be acknowledged on a main display screen and operators of both movements must communicate to each other on the radio to confirm their position. If for any reason the alarms are not acknowledged, a penalty brake application will be triggered on the non-responding locomotive.

However, the PDD system does not prevent a collision if the operator acknowledges an alarm but does not reduce speed or stop the movement in time. QNS&L is the only federally regulated railway in Canada that employs this type of physical defence.

---

52 TSB investigations R23H0006, R23E0079 and R23V0205.

1.15 TSB Watchlist

The TSB Watchlist identifies the key safety issues that need to be addressed to make Canada's transportation system even safer.

Not following railway signal indications—when train crews do not recognize or react to a signal indication, resulting in the signal not being followed and a train exceeding its limits of authority—**is a Watchlist 2022 issue.** This issue has been on the Watchlist since 2012. Although the probability of a missed signal leading to a train collision or derailment may be low, the consequences of such an accident could be catastrophic for people, property, and the environment.

ACTION REQUIRED

The issue of **following railway signal indications** will remain on the Watchlist until TC requires that railways implement additional physical safety defences to ensure that signal indications governing operating speed and operating limits are consistently recognized and followed.

2.0 ANALYSIS

The analysis will focus on the divided attention of the crew on Canadian Pacific Railway Company (CPKC) freight train 805-339 (train 805) on its approach to signal 1149N, which was displaying a Clear to Stop indication, and the crew's situational awareness and mental model when it approached the following signal, 1167N, which was displaying a Restricting indication.

The analysis will also discuss a means of ensuring crew focus at safety-critical times, the communication of non-urgent information, as well as the failure of the existing administrative defences during this occurrence and the absence of physical fail-safe defences in Canada capable of intervening by slowing or stopping a train.

2.1 The collision

Westbound freight train 805 was proceeding on the north main track of the CPKC Mountain Subdivision on a Clear to Stop indication, which it had received at signal 1149N, when it approached signal 1167N (Mile 116.8 at Greely). Signal 1167N was displaying a Restricting indication, to protect westbound freight train 301-230 (train 301) that had stopped on the north main track, with its tail-end car about 439 feet beyond the signal and around a curve; train 301 was waiting to cross over to the south track.

The crew on train 805 noticed the Restricting indication and, at about the same time, the flashing light of the end-of-train marker on train 301 came into view. Train 805 was about 523 feet away from the signal, 962 feet from the tail end of train 301, and travelling at 32.7 mph.

The locomotive engineer (LE) on train 805 realized that the train was going too fast and immediately made an emergency application of the train brakes, while also increasing the dynamic brake setting to the maximum. Despite these efforts, there was insufficient distance to stop the train in time to avoid a collision given that the theoretical emergency stopping distance for train 805 at this point, based on TSB calculations, was about 1426 feet, or 464 feet beyond the tail-end of train 301. Train 805 had slowed to about 22.3 mph when it struck the tail-end car on train 301.

Findings as to causes and contributing factors

Train 805 was operated past a Restricting indication at 30.4 mph and struck the tail end of stationary train 301 at about 22 mph.

Before the restricting signal, the crew on train 805 was operating on a Clear to Stop indication, but they were unprepared to stop at the restricting signal. The crew were also

unprepared to stop within one-half the range of vision of equipment immediately beyond the restricting signal.

The emergency application of brakes on train 805 was made with insufficient distance to stop the train before striking the tail end of train 301.

2.2 Severity of the derailment

The impact of the collision resulted in the derailment of the 4 head-end locomotives on train 805 and 4 cars on train 301. In addition, about 17 500 litres of diesel fuel leaked from the derailed locomotives and 400 tons of grains were spilled. Two crew members were taken to hospital, 1 with serious injuries.

Several factors contributed to the severity of the derailment:

- Around Mile 116.0 (about 0.75 mile from signal 1167N), the train was travelling at 29.3 mph and the LE released a 10 psi train brake application. About 0.2 miles and 30 seconds later, the speed had increased to 30.4 mph and the LE reapplied the brakes with a 10 psi brake pipe pressure reduction; however, the train speed continued to gradually increase. Standard industry practice requires that any subsequent brake applications made while the air brake system has not yet fully recharged from the release of a previous brake application involve reducing brake pipe pressure significantly more than the previous application to ensure that the brakes apply. Consequently, the train was accelerating at a critical time when train speed needed to be reduced to comply with the requirements of the upcoming Restricting indication. The impact speed, therefore, was greater than it otherwise would have been had the air brake application not been released and reapplied approaching signal 1167N.
- At the time of the collision, train 301 was stationary with its air brakes applied. Although the brake application was normal in the circumstances and unrelated to this occurrence, it nevertheless prevented the tail-end cars on train 301 from freely moving on impact.

2.3 Train 805 crew's divided attention while approaching signal 1149N

When train 805 was approaching signal 1149N, the crew received a call from the rail traffic controller (RTC) indicating that a wheel temperature detector (WTD) had identified cars with cold wheels (i.e., ineffective brakes) on the train.

The conductor began writing the car numbers, and there was some back and forth between him and the RTC to repeat and clarify some of them. He was still copying the car numbers when the train approached and passed signal 1149N, and he missed the signal.

The LE was operating the locomotive controls while listening to the conversation between the conductor and the RTC, which divided his attention. The mention of car DTTX 767871, in particular, stood out to him because he knew that cars with a DTTX reporting mark are

intermodal cars and therefore could not be on train 805, a unit coal train. This contradictory information diverted his focus to the details of the train consist listing, prompting him to look at the train consist listing several times to assist the conductor. Although the LE was keeping an eye on the track ahead and saw the Clear to Stop indication on signal 1149N, he resumed looking at the train consist listing.

The crew continued to discuss the cold wheel information after the RTC's call, and their attention remained focused on this information.

Finding as to causes and contributing factors

While approaching the Clear to Stop indication, the crew of train 805 received a call from the RTC providing some accurate and some erroneous cold wheel information for their train; the call divided the crew's attention and diverted their focus away from the upcoming signal.

2.4 Mental model of the indication at signal 1167N

After train 805 passed signal 1149N, the train was operating on a Clear to Stop indication. According to CPKC's *Rule Book for T&E Employees*, a freight train operating on a Clear to Stop indication must reduce speed to 30 mph or less, and be prepared to stop at the next signal.

Effective communication is essential for a crew to establish shared situational awareness. According to *Canadian Rail Operating Rules* (CROR) Rule 34 and CPKC's *Rule Book for T&E Employees*, crew members within physical hearing range must clearly communicate the indication by name of each fixed signal they are required to identify.

The conductor was communicating with the RTC and did not see the signal; his mental model was that the train was still operating on the Clear indication displayed at the previous signal (1131N).

The LE saw the Clear to Stop indication at signal 1149N but, as he did not want to interrupt the conductor's conversation with the RTC, he deferred calling out the Clear to Stop indication when he saw it and did not broadcast it over the radio.

Calling out signal indications has the dual effect of identifying and confirming amongst crew any changes in signal indication status and providing a means of reinforcing in memory an action that will be required in the future (prospective memory).

After the conversation between the conductor and the RTC ended, the LE's train handling actions suggest that, in his mind (his mental model), he was still operating on a Clear indication as he released the train brakes.

As a result, neither crew member anticipated the Restricting indication at signal 1167N that required, in part, that the train be able to stop within one-half the range of vision of equipment and in no case exceed 15 mph.

When the Restricting indication came into view, the train was travelling at about 32.7 mph. Due to the relatively short sightline (about 0.1 mile) to signal 1167N and given the train speed, it was not possible to stop the train within the available distance to avoid colliding with the tail end of train 301.

Finding as to causes and contributing factors

The crew on train 805 formed an incorrect mental model that they were still operating on the previous Clear indication rather than the Clear to Stop indication. Consequently, they were not prepared to stop when the tail end of train 301 came into view.

2.5 Communication of non-urgent information

The cold wheel report received by the RTC from the WTD at Mile 104.8 did not place train 805 below minimum operative brake requirements, and therefore the cold wheel information could not have affected the train's immediate operations. However, the RTC did not know this; rather, he knew that the conductor would need the cold wheel information to determine whether the train still met the minimum operative brake requirements and, therefore, he called the train crew on the radio. In addition, this information would have been needed by the outgoing crew at Revelstoke to determine if the train met the conditions of an exemption granted by Transport Canada to CPKC for coal trains that stipulates that a westbound train may not depart Revelstoke with less than 95% operative brakes.

CPKC's instructions regarding cold wheels identified by WTDs on the Mountain Subdivision require that RTCs report the cold wheel information to train crews. However, the instructions do not specify when and how RTCs should relay this information.

Neither the CROR nor CPKC's instructions provide direction or guidance on how soon to communicate cold wheel reports to train crews, and specifically, they do not stipulate that this information can be deferred to a time when the crew is not engaged in critical train handling operations.

RTCs do not know exact train locations within a block or their proximity to signals. In this occurrence, the RTC was unaware that he was making a call at an inopportune time for the train crew. Consequently, it was the crew's responsibility to inform the RTC that they needed to focus on more pressing matters. However, given the perceived authority of RTCs, crews are unlikely to delay such calls, unless imminent danger is apparent. Other factors also contributed to the crew's reluctance to do so: they were aware that if they do not take an RTC's call right away, it may be a long time before the RTC is available again, and they were also aware that the RTC was approaching shift change, which is an especially busy time for RTCs.

Normally, RTCs relay this information immediately upon receipt, which is what the RTC did in this occurrence. However, the RTC's call diverted the crew's attention away from critical train control tasks at a time and location where definitive action was required. Given that people have limited attention resources, attention on non-urgent information at an

inopportune time becomes a distraction. Such distractions can compete with other tasks, often resulting in decreased performance and potentially leading to accidents.

Since 2005, the TSB has made 16 findings related to distractions or divided attention of railway employees in 13 investigation reports.

Finding as to risk

If railway employees are distracted from train operations at times when focus is required to ensure safety, their performance may be negatively affected, increasing the risk of accidents.

2.6 Physical fail-safe defences to ensure signal indications are consistently recognized and followed

The centralized traffic control (CTC) method of train control has been in operation in Canada for many decades. Although newer signal circuitry has been integrated into the CTC system over the years, safe railway operations in CTC rely on administrative defences. That is, train crews observing signal indications in the field, accurately identifying them, and successfully fulfilling the administrative requirement of the signal indication specified in the CROR. Administrative defences, if not supplemented by physical fail-safe defences, place an over-reliance on employees to follow rules and procedures; they do not consider that erring is part of normal human behaviour.

To assist crews in preventing distractions when their attention and concentration is most important, both VIA Rail Canada Inc. (VIA) and Canadian National Railway Company (CN) have implemented an additional administrative defence: the cab red zone (CRZ) and the critical focus zone (CFZ), respectively. When these zones are in effect, crews in the cab of a controlling locomotive must cease any communication and other duties unrelated to the train's immediate operation. If contacted by another employee, such as an RTC, concerning a matter unrelated to the safe operation of their movement, they must respond by indicating that they are in a zone of critical focus and tell that other employee to stand by.

CPKC has not implemented similar instructions to VIA's CFZ or CN's CRZ. The company instead relies strictly on adherence to its *Rule Book for T&E Employees* and its training program. However, this rule book makes no mention of the term "stand by," nor does it provide guidance on deferring non-urgent radio communications when crews are engaged in safety-critical tasks requiring their full attention. Similarly, the CROR do not include any instructions or examples that clarify when the term "stand by" should be used.

Administrative defences have not proven to be fully effective in ensuring that signal indications are consistently recognized and followed and the issue of not following signal indications has been on the TSB Watchlist since 2012. While the introduction of additional administrative defences such as CRZ and CFZ can strengthen other administrative defences, they are still prone to failure and rely on crews being aware that they are in a CRZ or CFZ. The absence of physical fail-safe defences capable of intervening by slowing or stopping a

train when operating in CTC territory and the absence of a passive warning system to alert a crew when they approach their limits of authority has been raised by the TSB in its investigation reports since 1995.

Physical fail-safe defences in the form of positive train control (PTC) technology have been implemented on all 57 536 required freight and passenger railroad route miles, or about 41%, of the nearly 140 000 route-miles of the U. S. rail network since 31 December 2020. PTC is designed to automatically intervene to slow or stop a train in the event that an operating crew does not respond appropriately to a signal displayed in the field. In February 2022, Transport Canada published a Notice of Intent, identifying its intention to require that the highest risk corridors in Canada be equipped with fail-safe, automatic train protection (referred to as enhanced train control or ETC) by 2030. In its December 2024 response to Recommendation R22-04, TC indicated that it continues to engage with industry and other stakeholders to progress in developing its corridor risk assessment methodology for the implementation of ETC. TC also plans to draft regulations in 2025, with an anticipated publishing in the *Canada Gazette*, Part I, in 2026. However, details regarding which specific routes would require ETC and what the final solution for ETC would entail have not been determined. No interim measures to provide physical backup safety defences have been implemented to address the ongoing risk.

Finding as to risk

In the continuing absence of physical fail-safe train controls and in the absence of effective interim measures to help ensure the success of administrative defences, there is an ongoing risk of collisions and derailments in signalled territory in Canada.

3.0 FINDINGS

3.1 Findings as to causes and contributing factors

These are conditions, acts or safety deficiencies that were found to have caused or contributed to this occurrence.

1. Train 805 was operated past the Restricting indication at 30.4 mph and struck the tail end of stationary train 301 at about 22 mph.

2. Before the restricting signal, the crew on train 805 was operating on a Clear to Stop indication, but they were unprepared to stop at the restricting signal. The crew were also unprepared to stop within one-half the range of vision of equipment immediately beyond the restricting signal.

3. The emergency application of brakes on train 805 was made with insufficient distance to stop the train before striking the tail end of train 301.

4. While approaching the Clear to Stop indication, the crew of train 805 received a call from the rail traffic controller providing some accurate and some erroneous cold wheel information for their train; the call divided the crew's attention and diverted their focus away from the upcoming signal.

5. The crew on train 805 formed an incorrect mental model that they were still operating on the previous Clear indication rather than the Clear to Stop indication. Consequently, they were not prepared to stop when the tail end of train 301 came into view.

3.2 Findings as to risk

These are conditions, unsafe acts or safety deficiencies that were found not to be a factor in this occurrence but could have adverse consequences in future occurrences.

1. If railway employees are distracted from train operations at times when focus is required to ensure safety, their performance could be negatively affected, increasing the risk of accidents.

2. In the continuing absence of physical fail-safe train controls and in the absence of effective interim measures to help ensure the success of administrative defences, there is an ongoing risk of collisions and derailments in signalled territory in Canada.

3.3 Other findings

These items could enhance safety, resolve an issue of controversy, or provide a data point for future safety studies.

1. Cold wheel information transmitted to rail traffic controllers from wheel temperature detectors (WTDs) on the Mountain Subdivision can contain errors when 2 trains have passed the same WTD within minutes of each other on adjacent tracks.

4.0 SAFETY ACTION

4.1 Safety action taken

4.1.1 Transportation Safety Board of Canada

4.1.1.1 Rail Transportation Safety Advisory Letter 01/24

On 27 February 2024, as a result of this occurrence and other recent collisions involving trains operating under restricting signals in centralized traffic control territory,[53] the TSB sent Rail Transportation Safety Advisory Letter 01/24 to Transport Canada (TC). The TSB suggested that, as a priority, TC work with the railway industry to address the limitations with the existing administrative defences to reduce the likelihood of collisions when trains operate under restricting signals in centralized traffic control territory, and to reduce the risks to train crews and the travelling public.

On 14 May 2024, TC responded that it promptly conducted compliance inspections upon notification of each occurrence. TC indicated that, in each case, violations of Rule 436 of the *Canadian Rail Operating Rules* had been identified, leading to the issuance of letters of non-compliance.

4.1.1.2 Rail Transportation Safety Advisory Letter 02/24

On 15 April 2024, as a result of this tail-end collision, the TSB sent Rail Transportation Safety Advisory Letter 02/24 to CPKC. The letter indicated that the crew's attention was drawn away from critical train control tasks at a time and location when and where definitive action was required to reduce train speed approaching the next signal. The letter also specified that, in the absence of backup physical defences to prevent collisions when a signal indication is misinterpreted or misapplied, or when crew response is inadequate to ensure safety, CPKC may wish to review its procedures to ensure that:

- non-urgent communications with train crews are minimized during times when attention and focus on critical tasks is absolutely necessary, and
- train crews are not compelled to engage in non-urgent tasks when approaching points of restriction.

On 17 June 2024, CPKC responded that it had taken the differences in actions and attention of each employee into consideration. CPKC indicated that, as part of their training, employees learn about communication requirements when operating, and of the responsibility for all employees to comply with all operating and safety rules. CPKC also believes that "train crews are enabled and educated to minimize distractions and to interrupt; defer and stop non-urgent communications during times when attention and focus on critical tasks is absolutely necessary."

---

53 TSB investigations R23T0205 and R23V0137.

4.1.2 CPKC

Following this occurrence, CPKC took the following safety actions:

- In February 2024, it implemented a module on situational awareness as part of the conductor training. This module builds on the concepts of crew resource management and is tailored to the specific needs of the railway industry. This training reminds employees that it is each crew member's responsibility to develop and maintain situational awareness in order to contribute to a safe working environment.
- On 08 March 2024, it installed software that provides a message to mechanical support personnel when a report from a wheel temperature detector (WTD) on the Mountain Subdivision includes a car that would not be on a unit train subject to WTD inspection.
- On 21 March 2024, mechanical support personnel began creating a master list to verify that car numbers on cold car reports are correct for unit trains subject to the exemptions granted by TC for coal, sulfur, potash, and grain trains.
- On 17 May 2024, it created a job aid intended for the mechanical support personnel, which provides instructions to verify that the cars with cold wheels listed in WTD reports are the proper series. If the report contains a car number from another train, the car number must not be provided to the train crew of the unit train identified on the report. This process reduces the time it takes a train crew to obtain accurate information on cars with cold wheels.
- In October 2024, it incorporated in its training program a module about respecting signal indications. This module highlights the importance of signal recognition and compliance. It discusses the need to positively identify signals and to check that a called signal indication is correct before repeating it. The module also provides guidance on avoiding distractions, such as stopping conversation, keeping eyes forward, and not engaging in non-urgent activities at critical times.
- From 16 September to 16 October 2024, it conducted a blitz to ensure that all train and engine employees watched a new *Respect the Signal* video and discussed its content. This 5-minute video demonstrates what can happen if employees lose situational awareness and fail to respect the signals.

This report concludes the Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 12 March 2025. It was officially released on 31 March 2025.

inadequate, and that industry and regulators need to take additional concrete measures to eliminate the risks.

APPENDICES

Appendix A – Sequence of events

Table A1 provides a summary of the events based on the review of the available information, including locomotive event recorder data, locomotive voice and video recorder data, forward-facing video camera recordings, radio communication records, interviews, and signal logs.

Unless otherwise indicated, the events and action pertain to train 805 and its crew.

Table A1. Sequence of events

Time	Mile	Event
2150:52	112.75	The conductor broadcast over the radio a Clear indication approaching Greely (he meant Twin Butte) on the north track (signal 1131N).
2151:12	112.92	The head end of the train passed signal 1131N displaying a Clear indication.
2153:23	114.05	The rail traffic controller (RTC) contacted the train crew to discuss a cold wheel report. The conductor started to copy the car numbers.
2153:53	114.33	The locomotive engineer (LE) made a minimum air brake application (7 psi brake pipe pressure reduction).
2154:01	114.41	The headlight from opposing eastbound train 100-16 became visible on the south track.
2154:05	114.45	The LE consulted the train consist listing on his desk.
2154:09	114.49	The LE extinguished the headlight for the opposing eastbound train.
2154:14	114.54	The LE consulted the train consist listing on his desk.
2154:19	114.59	The LE flashed the overhead reading light twice as train 100-16 passed by.
2154:22	114.62	The LE turned the headlight to full power.
2154:24	114.64	Signal 1149N came into view after the train traversed a left-hand curve.
2154:43	114.83	The lead locomotive, travelling at 36.6 mph, passed signal 1149N displaying a Clear to Stop indication.
2154:49	114.89	The LE picked up the radio handset.
2154:53	114.93	The LE made a further 2 psi brake pipe pressure reduction.
2154:58	114.98	The LE consulted the train consist listing on his desk.
2155:06	115.07	The LE consulted the train consist listing on his desk.
2155:14	115.15	The LE consulted the train consist listing on his desk.
2156:00	115.59	The RTC stated to the conductor that all car numbers copied were correct.
2156:02	115.61	The LE looked at his wristwatch to confirm the time stated by the RTC for the relief crew members who were on duty for 2330.
2156:14	115.71	The conductor finished his conversation with the RTC.
2156:15	115.72	The tail end of train 100-16 passed by.
2156:16	115.73	The conductor put his radio handset away and looked up.
2156:21	115.77	The LE asked the RTC over the radio about the DTTX car number.

Time	Mile	Event
2156:22	115.78	The LE lowered his radio handset and placed it on the desktop.
2156:26	115.82	The LE stated to the conductor that the RTC had already ended the radio call.
2156:27	115.83	The LE put his radio handset back in the cradle and started a conversation with the conductor concerning the call from the RTC.
2156:37	115.91	The LE told the conductor that the DTTX car was not on the train.
2156:44	115.97	The LE released the air brakes; train speed was 29.3 mph.
2157:17	116.23	The LE initiated a 10 psi brake pipe pressure reduction for speed control: train speed was 30.4 mph.
2157:52	116.55	Signal 1167N came into view around curve and the conductor called the Restricting indication; train speed was 32.7 mph.
2157:53	116.55	The flashing light on the end-of-train marker on the rear car of train 301 came into view.
2157:55	116.57	While travelling at 32.7 mph, the LE made an emergency application of the train brakes and increased the dynamic brake application to maximum; the train was 379 feet from the Restricting indication at Greely.
2158:03	116.64	The lead locomotive, travelling at 30.4 mph, passed Signal 1167N displaying a Restricting indication.
2158:14	116.73	While travelling at 22.3 mph, the lead locomotive collided with the tail end car on train 301, after having travelled approximately 818 feet since having made an emergency application of the train brakes.
2158:23	116.76	The lead locomotive came to a stop.
2222:55	n/a	The local police dispatched an ambulance to respond to the collision. The local fire service was informed of the situation.
23:02	n/a	The ambulance received an update, indicating that there was 1 patient.
00:50	n/a	The hi-rail vehicle transporting the conductor arrived at the ambulance.
01:00	n/a	The paramedics assessed and treated the conductor in the ambulance.
01:43	n/a	The ambulance, with the conductor on board, arrived at the hospital in Revelstoke.