Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

RAIL TRANSPORTATION SAFETY INVESTIGATION REPORT R23D0108

MAIN TRACK COLLISION AND DERAILMENT

Canadian National Railway Company freight train X37631-20 and
Réseau de transport métropolitain (exo) commuter train EXO 1212
Mile 135.89, St-Laurent Subdivision
Montréal, Quebec
21 November 2023

Canada

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Summary

On 21 November 2023, at approximately 1827 Eastern Standard Time, Canadian National Railway Company train X37621-20 (CN 376), a light engine movement, was travelling southward on the east track of the St-Laurent Subdivision when it collided at 32 mph with the tail end of a stationary Réseau de transport métropolitain commuter train (EXO 1212). At the time of impact, the train EXO 1212 was stopped at Saint-Léonard–Montréal-Nord station (Mile 135.89) in Montréal, Quebec. Four of the 8 passengers on board train EXO 1212 and the 2 crew members of this train received minor injuries. The 2 crew members of train CN 376 were not injured. Locomotive EXO 1346 and passenger car EXO 3062 were damaged, as were the 2 locomotives on train CN 376.

The investigation established the following facts:

- Before the collision, train CN 376 passed a Restricting signal that restricted its speed to 15 mph until the next signal.
- The crew of train CN 376 likely assumed that the block governed by the Restricting signal indication was clear and expected the next signal to become permissive for their movement.
- The emergency brakes on train CN 376 were applied when the train was travelling at 26 mph above the maximum speed permitted by the Restricting signal indication. Train CN 376 was unable to stop in time and struck the tail end of train EXO 1212 at approximately 32 mph.

Safety action required

Physical fail-safe train controls

In 2000 and 2013, the TSB made 2 recommendations (R00-04 and R13-01, respectively) urging Transport Canada (TC) to adopt physical fail-safe defences. In February 2022, TC issued a notice of intent indicating that it intended to require Canada's most at-risk corridors to be equipped with a fail-safe automatic train protection system (known as enhanced train control, or ETC) in accordance with the objectives of its strategic plan entitled *Transportation 2030: A Strategic Plan for the Future of Transportation in Canada* (*Transportation 2030* strategic plan). Although several initiatives and projects were launched to design and develop such a system in Canada, few meaningful steps have been taken.

In 2022, following its investigation into a collision between 2 CN trains in 2019 near Portage la Prairie, Manitoba, the TSB recommended that

> the Department of Transport require major Canadian railways to expedite the implementation of physical fail-safe train controls on Canada's high-speed rail corridors and on all key routes.
>
> **TSB Recommendation R22-04**

Furthermore, on 17 April 2024, following 3 other occurrences under investigation, the TSB sent a letter to the Minister of Transport regarding the absence of physical fail-safe defences for trains operating in Canada, urging the Minister of Transport to accelerate the implementation of such a system in Canada's high-speed rail corridors and on all key routes across the country. As of the release of this report, the TSB had not received a response.

In December 2024, TC announced that it planned to draft regulations in 2025 for publication in Part I of the *Canada Gazette* in 2026. However, details regarding the specific rail corridors and routes that would require an ETC system and the final configuration of such a system have not yet been determined. In the meantime, safety surrounding rail traffic in Canada continues to rely solely on administrative defences.

Given recent events involving crews not following signal indications that continue to occur in Canada, the TSB urges TC to expedite efforts to adopt fail-safe physical defences for trains, particularly on high-speed corridors and key routes, to better protect passengers, property, and the environment.

Accordingly, the TSB is reiterating Recommendation R22-04.

Additional interim measures

Current administrative defences rely solely on train crews recognizing and complying with signal indications. However, numerous TSB investigations have identified various circumstances in which these administrative defences have failed. As highlighted in Rail Safety Advisory 01/24 and the letter to the Minister of Transport, the risks associated with

failure to comply with signal indications remain high, and it is unlikely that the level of risk will be significantly reduced before physical fail-safe defences are implemented.

However, in recent years, several railway companies operating in Canada have, on their own initiative, introduced measures to partially compensate for the absence of such regulations by TC. Some companies have added additional administrative defences, while others have integrated satellite geolocation technology (see section 4.2.2).

These examples of initiatives implemented by some railway companies are a step in the right direction pending the implementation of the ETC, which TC has stated it intends to implement in accordance with the objectives of its *Transportation 2030* strategic plan.

As of the release of this report, TC had not yet completed many of the necessary steps to implement the ETC in Canada, including corridor risk assessments. Given the scope and complexity of some of these critical actions, it is unlikely that such a system will be developed and implemented within the next few years. If train control systems rely solely on administrative defences, there will be no automatic intervention to stop trains if train crews fail to follow signals or misinterpret them, increasing the risk of accidents.

Pending the implementation of the ETC, no interim measures are required or planned by TC to reduce the risk of train collisions. Consequently, in the coming years, there will be few or no regulatory physical defences to stop a train when a crew fails to follow a signal indication.

The Board therefore recommends that

> the Department of Transport immediately implement additional interim measures to mitigate the risks associated with train crews not complying with railway signal indications, such as collisions between trains, until adequate and permanent physical fail-safe defences are implemented.
>
> **TSB Recommendation R25-01**

1.0 FACTUAL INFORMATION

1.1 The occurrence

On 21 November 2023, at approximately 1804,[1] Canadian National Railway Company (CN) freight train X37621-20 (CN 376), a light engine movement,[2] was at CN's Rivière-des-Prairies Yard, where it had just set off all its rail cars, and preparing to depart for Taschereau Yard. Train CN 376 consisted of 2 locomotives (CN 3100, the movement's lead locomotive, and CN 3201), weighed approximately 426 tons[3] and was 146 feet long. Before

1 All times are Eastern Daylight Time.

2 Light engines refers to a movement consisting solely of locomotives, without rail cars.

3 In this report, "ton" refers to a short ton, which corresponds to 2000 lb or approximately 907 kg.

departure, the rail traffic controller (RTC) informed the crew of train CN 376, made up of a locomotive engineer (LE) and a conductor, that they would obtain the required signal indications to leave the yard and would be following commuter train EXO 1212 after it had passed.

At approximately 1813, train EXO 1212, travelling southward on the east main track of the St-Laurent Subdivision, passed the CN Rivière-des-Prairies Yard. The train consisted of 3 Bombardier multilevel cars, namely a control car[4] and 2 passenger cars,[5] and a diesel-electric locomotive[6] coupled to the tail end. It weighed approximately 335 tons and was about 313 feet long. Eight passengers and 2 crew members were on board. The train was controlled by the LE from the operating cab of the control car while the conductor was on board car EXO 3062. The train was bound for its next stop, Saint-Léonard–Montréal-Nord station in Montréal, Quebec (Figure 1).

Figure 1. Map of the occurrence site (Source: Google Maps, with TSB annotations)

At approximately 1817, after train EXO 1212 had passed Rivière-des-Prairies, train CN 376 received the required signal indications and left the yard, heading south on the east main track, the same track on which the commuter train was travelling. At about 1824, train

4 The EXO 3008 control car has 127 seats on 2 levels, and features a cab at the front from which the locomotive engineer can control a shoving locomotive at the tail end of the train.

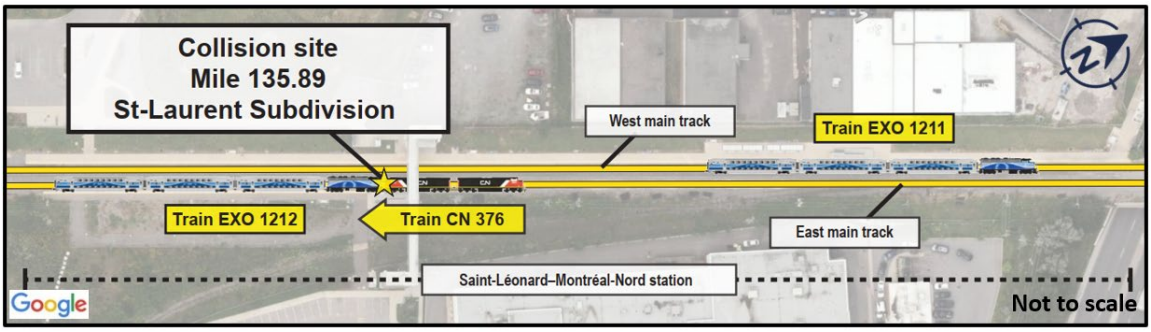
5 Passenger cars EXO 3082 and EXO 3062 have 142 seats on 2 levels.

6 The EXO 1346 locomotive, model F59PH, was built in 1990 by General Motors Diesel Division.

CN 376 passed a Restricting signal[7] (signal 1349E) located about 1 mile from the Saint-Léonard–Montréal-Nord station, where train EXO 1212 was already stopped. As the crew of train CN 376 approached the station platform, they spotted in the distance another commuter train, EXO 1211, travelling in the opposite direction on the west track. The LE of train CN 376 then dimmed the headlight and switched off the ditch lights of the lead locomotive before meeting train EXO 1211, in accordance with Rule 17 of the *Canadian Rail Operating Rules* (CROR).

After meeting train EXO 1211, the LE of train CN 376 switched the locomotive's headlights back to full power. He then spotted the tail end of train EXO 1212 (locomotive EXO 1346) stopped on the same track, about 500 feet ahead. The LE immediately made an emergency application of the train brakes while the train was travelling at approximately 41 mph. Train CN 376 had slowed to approximately 32 mph when it collided with train EXO 1212 (Figure 2), at approximately 1827.

Figure 2. Collision site (Source: Google Maps, with TSB annotations)



Four of the 8 passengers on board train EXO 1212 and the 2 crew members on this train suffered minor injuries.

At the time of the occurrence, it was dark, the sky was overcast, and the temperature was 1 °C.

1.2 Site examination

The coupler arrangements between the CN 3100 and CN 3201 locomotives of train CN 376 broke on impact, causing the 2 locomotives to separate. Locomotive CN 3100 slammed into the locomotive of train EXO 1212 and pushed this train southward for about 150 feet. A truck on car EXO 3062 derailed. Locomotives CN 3100 and CN 3201 sustained damage mainly to their coupler systems, while locomotive EXO 1346 and car EXO 3062 on

7 A Restricting signal authorizes trains to travel at restricted speed. This speed allows trains to stop not only within half the range of vision of rolling stock but also before a switch not correctly lined. Restricted speed requires attention to broken rails and must never exceed slow speed. (15 mph). (Source: *Canadian Rail Operating Rules* (CROR) [effective 01 October 2022, approved by Transport Canada 09 May 2022], Definitions).

train EXO 1212 were structurally damaged to the point where they were considered total losses (figures 3 and 4).

Figure 3. Damage to the front ends of locomotives EXO 1346 and CN 3100 (Source: TSB)

Figure 4. Damage to car EXO 3062 and the rear portion of locomotive EXO 1346 (Source: TSB)

Car EXO 3062, which was coupled to locomotive EXO 1346, suffered damage to its vestibule and intermediate areas when the rear portion of locomotive EXO 1346 plowed into its

A end,[8] causing the wheels of the 1st axle to derail. The multilevel area did not suffer any visible deformation, and all the windows remained intact and fixed to their frames.

The train's 2nd car (EXO 3082) and control car (EXO 3008) suffered no apparent damage.

Following an interruption, normal rail traffic was restored at around 0541 the next morning after car EXO 3062 was re-railed, and the rolling stock of the 2 trains involved was moved to CN's Rivière-des-Prairies Yard, located about 3 miles from the collision site.

1.3 Power failure and passenger evacuation

Following the impact:

- The main alternator on locomotive EXO 1346 stopped working, cutting the train's power supply. The locomotive's batteries powering its auxiliary systems (radio, lighting, etc.) were dislodged from their mountings, cutting off the power to these systems.
- Car EXO 3062's emergency batteries were also dislodged from their mountings, cutting off its emergency power supply and disabling the emergency lighting system, electric door openers, and emergency intercom system.
- The safety switch for the emergency power circuit in the control car EXO 3008, from which the LE was operating the train, tripped due to a short circuit in the electrical wiring, whose origin was unable to be determined with certainty. This cut off the car's emergency power supply and disabled the onboard railway radio. As a result, the LE could not place the necessary emergency calls using the railway radio.[9]
- Car EXO 3082's emergency interior lighting remained operational.

After the collision, the passengers on board train EXO 1212 were evacuated to the station platform via the car doors that were already open. With no emergency lighting, which was disabled in 2 of the 3 cars (car EXO 3062 and control car EXO 3008), passengers were guided in the dark by onboard luminescent signage (Figure 5).

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8 Passenger cars have ends designated "A" and "B", with the "B" end generally being the end where the braking system's compressed-air reservoir is located.

9 The emergency calls were made by the LE of train EXO 1211, which was stopped on the adjacent track at the west platform of Saint-Léonard–Montréal-Nord station at the time of the occurrence.

Figure 5. Luminescent signage on board exo cars (Source: TSB)

1.4 Recorded information

The sequence of events (Appendix A) was established from a review of available information, including data from the event recorders and forward-facing cameras on the locomotives involved, RTC screen recordings, locomotive voice and video recorders (LVVR) data from locomotive CN 3100 and control car EXO 3008, and data from surveillance cameras at Saint-Léonard–Montréal-Nord station.

Following a review of the various recorded data collected, the following points of interest were identified:

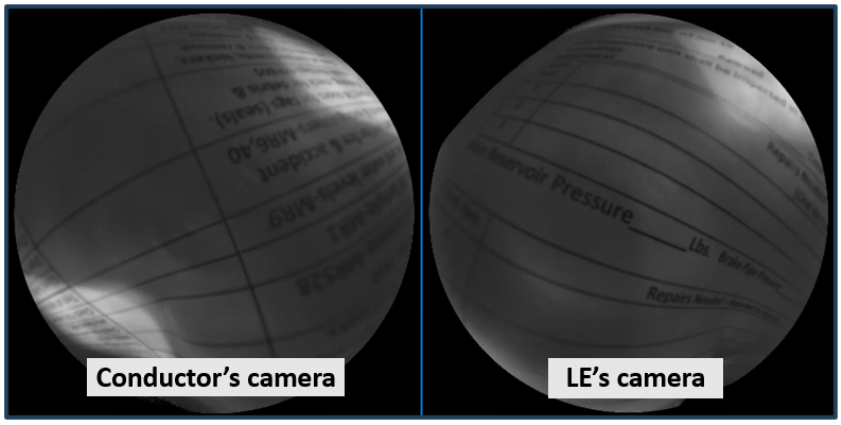
- Train EXO 1212 was stopped on the east track at Saint-Léonard–Montréal-Nord station with the air brakes fully applied.
- Train CN 376 was travelling at 41 mph and was approximately 514 feet from the tail end of train EXO 1212 when an emergency application of the train brakes was initiated.
- The collision occurred when train CN 376 had decelerated to 32 mph.
- Following the impact, a train-initiated emergency brake application occurred on train EXO 1212.
- The collision caused train EXO 1212 to travel approximately 150 feet to the south.
- The signal system was functioning normally and the signal indication progression for train CN 376 was compliant with CROR rules. The last signal passed by the train, signal 1349E, displayed a “Restricting” indication (Rule 436).

- Before departing from Rivière-des-Prairies Yard, no brake tests were performed on the locomotives of train CN 376.[10]

1.4.1 Locomotive CN 3100 voice and video recorder data

When analyzing the LVVR[11] data from the CN 3100 locomotive, the TSB found that the 2 cameras inside the cab were obstructed by sheets of paper (Figure 6).[12] However, the voice recording was unaffected by the obstruction of the cameras, and conversations between crew members were still audible.

Figure 6. Obstructed view from the 2 cameras in the cab of the locomotive CN 3100 (Source: TSB)



In accordance with current regulations:[13,14]

- LVVRs must be equipped with physical safeguards to prevent tampering, including reducing the field of view of cameras.
- Tampering with LVVRs to prevent the recording of information is prohibited.

At the time of the occurrence, the regulations in effect did not explicitly prohibit train crews from operating a locomotive with an altered or non-functional LVVR, such as when the LVVR cameras are obstructed.

On 22 December 2023, the TSB issued Rail Transportation Safety Advisory Letter 07/23 (Obstruction of locomotive voice and video recorder [LVVR] cameras) to TC.

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10 At the time of leaving Rivière-des-Prairies Yard, locomotive CN 3100 was configured as the lead locomotive in the movement. When a locomotive becomes the lead locomotive, a brake test must be carried out on the shop track. (Source: Canadian National Railway Company, *Locomotive Engineer Operating Manual*, Form 8960 [01 May 2016], section F9.1.2, p. 69).

11 Transport Canada, SOR/2020-178, *Locomotive Voice and Video Recorder Regulations* (23 August 2020, effective 02 September 2022).

12 It was not possible to determine when or by whom the cameras had been obstructed in this way.

13 Transport Canada, SOR/2020-178, *Locomotive Voice and Video Recorder Regulations* (23 August 2020, effective 02 September 2022), subsection 16(1).

14 Transport Canada, *Railway Safety Act* (1985, c. 32 [4th Supp.]), subsection 17.31(3).

In the Safety Advisory Letter, the TSB asked TC to ensure that LVVR systems were operational and capturing the required data.

1.5 Crew information

The crews of the 2 trains involved in the occurrence were each made up of an LE and a conductor.[15] The crew members were qualified for their positions, met fitness and rest requirements, and were familiar with the territory.

Data collected during the investigation revealed that none of the factors contributing to fatigue for both train crews were present at the time of the occurrence.

1.5.1 Crew on the Réseau de transport métropolitain train

The LE of train EXO 1212 had approximately 43 years of railway experience. Meanwhile, the conductor had over 32 years' experience in train operation. Both had been working on exo's Line 15 Mascouche for over 2 years.

On the day of the occurrence, the crew began its shift around 1245 at Mascouche station.

1.5.2 Crew on Canadian National Railway Company train

The LE of train CN 376 had over 16 years' experience in railway operations. The conductor had about 9 years of railway experience.

On the day of the occurrence, the crew began its shift at approximately 1330. The crew was assigned as a relief crew for train CN 376, which was then at Dorval station. Their task was to move the train to CN's Rivière-des-Prairies Yard, setting off all the cars in the train's consist at that location, and to bring the 2 locomotives back to CN's Taschereau Yard, where their shift was to end.

According to the information obtained during the investigation, there was no indication that either of the crew members' performance was affected by medical or physiological factors.

1.6 Subdivision and track information

The St-Laurent Subdivision extends from Pointe-aux-Trembles station in the north (Mile 127.8) to Josy station in the south (Mile 144.4).

Every week, some 112 trains[16] operate on this subdivision, in either direction, for an approximate annual tonnage of 17 million gross tons. The St-Laurent Subdivision is

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15 The crew members of train EXO 1212 were employed by Alstom Transport Canada Inc. a company contracted by the Réseau de transport métropolitain to operate all its commuter train lines.

16 The breakdown is as follows: 26 CN freight trains, 6 VIA Rail Canada Inc. passenger trains and 80 exo commuter trains.

considered a key route,[17] with many trains carrying dangerous goods operating there on a regular basis.

This subdivision is a Class 4 track under the *Rules Respecting Track Safety*. In the area of the occurrence, the maximum allowable speed is 60 mph for passenger trains and 50 mph for freight trains.

The single main track becomes a double main track between Grou station (Mile 128.2) and Montréal-Nord station (Mile 136.3). The 2 tracks are then designated "west track" and "east track", in accordance with CROR Rule 81. Train movements are controlled by the centralized traffic control (CTC), as authorized by the CROR, and are dispatched by a CN RTC located in Edmonton, Alberta.

1.7 Centralized traffic control system

Rail traffic control systems ensure the safety of train operations, track work, and track maintenance. CTC, in particular, uses track circuits interconnected with signals installed along the track, whose indications control train movements.

The CTC system comprises 2 types of signalling systems:

- Controlled signals are fixed signal installations in the field at the entrance to a block[18] to govern a movement. By default, these signals display a "Stop" indication (all the signal lights are red). They display a less restrictive signal depending on the route programmed by the RTC. The signal system determines how permissive each signal indication will be.
- Advanced signals are fixed installations that are not controlled by the RTC, but that are connected to one or more other signals. The indication displayed by these signals depends, among other things, on the occupancy of the next block, the indication of the next signal, and the track circuit integrity.

Signal indications specify the maximum speed at which movements may pass through controlled locations and the speed at which they must approach the next signal. They also provide information on track conditions. These indications let crews know if the next block

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17 "'**Key route** [bold in original] means any track on which, over a period of one year, is carried 10,000 or more loaded tank cars or loaded intermodal portable tanks containing dangerous goods, as defined in the *Transportation of Dangerous Goods Act, 1992* or any combination thereof that includes 10,000 or more loaded tank cars and loaded intermodal portable tanks." (Source: Transport Canada, *Rules Respecting Key Trains and Key Routes* [2016], subsection 3.3).

18 A length of track of defined limits, the use of which by a movement is governed by block signals. (Source: *Canadian Rail Operating Rules* (CROR) [effective 01 October 2022, approved by Transport Canada 09 May 2022], Definitions).

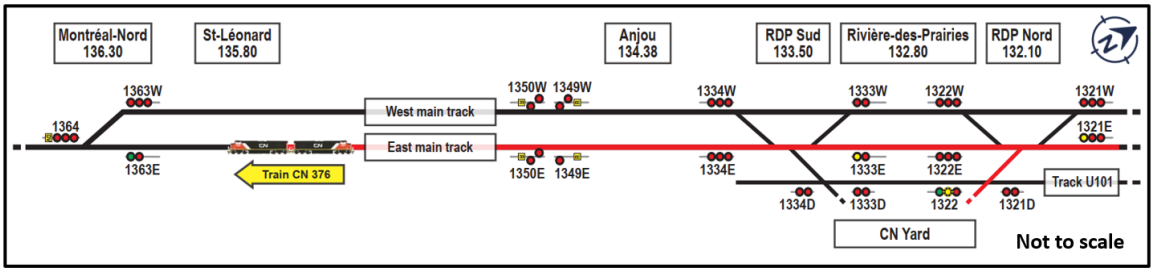
is occupied[19] by another movement and they protect against certain situations, such as the presence of rolling stock, a broken rail, or a switch left open.

Signal indications are progressive: when a movement approaches a signal, its indication depends on the likely indication of the next signal. For example, if a movement encounters a "Clear to Stop" indication, it should expect the next signal to display a "Stop" indication, unless CTC circuit conditions have changed in the meantime. The operation of movements within blocks is governed by CROR Rule 401.1,[20] which stipulates that "[t]he indications displayed on block and interlocking signals govern operation to the next signal or block end sign."

1.7.1 Signal indications on the route of train CN 376

When train CN 376 left CN's Rivière-des-Prairies Yard, it passed by 4 CTC signals on its way to Saint-Léonard–Montréal-Nord station (Figure 7):

Figure 7. Train CN 376 route between Rivière-des-Prairies Yard and the collision site (Source: TSB)



- The 1st signal, 1322, displayed a "Slow to Medium"[21] indication, allowing the train to exit the yard northward onto the east main track of the St-Laurent Subdivision.
- The 2nd signal, 1321E, displayed a "Clear to Stop"[22] indication, allowing the train to reverse direction and head south.
- The 3rd signal, 1333E, which had previously indicated "Stop,"[23] changed to display a "Clear to Stop" indication, allowing the train to continue southward.
- The 4th signal, 1349E displayed a "Restricting" indication, allowing the train to proceed at the restricted speed.

The next signal, 1363E, is located south of the station. This light-emitting diode (LED) signal becomes visible about 1400 feet past signal 1349E, at the exit of a curve to the left. This

19 "Occupied" is understood to indicate that either a section of track is occupied by equipment or the track circuit is broken. A track circuit can be broken for many reasons (e.g., a broken rail or a switch left in the open position).

20 *Canadian Rail Operating Rules* (CROR) (effective 01 October 2022, approved by Transport Canada 09 May 2022), Rule 401.1.

21 Ibid., Rule 433.

22 Ibid., Rule 411.

23 Ibid., Rule 439.

signal, which initially displayed a "Stop" indication, changed to a "Clear"[24,25] indication. This change in indication, intended for train EXO 1212, occurred when southbound train CN 376 was about 900 feet from the station platform.

1.8 Speed of train CN 376

Although the maximum allowable speed on the St-Laurent Subdivision is 50 mph for freight trains, a CN operating bulletin in effect[26] required a speed reduction of 10 mph below the maximum allowable speed after passing any signal displaying a "Clear to Stop" indication. In this occurrence, after train CN 376 passed signal 1333E, its speed reached 52 mph within the block.

As the train approached signal 1349E, which displayed a "Restricting" indication, it reduced speed to approximately 4 mph. After passing this signal, the train initially accelerated to 20 mph. Signal 1363E of the controlled location at Montréal-Nord, which was displaying a "Stop" indication, then became visible. At the same time, the crew spotted train EXO 1211 which was entering northward on the west track from the same controlled location. CN 376's LE slowed the train to approximately 8 mph. Then, seeing that train EXO 1211 had cleared the controlled location at Montréal-Nord, he accelerated to 41 mph even before reaching signal 1363E (Figure 8).

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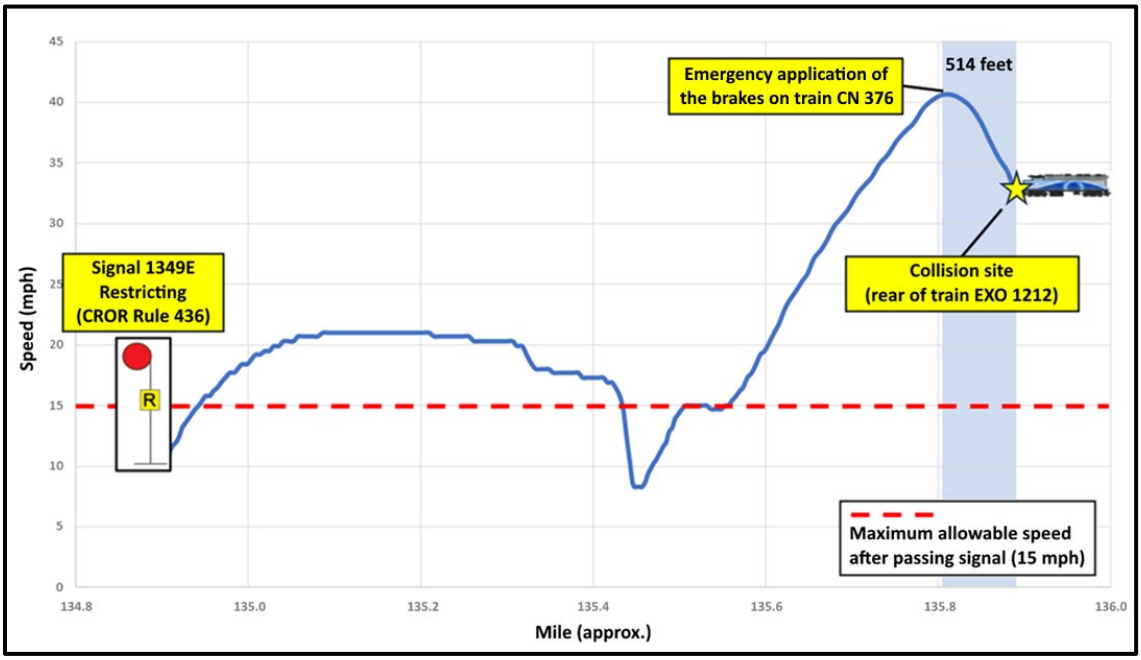
24 Ibid., Rule 405.

25 This signal was intended for train EXO 1212, which was in the station at the time, so that it could continue southbound on its regular schedule.

26 According to CN Operating Bulletin 010, issued on 19 October 2023, freight trains approaching a Clear to Stop indication must reduce speed to 10 mph below the maximum allowable speed. This speed reduction must begin before passing any such signal.

Figure 8. Change in speed of train CN 376 after passing signal 1349E (Source: Locomotive CN 3100 event recorder)



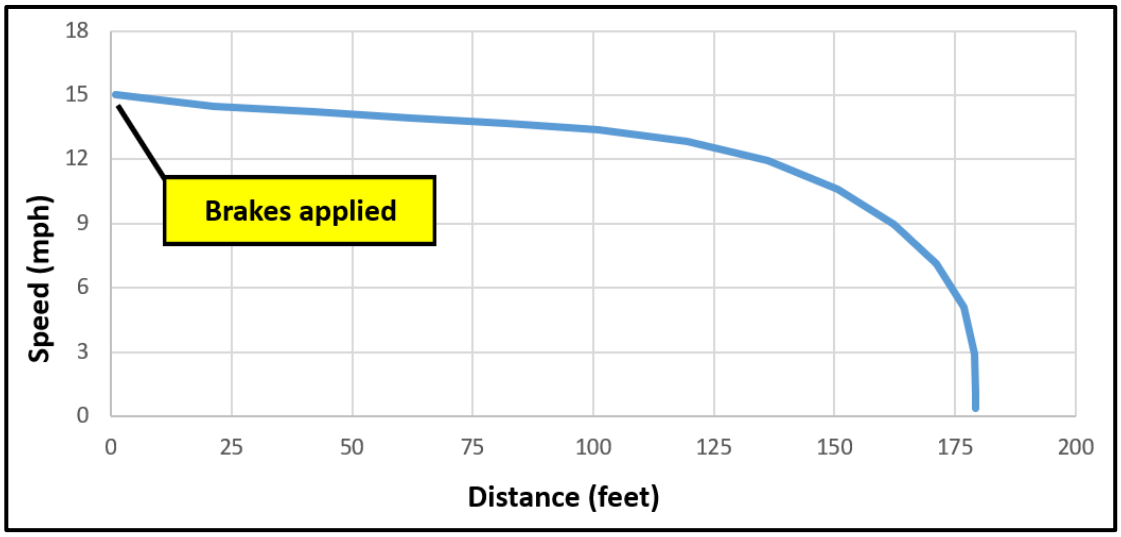
1.8.1 TSB simulations

The TSB conducted simulations[27] to estimate the approximate stopping distance of a train with the same characteristics as the occurrence train (exemplar train). The objective of these simulations was to determine the approximate stopping distance of an exemplar train operating at 15 mph, which is the maximum speed authorized by CROR Rule 436 (Restricting) in the same operating conditions as the occurrence train.

Figure 9 shows the simulated deceleration curve, which includes a progressive full-service independent brake application.

27 Simulations were performed using Freight Train Operations Simulator (FTOPS) software.

Figure 9. Exemplar train deceleration curve from simulations (Source: TSB)



The simulations showed that the distance required to stop the exemplar train would have been less than 200 feet.

1.9 Rules and instructions related to signal compliance

Signal compliance by train crews is governed by the CROR and special instructions specific to each railway company. These rules are administrative defences that help train crews comply with the indication of each signal. Rules and instructions concerning block signals include:

- CROR Rule 34 (Fixed Signal Recognition and Compliance) – This rule requires crew members within physical hearing range of each other to communicate in a clear and audible manner the name of each fixed signal they are required to identify. Each signal affecting a movement must be called out as soon as it is positively identified, but crew members must watch for and promptly communicate and act on any change of indication which may occur.
- CROR Rule 578 (Radio Broadcast Requirements) – This rule requires a crew member on each train and transfer to transmit a radio message on the designated standby channel specifying the indication given by the advance signal of the next controlled location, controlled point, or interlocking. On 03 April 2023, CN added a special instruction to this rule specifying that it also applies to multi-track territory.

In this occurrence, when departing from CN's Rivière-des-Prairies Yard, the crew members of train CN 376 verbally communicated to each other the indications of each signal on their route. However, no signal indications were transmitted over the railway radio.

1.9.1 Critical focus zones

On 23 August 2022, CN issued an operating bulletin modifying CROR Rule 34 to introduce critical focus zones (CFZ).

A CFZ is an environment you create in the cab of the controlling locomotive that allows the LE to focus on controlling the speed of the movement while approaching upcoming restrictions. The purpose of the CFZ is to reduce/eliminate distractions while approaching a potentially hazardous situation. According to CFZ instructions, a CFZ

> […] requires freight train crews to begin reducing their speed prior to passing clear to stop signals and engage them in slow brain behaviour. [28]
>
> While this reduction in speed is occurring, the conductor must ensure that the stopping location is discussed and determined with the Locomotive Engineer. This conversation MUST occur no less than 1 mile from the stop requirement as per the Critical Focus Zone (CFZ) Instructions.[29]

In this occurrence, there was no discussion of the stopping location between the crew members of train CN 376 before passing signals displaying a "Clear to Stop" indication. In addition, when the crew passed signal 1349E displaying a "Restricting" indication (which constitutes a restriction subject to CFZ rules), there was no discussion of this restriction.

Following this occurrence, CN extended CFZ rules to include situations where trains are required to operate at restricted speed.

CN also introduced a new special instruction under CROR Rule 411.[30] From now on, freight trains must reduce their speed by 10 mph below the maximum allowable speed when approaching a Clear to Stop signal, starting before passing the signal.

1.10 Train EXO 1212 end-of-train markers

1.10.1 Requirements for end-of-train markers

End-of-train markers indicate the last piece of equipment in a movement. They consist of fixed or flashing red lights or red reflective plates and are controlled by the train crew. There are no specific requirements in Canada for the use of end-of-train markers. Railway companies determine whether and what type of markers to use on their trains depending on their needs.

According to exo's railway operating manual,[31] all the company's trains must be equipped with illuminated red end-of-train markers to identify the end of the last piece of equipment in relation to the direction of travel. These signals must be used at all times.

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28 D.Kahneman, *Thinking, Fast and Slow*, 2011. Theory that the human brain has 2 speeds of thought. The "slow brain system" is involved in complex problem solving, due to its more analytical approach.

29 Canadian National Railway Company, Operating Bulletin No. 010 (19 October 2023).

30 *Canadian Rail Operating Rules* (CROR) (effective 01 October 2022, approved by Transport Canada 09 May 2022), Rule 411: Clear to Stop – Proceed, preparing to stop at next signal.

31 Exo, *Manuel d'exploitation ferroviaire* (June 2021), section 6 : Matériel roulant, subsection 6.3: Signaux de queue.

However, exo's rules do not include any specific technical requirements, such as the minimum brightness level or the alignment and orientation of the light beam.

1.10.2 TSB laboratory simulations results

For this occurrence, the TSB laboratory examined the end-of-train markers on locomotive EXO 1346 to determine if they worked as intended and ran simulations to determine if they would be visible under conditions similar to those at the time of the collision.

The simulations revealed that the end-of-train markers were working as intended. They also revealed that because of the ambient lighting in the station combined with the lighting from the railway signals beyond it, the end-of-train markers of train EXO 1212 were not visible from the perspective of the cab in the train CN 376 lead locomotive, with its forward headlight at a lower intensity, as it headed toward the Saint-Léonard–Montréal-Nord station.

1.11 Multilevel cars in exo's fleet

Multilevel cars in exo's fleet (Bombardier 3000 Series) were designed and manufactured by Bombardier Transportation[32] in the early 2000s.

The cars were originally designed for the New Jersey Transit Authority (NJT). Their design complies with the applicable regulations of the United States Federal Railroad Administration,[33] the technical standards of the American Public Transportation Association,[34] and the additional special requirements of the NJT.

To ensure strength and safety in the event of a collision, these passenger cars have the following features, among others:

- The body structure is designed to withstand a static compressive load of 800 000 pounds applied longitudinally on the traction axis, without permanent deformation.
- The body structure is designed to withstand a compressive load of 500 000 pounds applied to an area measuring 6 inches high by 24 inches wide, centred on the end threshold plate or buffer beam, without permanent deformation.
- The cars are fitted with 2 full-height collision posts at both ends to withstand various horizontal loads. The top connection is also designed to withstand specific longitudinal and vertical loads.

Bombardier 3000 Series multilevel cars are not equipped with an energy management system in the event of a collision. However, one of the NJT requirements is that, in a

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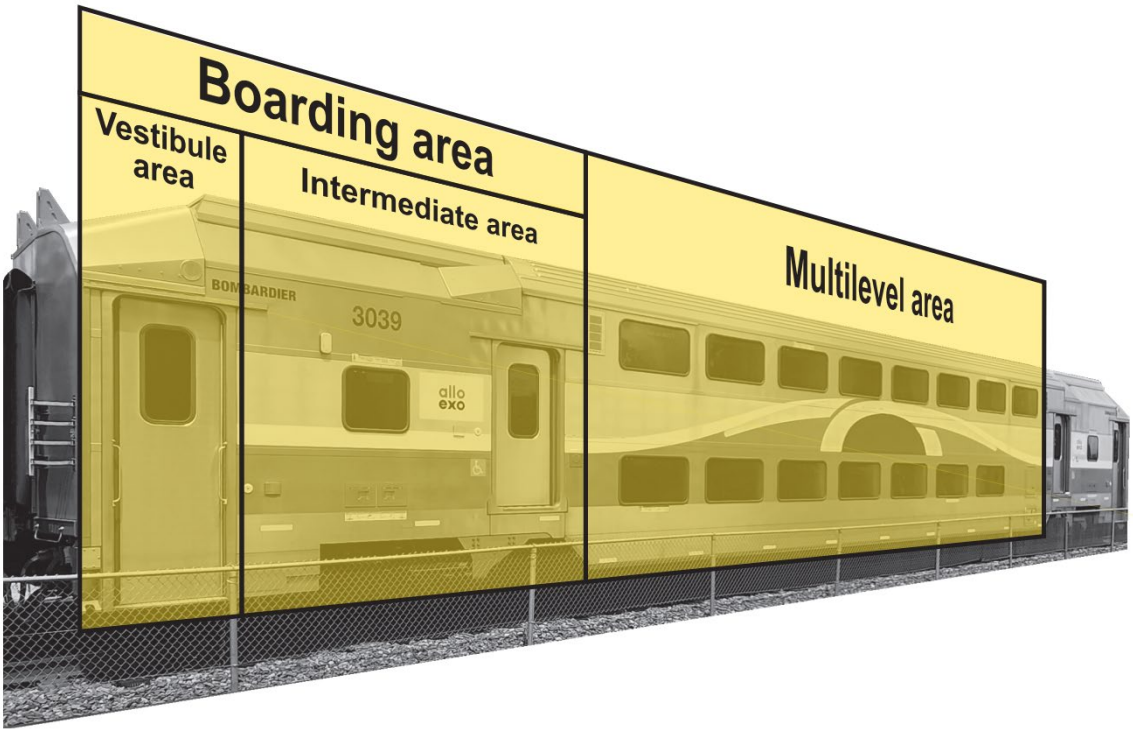
32 Bombardier Transportation was acquired by Alstom in January 2021.

33 U.S. *Code of Federal Regulations*, Title 49, Part 238: Passenger Equipment Safety Standards.

34 American Public Transportation Association APTA SS-C&S-034-99, Rev. 1 *Standard for the Design and Construction of Passenger Railroad Rolling Stock* (28 September 2003).

collision, the ends of the cars must collapse before the multilevel passenger area between the body crossmembers and the boarding area (Figure 10).

Figure 10. Zones of an exo multilevel car (Source: TSB)



1.12 Situational awareness and mental model

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.[35] In a dynamic environment, situational awareness requires continuously extracting information, integrating this information with the information that is already available to create a coherent mental model, and using this model to anticipate future events. Train crew members who have a shared situational awareness can anticipate and coordinate their actions, and therefore act with cohesion and efficiency.

A mental model is an organized internal construct that enables people to describe, explain, and predict events in their environment, and to develop expectations of what will happen in the future.[36] When a mental model is adopted, it is resistant to change. New, compelling, and convincing information must be perceived and assimilated in order to modify an existing

35 M.R. Endsley, "Design and evaluation for situation awareness enhancement" in Proceedings of the Human Factors Society: 32nd Annual Meeting (Santa Monica, California: 1988), pp. 97–101.

36 E. Salas, F. Jentsch and D. Maurino, *Human Factors in Aviation*, 2nd Edition, Academic Press, 2010, p. 266.

mental model. An inaccurate mental model will interfere with situational awareness, notably in the perception of critical elements or the comprehension of their importance.[37]

In this occurrence, the crew of train CN 376 knew that it was following train EXO 1212 southward on the east track. The crew anticipated the position of the commuter train and likely wrongly concluded that the block following the signal displaying a Restricting indication (signal 1349E) was clear until the next signal.

1.13 Adaptations

Adaptations are intentional deviations of rules and procedures. Routine adaptations are deviations that are repeated over time. These deviations can arise because the rule or procedure is considered unnecessary or redundant, or simply because it is not enforced. When adaptations are performed with no negative consequences, they can persist and become standard practice. This way of working becomes normalized and can erode the safety margins that the rules and procedures were intended to provide.

Organizational monitoring of compliance with procedures can identify certain adaptations, such as those related to calling rail signals on the radio. This monitoring consists of spot-checking radio communications, riding along with train crews during operations, training, and periodic certification.

In this occurrence, the crew of train CN 376 did not comply with certain rules while switching between CN's Rivière-des-Prairies Yard and the occurrence site. The train left the yard without a brake test having been performed on the locomotive consist, the signal indications were not communicated on the railway radio standby channel, the crew did not comply with the restricted speed indicated by signal 1349E, and there was no discussion of this restriction as required by the CFZ.

1.14 Transport Canada oversight methods

As part of its oversight activities, TC performs inspections in the field during which the railway's supervisory procedures are reviewed to ensure they comply with current applicable regulations and appear effective.

When discrepancies are discovered between the application of procedures and observations resulting from inspections, TC notifies the railway company of the deficiencies and asks it to submit and implement a corrective action plan. TC provides feedback after evaluating the measures taken or the action plan submitted.

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[37] 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 [Florida]: CRC Press, 2010), part II: Human Capabilities and Performance, chapter 12, p. 12.

Between 2019 and 2024 in Quebec, TC conducted audits to verify CN's compliance with several rail operating rules as described in the CROR. Table 1 shows the rules most relevant to railway signal observance.

Table 1. Railway operating rules audited by Transport Canada for CN, between 2019 and 2024

Rule	Audits	Non-compliance identified	Rate of compliance (%)
Rule 33 - Speed Compliance	153	1*	99.3
Rule 34 - Fixed Signal Recognition and Compliance**	147	2	98.6
Rule 401.1 - Signal Displayed	64	0	100
Rule 436 - Restricting	57	1*	98.2

* This non-compliance is related to this occurrence and was identified after the accident.

** This item includes the requirements of Rule 34(b) regarding the obligation of crew members to verbally communicate required information to each other.

Most of the time, TC's field inspections of train crew compliance are unannounced. Typically, inspectors shadow and observe employees during their regular activities as they relate to the railway operations in question, such as verifying fixed signal recognition and compliance.

1.14.1 Auditing compliance with the *Locomotive Voice and Video Recorder Regulations*

TC also conducts compliance audits for the *Locomotive Voice and Video Recorder Regulations* (LVVR Regulations), which came into force in September 2022. As of 01 March 2024, TC has performed over 660 inspections of railway companies. These inspections focused mainly on the following areas:

- Compliance of recording equipment installation
- Signage notifying people in the controlling locomotive that they are being video and audio recorded
- No tampering of the LVVRs
- Verifying compliance with policies and procedures designed to ensure that privacy requirements are respected

During these inspections, 85 instances of non-compliance have been identified:

- 55 instances for failure to install an LVVR on controlling locomotives
- 29 instances for absence of required signage inside LVVR-equipped controlling locomotives
- 1 instance for tampering with recording systems, preventing data collection (this non-compliance, where the cameras of the locomotive voice and video recording system had been obstructed, is related to this occurrence and was identified after the occurrence).

Currently, TC does not systematically use data from locomotive event recorders or other available onboard systems for its regulatory oversight activities and compliance verification for LVVR equipment.

1.15 Canadian National Railway Company's employee compliance management

Under CN's safety management system (SMS),[38] all company employees are responsible for complying with the company's safety policies, rules, standards, and procedures. Employees must be committed to their own safety and well-being, to looking out for each other, and to prioritizing the safe transportation of goods.

1.15.1 Employee monitoring by Canadian National Railway Company supervisors

The SMS provides for employee monitoring activities by company supervisors. For the most part, these activities involve checks on the ability of employees in the field to apply rules, regulations, and special instructions when performing their duties. These controls are part of the Performance Monitoring and Rules Compliance program (PMRC), and include dynamic checks and direct observation of employees to assess their ability to perform their work while following the applicable rules. These monitoring activities may occur with or without the knowledge of employees; once the observations have been made, supervisory staff are expected to meet with employees to provide feedback on their performance.

Table 2 shows the rates of compliance with regulations and instructions of CN employees working in the Transportation division, in Canada, when monitored by the company's supervisors, for the years 2021 to 2023.

Table 2. Compliance rates of CN employees in the Transportation division during inspections carried out in Canada as part of the Performance Monitoring and Rules Compliance program

Year	Rate of compliance (%)
2021	96.2
2022	96.4
2023	96.4

With respect to compliance with CROR Rule 34[39] in particular, in 2023, LEs, conductors, and assistant conductors achieved an average rate of 98.1% when audited by CN supervisors (Table 3).

38 A safety management system (SMS) is an internationally recognized framework that allows companies to identify hazards, manage risks, and make operations safer. An SMS improves safety by building on existing processes, demonstrating corporate due diligence, and growing the overall safety culture.

39 *Canadian Rail Operating Rules* (CROR) (effective 01 October 2022, approved by Transport Canada 09 May 2022), Rule 34: Fixed signal recognition and compliance.

Table 3. Rule 34 compliance rate for audits performed by CN supervisors (2023)

Rule	Number of observations	Non-compliance identified	Rate of compliance (%)
Rule 34 - Fixed Signal Recognition and Compliance*	1525	29	98.1

* This item includes the requirements of Rule 34(b) regarding the obligation of crew members to verbally communicate required information to each other.

When CN supervisors observe "risky" employee behaviour, they are required to intervene and implement corrective measures, depending on the severity and frequency of the behaviour, if applicable. These measures may include mentoring, additional training, or referral for internal investigation.

1.15.2 Random examination of locomotive voice and video data by Canadian National Railway Company

In accordance with the *Railway Safety Act*, as well as the LVVR Regulations in effect since September 2022, CN may perform random selections of voice and video data on an ad hoc basis[40] only to identify any safety deficiencies. The aim is to use this data to verify employee compliance with operating rules and perform trend analyses. This is done to provide guidelines to first-line supervisors as to which specific rules to address in discussions with train crews in their respective regions, in line with the provisions set out in CN's SMS.

The LVVR Regulations identify certain specific risks to railway safety which, when observed, allow railway companies to use LVVR data to address these risks. These specific risks are:

> (a) an operating employee who uses a cellular telephone while on duty when normal railway radio communication systems are available, except as provided for in company policies;
>
> (b) an operating employee who assumes a sleeping position while on duty, except as provided for in company policies;
>
> (c) an operating employee who uses a personal entertainment device while on duty, except as provided for in company policies;
>
> (d) the presence of an unauthorized person in the controlling locomotive;
>
> (e) an operating employee who is consuming or using intoxicants or impairing drugs;
>
> (f) an operating employee who reads materials not required in the performance of their duties while on duty, except as provided for in company policies; and
>
> (g) operating employees who are within hearing range of each other but who are not verbally communicating, in a clear and audible manner, information they are

40 Transport Canada, SOR/2020-178, *Locomotive Voice and Video Recorder Regulations* (23 August 2020, effective 02 September 2022), section 27.

> required to verbally communicate in accordance with rules approved or established by the Minister under sections 19 and 20 of the Act.[41]

At CN, when one of these threats is observed, a follow-up is initiated and appropriate actions can be taken.

In the 12 months preceding the occurrence, between November 2022 and October 2023, CN conducted several random observations of train crews. The data collected for trend analysis purposes made it possible to observe employee behaviour in a situation where they performed their regular tasks without the presence of supervisors.

These observations also identified certain behaviours posing threats to the safety of railway operations, as defined in the LVVR Regulations. In particular, the observations revealed that crew members sometimes do not verbally communicate the required information to each other,[42] as stipulated by CROR Rule 34(b).[43]

During these observations, only 75.2% of LEs, conductors, and assistant conductors correctly applied the requirements of CROR Rule 34(b) (Table 4).

Table 4. Rate of compliance with crew members' duty to verbally communicate required information, as identified during random observations of locomotive voice and video recorders

Threat to the safety of railway operations	Number of observations	Non-compliance identified	Rate of compliance (%)
Duty of crew members to verbally communicate the required information (CROR Rule 34[b])	475	118	75.2

In addition, during these observations, CN also identified 4 situations where the LVVR cameras had been deliberately obstructed, preventing the capture of video images from inside the locomotive cab. However, under current regulations, tampering with LVVRs (including obstructing cameras) is not identified as a specific risk to railway safety.

1.16 Advanced train control system

In Canada, train control systems have only administrative defences. In the United States, Class 1 railways have implemented a physical fail-safe train control system, known as positive train control (PTC). The PTC system has been implemented on all high-hazard routes, spanning over a total of 57 536 miles, which represents approximately 41% of nearly 140 000 route-miles of the United States rail network, since 29 December 2020. The

41 Ibid., section 30.

42 Ibid., subsection 30(g).

43 *Canadian Rail Operating Rules* (CROR), Rule 34(b): "Crew members within physical hearing range must communicate to each other, in a clear and audible manner, the indication by name, of each fixed signal they are required to identify […]"

PTC system is described in the Association of American Railroads's (AAR)*Manual of Standards and Recommended Practices* as follows:

> 2.0 PTC SYSTEM DESCRIPTION
>
> 2.1 Theory of Operation
>
> 2.1.1 The PTC system requires an interface to the locomotive air brake system for commanding a penalty brake application to stop a train prior to violating an authority or for exceeding authorized speed.
>
> 2.1.2 The PTC system uses train consist and track database information along with current operating status to calculate a safe stopping distance for the train. Predictive enforcement in the PTC system uses the calculation of stopping distance with a full-service application[44] and compares that distance against upcoming targets. If an upcoming target requires a stop and the train operator has not responded to warnings provided by the PTC system, then a command is sent to the brake system to initiate a full-service penalty application.[45] While that braking event is in progress, the PTC system continues to monitor reduction in train speed and will initiate an emergency brake application if the initial penalty brake application is projected to be insufficient to stop the train prior to reaching the target.[46]

The absence of physical fail-safe defences capable of intervening by stopping a train when operating in CTC territory, and the absence of passive[47] warning systems on trains to alert train crews 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,[48] and this issue has been on the TSB Watchlist since 2012.[49]

A PTC system has certain limitations when trains are running at restricted speed. It cannot intervene to prevent a collision when the train is travelling at or below the slow speed, which is the maximum limit allowed under restricted speed. However, the PTC system can intervene if movements exceed the maximum speed allowable under restricted speed.

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44 A full-service brake application corresponds to a brake pipe pressure reduction of 0.72 times the operating pressure of the feed valve setting. For instance, for air brake systems with a brake pipe pressure of 90 psi, a full-service brake application corresponds to a 25.2 psi brake pipe pressure reduction.

45 A penalty brake application initiated by a positive train control system reduces brake pipe pressure by a further 3 to 9 psi compared to a full-service brake application.

46 Association of American Railroads, *Manual of Standards and Recommended Practices* (March 2017), standard S-4047, section 2.

47 A passive warning system can alert train crews operating in non-signalled territory if traffic limits or authorized speeds are exceeded.

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

49 TSB Watchlist, "Following railway signal indications", at https://www.tsb.gc.ca/eng/surveillance-watchlist/rail/2022/rail-01.html (last accessed 08 August 2025).

By the end of 2020, CN and Canadian Pacific Railway (now doing business as CPKC)[50] had fully implemented a PTC system on their respective subdivisions in the United States where required. In Canada, the infrastructure required to support PTC systems is currently non-existent. However, TC indicates that it will continue to work with railway companies and industry stakeholders to develop and implement an enhanced train control (ETC) system in Canada, in accordance with the objectives in its strategic plan titled *Transportation 2030: A Strategic Plan for the Future of Transportation in Canada*[51] (*Transportation 2030* strategic plan).

For their part, some railway companies have taken the initiative to develop their own warning systems. For example, the QNS&L Railway has implemented a combined administrative and physical defence system, introducing proximity detection devices (PDDs) in 1997. PDDs are equipped with GPS to determine the position, direction, and speed of locomotives and maintenance vehicles equipped with these devices. They are configured to receive alerts of approaching movements. The conductors of both movements must confirm on a screen that they have acknowledged the alert and must communicate with each other by radio to verify their respective positions. A penalty brake is automatically applied to the locomotive of a train whose crew has not acknowledged receipt of the alert.

Despite the technological evolution in this field, no interim measures to reinforce the existing defences related to identifying railway signals are being considered by TC.

1.16.1 TSB Recommendation on additional physical defences

On 03 January 2019, 2 CN trains collided after one of them passed a Stop signal near Portage la Prairie, Manitoba.[52] Following this occurrence, the Board recommended that

> the Department of Transport require major Canadian railways to expedite the implementation of physical fail-safe train controls on Canada's high-speed rail corridors and on all key routes.
>
> **TSB Recommendation R22-04**

In its December 2024 response, TC stated that it had made significant progress in developing its corridor risk assessment methodology that will guide the implementation of the ETC on the Canadian rail network. It also informed the TSB that it was continuing to work with industry and other stakeholders to finalize the methodology. Consultations are also underway to assess the cumulative effects of these requirements on regulated parties.

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50 On 14 April 2023, Canadian Pacific Railway Company (CP) and Kansas City Southern (KCS) combined into a single railway company doing business as CPKC.

51 Transport Canada, *Transportation 2030 – A Strategic Plan for the Future of Transportation in Canada*, at https://tc.canada.ca/en/initiatives/transportation-2030-strategic-plan-future-transportation-canada (last accessed on 08 August 2025).

52 TSB Rail Transportation Safety Investigation Report R19W0002.

Regulatory drafting is planned for 2025, with an anticipated timeline for publication in the *Canada Gazette*, Part I in 2026. Timelines for implementation of ETC will be determined as the regulation is developed.

In its March 2025 assessment of TC's response, the Board recognized that developing and implementing the ETC is a complex undertaking requiring significant investment and that TC and the industry have taken steps to address this. However, the Board notes that the corridor risk assessment methodology has not yet been completed, which calls into question the timing of the implementation of a fail-safe train control system. Given the risks to persons, property, and the environment, the Board urged TC and the rail industry to expedite the implementation of physical fail-safe train control technologies on Canada's high-speed rail corridors and on all key routes across the country. Although the Board believes that the response to Recommendation R22-04 indicates **satisfactory intent**,[53] if further delays in implementing the recommendation occur, this assessment could be downgraded in the future.

1.16.2 Letter to the Minister of Transport

On 17 April 2024, as a result of 3 other occurrences under investigation,[54] the TSB sent a letter to the Minister of Transport concerning the absence of physical fail-safe defences for trains operating in Canada. The TSB stated that, despite its calls for additional physical fail-safe defences since 2000 and the implementation of such a solution in the form of PTC in the United States since 2020, the safety of the Canadian railway system continues to rely on administrative defences centred on compliance with rules by train crews.

Since 2013, TC and the rail industry have continued to discuss possible solutions for implementing an ETC system. Given the slow pace of progress toward the implementation of this solution and the risks involved, the TSB has urged the Minister of Transport to accelerate the implementation of this type of system in Canada's high-speed rail corridors and on all key routes across the country. At the end of 2024, the TSB was still waiting for a response from the Minister on this subject.

1.17 TSB Watchlist

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

Following railway signal indications is a Watchlist 2022 issue. As this occurrence demonstrates, railway signal indications are not consistently recognized and/or followed, which poses a risk of serious train collisions and derailments.

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53 TSB Recommendation R22-04: Enhanced train control for key routes, at https://www.tsb.gc.ca/eng/recommandations-recommendations/rail/2022/rec-r2204.html (last accessed on 08 August 2025).

54 TSB occurrences R23H0006, R23E0079, and R23V0205.

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.

The issue of regulatory surveillance in rail transportation is a Watchlist 2022 issue. As this occurrence demonstrates, regulatory surveillance has not always proven effective at verifying whether operators are compliant with regulations and able to manage the safety of their operations.

ACTION REQUIRED

Regulatory surveillance will remain on the Watchlist for the **rail transportation sector** until TC oversight assesses and validates that operators' SMSs are effective— that operators are identifying hazards and assessing risks, that effective risk-mitigation measures are being implemented, and that operators are validating the effectiveness of implemented safety actions. When operators are unable to manage safety effectively, TC must demonstrate that it can and does intervene in a way that changes unsafe operating practices.

1.18 TSB laboratory report

The TSB completed the following laboratory report in support of this investigation:

- LP022/2024 – R23D0108-Light Analysis

2.0 ANALYSIS

The data collected during the investigation showed that the 2 crew members on the CN 376 train were fit for duty. No medical or physiological conditions, including fatigue, were found to have affected their performance. The analysis will focus on the sequence of events leading up to the collision between the 2 trains, the mental model and expectations of the train CN 376 crew, visibility of the tail end of train EXO 1212, physical fail-safe defences to ensure compliance with signal indications, power failure, collision damage, locomotive voice and video recorder (LVVR) data, and oversight activities carried out by Transport Canada (TC) and the Canadian National Railway Company (CN).

2.1 The occurrence

On 21 November 2023, at approximately 1827, train X37621-20 (CN 376), consisting of 2 CN locomotives, was travelling southward on the east track of the St-Laurent Subdivision when it collided with the tail end of a stationary Réseau de transport métropolitain (exo) commuter train. When the crew of train CN 376 spotted the tail end of commuter train EXO 1212 at Saint-Léonard–Montréal-Nord station, the locomotive engineer (LE) immediately made an emergency application of the train brakes. Train CN 376 had slowed to about 32 mph when it collided with the tail end of train EXO 1212. Four of the 8 passengers on board train EXO 1212 were injured, as were the 2 crew members. The 2 crew members on board train CN 376 were not injured.

The train's speed when the emergency application of the train brakes occurred (41 mph) made it impossible to stop the train as stipulated by the restricted speed provisions of Rule 436 of the *Canadian Rail Operating Rules* (CROR), i.e., a speed that allows the train to be stopped within half the range of vision of equipment, without exceeding 15 mph.

Findings as to causes and contributing factors

After the emergency brakes were applied on train CN 376, it collided with the tail end of commuter train EXO 1212, which was stopped at Saint-Léonard-Montréal-Nord station. At the time of impact, train CN 376 was travelling at 32 mph.

Before the collision, train CN 376 had entered the same block as train EXO 1212, having passed a Restricting signal (signal 1349E) limiting its speed to 15 mph until the next signal (signal 1363E).

The emergency brakes on train CN 376 were applied when the train was travelling at 26 mph above the maximum allowable speed and was 514 feet from train EXO 1212, which did not leave enough time to stop train CN 376, and it struck the tail end of EXO 1212.

TSB simulations showed that the distance required to stop an exemplar train with the same characteristics as the occurrence train travelling at 15 mph would have been less than 200 feet.

2.2 The mental model and expectations of the train CN 376 crew

Before departing CN's Rivière-des-Prairies Yard, the train CN 376 crew had been informed by the rail traffic controller that they would obtain the required signal indications to leave the yard after the passage of train EXO 1212 on the east track of the St-Laurent Subdivision, heading south. While waiting for the signal to exit the yard, the crew of train CN 376 saw southbound train EXO 1212.

After receiving the signal indication to exit the yard, train CN 376 proceeded southward on the east track. Beyond signal 1349E, the crew operated the train at speeds above the "Restricting" signal indication. This suggests that the crew's mental model was that train EXO 1212 had cleared the block. This mental model was reinforced when the crew saw train EXO 1211 travelling northward on the west track from the controlled location at Montréal-Nord. Once this location was cleared, the train CN 376 crew likely assumed that the main track beyond signal 1364 was clear. Approaching the Saint-Léonard–Montréal-Nord station, the train's speed reached 41 mph, suggesting that this mental model persisted.

Finding as to causes and contributing factors

The crew of train CN 376 likely assumed that the block governed by the Restricting signal indication (signal 1349E) was clear and expected the next signal (signal 1363E) to become permissive for their movement. Therefore, the crew increased the train's speed to 41 mph.

2.3 Visibility of the tail end of train EXO 1212

Train EXO 1212 was stopped at Saint-Léonard–Montréal-Nord station with its end-of-train markers activated. Due to the station's ambient lighting and the railway signals beyond it, the end-of-train markers of train EXO 1212 were not visible from the perspective of the cab of train CN 376's lead locomotive when it was heading toward the station with its headlight set at a lower intensity. It was only when the locomotive lights were set to full power, just over 500 feet from the tail end of the train EXO 1212, that it became visible from the perspective of the locomotive cab of train CN 376. Given the speed at which train CN 376 was travelling at the time, this distance was insufficient to prevent the collision.

Finding as to causes and contributing factors

Due to the ambient lighting conditions at the time of the occurrence, the tail end of train EXO 1212 stopped at the Saint-Léonard–Montréal-Nord station became visible to the crew of train CN 376 only when the locomotive lights were set to full power, just over 500 feet from the other train, which was an insufficient distance to avoid the collision given the train's speed.

2.4 Physical fail-safe defences to ensure compliance with signal indications

The basic design of centralized traffic control (CTC) signalling systems in Canada has been well established for some time. Although newer signal circuitry has been integrated into the CTC system over the years, railway operations still rely predominantly on administrative

defences. Administrative defences, if not supplemented by physical fail-safe defences, place an over-reliance on employees to follow rules and procedures that often do not consider the human factors that affect behaviour.

However, 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. The absence of physical fail-safe defences capable of intervening by stopping a train when operating in CTC territory has been raised by the TSB in its investigation reports since 1995. The TSB has also highlighted the absence of passive warning systems to alert crew members when they approach their limits of authority.

Since 29 December 2020, physical fail-safe defences in the form of positive train control (PTC) technology system have been implemented in the United States on all high-hazard routes, spanning a total of 57 537 miles, which is about 41% of the nearly 140 000 route-miles of the United States rail network. PTC is designed to automatically intervene to stop a train if an operating crew does not respond appropriately to a signal indication. In February 2022, TC published a notice of intent, identifying its intention to require that the highest risk corridors in Canada be equipped with a fail-safe, automatic train protection (referred to as enhanced train control or ETC) in accordance with the objectives in its strategic plan titled *Transportation 2030 – A Strategic Plan for the Future of Transportation in Canada* (*Transportation 2030* strategic plan). In its December 2024 response to TSB Recommendation R22-04, TC stated that it had made significant progress in developing its corridor risk assessment methodology that will guide the implementation of the ETC across the Canadian rail network and that it continued to work with industry and other stakeholders to finalize the methodology. However, details regarding which specific routes would require ETC and what ETC would entail have not been determined. No interim measures to provide physical backup safety defences have been implemented to address the ongoing risk.

In this occurrence, as train CN 376 passed signal 1349E while entering into the block occupied by train EXO 1212, its speed rapidly exceeded the maximum speed of 15 mph prescribed by the “Restricting” indication. This adaptation by the crew members was not corrected, and the train’s speed reached 41 mph by the time emergency braking was applied. An advanced train control system, such as PTC, issues alerts to the LE as soon as the signal’s allowable speed is exceeded. If the LE does not respond to these alerts, the PTC system can initiate a penalty brake application.

Without a physical defence, there was no automatic response to stop train CN 376 when it exceeded the restricted speed indicated by signal 1349E.

Following the TSB’s recommendations on fail-safe physical defences, TC developed the ETC concept and reported that it had begun working with industry partners on several initiatives to advance its implementation:

- In February 2022, TC published a notice of intent outlining the next steps for implementing ETC technologies in Canada, in line with the objectives of its *Transportation 2030* strategic plan.
- In 2023, a risk assessment methodology to guide the implementation of ETC in Canada was developed, and consultations on this issue were undertaken.
- In 2023, guidelines for the interoperability of ETC applications were published by the Canadian Standards Association (CSA).

As of the release of this report, several of the above-mentioned measures had not yet been completed by TC. The scope and complexity of some of these critical actions may require several years to complete, calling into question TC's anticipated timeline outlined in its *Transportation 2030* strategic plan. Consequently, for the coming years, there will be few or no physical defences to stop a train when a crew fails to follow a signal indication.

Finding as to risk

If train control systems rely solely on administrative defences, there will be no automatic intervention to stop trains if train crews fail to follow signals or misinterpret them, increasing the risk of accidents.

2.5 Power failure

The collision also caused a power failure affecting train EXO 1212.

The emergency batteries in car EXO 3062 were dislodged from their mountings, and the car's emergency power system could not take over. As a result, the car's emergency lighting, electric door openers, and emergency intercom system failed.

Control car EXO 3008, from which the LE was operating the train, also lost power for a reason that could not be determined with certainty. As a result, this car's railway radio was no longer operational, and the LE could not make emergency calls using this equipment following the occurrence.

During an emergency, safety-critical equipment on board trains (e.g., emergency lighting, intercom system, and radio communication equipment) must remain functional and accessible.

Finding as to risk

If safety-critical equipment on board passenger trains becomes inoperative following an accident, implementing the necessary emergency measures could be compromised, affecting the safety of passengers and onboard personnel.

2.6 Collision damage

During a collision, the deformation of the rolling stock's frame can be beneficial since energy is absorbed and dissipated instead of being transmitted directly to the occupants. Bombardier 3000 Series cars comply with the United States Federal Railroad

Administration regulations, the American Public Transportation Association technical standards, and the additional special requirements of the New Jersey Transit Authority.

Although not equipped with an energy management system in the event of a collision, Bombardier 3000 Series cars are designed so that their ends deform before the passenger area, between the body crossmembers and the boarding area.

In the collision, locomotive EXO 1346 and the 1st passenger car (EXO 3062) sustained the most deformations. The damage to car EXO 3062 was limited to the boarding area (vestibule and intermediate areas). The car's structure performed as designed: the multilevel central area, designated for passengers, was not visibly deformed, and all the car's windows remained intact.

Finding: Other

Following the collision, the structure of car EXO 3062 performed within its design parameters.

2.7 Locomotive voice and video recorder

Data recorded by LVVRs provide TSB investigators with additional information on the causes and contributing factors of accidents or incidents. They help to determine, objectively and reliably, the role of human factors in a railway occurrence. This information can help determine whether corrective measures are required to improve rail safety in Canada. Therefore, it is essential that LVVR system equipment be operational and in unaltered working order at all times.

In this occurrence, the 2 voice and video recording system cameras on the lead locomotive of train CN 376 had been obstructed with sheets of paper and therefore could not capture video images inside the cab. This issue was discovered by the TSB when analyzing LVVR data collected as part of the investigation. Current regulations prohibit tampering with LVVRs.

Without video data from the LVVR system, the TSB's analysis of some of the activities that could have occurred on board the locomotive in the minutes leading up to the occurrence may be limited. For example, it was impossible to determine whether there were distractions and whether the crew members were at their designated workstations. In this occurrence, because the voice recording was not affected, the conversations between the crew members were audible, enabling the TSB to confirm its analysis of the sequence of events leading up to the collision despite the absence of video images.

Finding: Other

The video and voice recording system cameras on the lead locomotive of train CN 376 had been obstructed and therefore could not capture video images from inside the cab, which

limited the analysis of the crew members' activities in the minutes leading up to the occurrence.

2.8 Oversight activities

TC's regulatory oversight activities consist of ensuring that railways' employees perform their work in accordance with the *Railway Safety Act* and the CRORs. To this end, TC performs inspections and audits in the field. When deviations are identified, TC requires railway companies to provide an action plan and implement the necessary corrective measures.

TC's oversight activities regarding the *Locomotive Voice and Video Recorders Regulations* consist primarily of verifying that LVVR equipment is installed correctly on locomotives, that the equipment has not been tampered with, and that privacy protections are respected. TC does not randomly sample data captured by LVVR systems for these checks. As a result, situations similar to this occurrence, where onboard LVVR system hardware had been tampered with, may not be identified by TC.

For its part, CN also carries out oversight activities with its employees under its safety management system, notably through its Performance Monitoring and Rules Compliance program. These activities generally involve checking employees' compliance with rules, regulations, and special instructions when performing their work.

In addition, CN randomly samples data captured by LVVR systems in accordance with the *Locomotive Voice and Video Recording Regulations*. CN uses this data for trend analysis to improve safety. As stipulated in the regulations, when specific threats to safe railway operations are observed, CN may also use this data to address these threats and take appropriate action.

During oversight activities carried out by TC inspectors or CN supervisors, compliance rates near 100% were observed when employees were, in most cases, directly shadowed and observed as they performed their duties.

However, when CN analyzed random samples of the data captured by the LVVR systems when employees were not observed in real time, the compliance rate for one of the specific threats to safe railway operations[55] was around 75%.

This discrepancy between the 2 methods suggests that direct monitoring activities may lead to greater motivation on the part of employees, temporarily improving their performance and compliance with the rules in force when carrying out their duties. This motivation effect, known as the "Hawthorne effect,"[56] occurs when employees change their behaviour

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55 Duty of crew members to verbally communicate required information.

56 J.G. Adair, "Hawthorne effect" in A.E. Kazdin (Ed.), *Encyclopedia of Psychology* Vol. 4, Oxford University Press, p. 66.

once they realize they are being observed performing their duties. This could distort the results of direct monitoring activities and bias their validity.

The likelihood of identifying safety issues decreases when employees know they are being directly observed. This situation may prevent the identification of potential safety violations, including intentional deviations and routine adaptations, from being identified that might otherwise have occurred.

Therefore, it is important that the Hawthorne effect be considered when developing and implementing monitoring measures.

Finding: Other

TC's approach to compliance verification could affect the reliability of inspection and verification results, thereby reducing the likelihood of identifying potential safety deficiencies.

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. After the emergency brakes were applied on train CN 376, it collided with the tail end of commuter train EXO 1212, which was stopped at Saint-Léonard-Montréal-Nord station. At the time of impact, train CN 376 was travelling at 32 mph.

2. Before the collision, train CN 376 had entered the same block as train EXO 1212, having passed a Restricting signal (signal 1349E) limiting its speed to 15 mph until the next signal (signal 1363E).

3. The emergency brakes on train CN 376 were applied when the train was travelling at 26 mph above the maximum allowable speed and was 514 feet from train EXO 1212, which did not leave enough time to stop train CN 376, and it struck the tail end of EXO 1212.

4. The crew of train CN 376 likely assumed that the block governed by the Restricting signal indication (signal 1349E) was clear and expected the next signal (signal 1363E) to become permissive for their movement. Therefore, the crew increased the train's speed to 41 mph.

5. Due to the ambient lighting conditions at the time of the occurrence, the tail end of train EXO 1212 stopped at the Saint-Léonard–Montréal-Nord station became visible to the crew of train CN 376 only when the locomotive lights were set to full power, just over 500 feet from the other train, which was an insufficient distance to avoid the collision given the train's speed.

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 train control systems rely solely on administrative defences, there will be no automatic intervention to stop trains if train crews fail to follow signals or misinterpret them, increasing the risk of accidents.

2. If safety-critical equipment on board passenger trains becomes inoperative following an accident, implementing the necessary emergency measures could be compromised, affecting the safety of passengers and onboard personnel.

3.3 Other findings

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

1. Following the collision, the structure of car EXO 3062 performed within its design parameters.

2. The video and voice recording system cameras on the lead locomotive of train CN 376 had been obstructed and therefore could not capture video images from inside the cab, which limited the analysis of the crew members' activities in the minutes leading up to the occurrence.

3. Transport Canada's approach to compliance verification could affect the reliability of inspection and verification results, thereby reducing the likelihood of identifying potential safety deficiencies.

4.0 SAFETY ACTION

4.1 Safety action taken

4.1.1 Transportation Safety Board of Canada

On 22 December 2023, the TSB sent Rail Transportation Safety Advisory Letter 07/23 to Transport Canada (TC) regarding the obstruction of the locomotive voice and video recorder (LVVR) cameras. The TSB recommended that TC ensure the LVVR systems remain operational at all times to capture the required data.

On 27 February 2024, the TSB sent TC Rail Transportation Safety Advisory Letter 01/24 regarding recent collisions involving trains operating under Restricting signal indications in CTC territory. The TSB recommended that TC work with the rail industry to address the limitations of existing administrative defences.

4.1.2 Transport Canada

In its response to Advisory Letter 07/23, dated 26 March 2024, TC stated that it had undertaken a compliance inspection in response to the TSB's Safety Advisory Letter. As part of its ongoing oversight, TC has asked that the Canadian National Railway Company (CN) implement mitigation measures to ensure LVVRs are clear of obstructions before locomotives are operated.

In its response dated 14 May 2024, to Safety Advisory 01/24, TC stated that it had promptly conducted compliance inspections upon notification of each occurrence. In each case, violations of Rule 436 of the *Canadian Rail Operating Rules* were identified, resulting in the issuance of non-compliance letters. TC continues to actively engage with the railways to ensure that appropriate corrective measures have been taken and will actively engage in constructive dialogue with industry stakeholders to explore potential mitigation solutions.

4.1.3 Canadian National Railway Company

On 12 December 2023, CN issued a system operating bulletin amending the instructions on critical focus zones (CFZ). CFZ now also applies when a train is operating at restricted speed.

On 12 April 2024, in response to a letter from TC regarding the compliance inspection, CN stated that, before this occurrence, it was already concerned about the obstruction of LVVR cameras. Accordingly, on 18 August 2023, CN issued Circular 938-23 about the obstruction of LVVR cameras.

On 29 May 2024, CN issued another circular to train crews, indicating that they must now inspect LVVR cameras on their train's lead locomotive before operating the movement. If any obstructions are found, they must be removed, and the situation must be reported immediately to the appropriate authority. Employees found to have tampered with LVVR

cameras or operating a locomotive with tampered or obstructed LVVR cameras will be subject to appropriate follow-up action.

4.2 Safety action required

On 21 November 2023, train CN 376, travelling south on the east main track of the St-Laurent Subdivision, passed a Restricting signal located approximately 1 mile from Saint-Léonard–Montréal-Nord station, where commuter train EXO 1212 was stopped.

After passing the signal, train CN 376's speed increased to 41 mph, 26 mph above the maximum speed allowed by the Restricting signal. When train CN 376 was approximately 514 feet from commuter train EXO 1212, the emergency brakes were applied and train CN 376 collided with the tail end of the commuter train at approximately 32 mph.

Four of the 8 passengers on board train EXO 1212 and the 2 crew members suffered minor injuries.

The investigation established the following facts:

- Before the collision, train CN 376 passed a Restricting signal that restricted its speed to 15 mph until the next signal.
- The crew of train CN 376 likely assumed that the block governed by the Restricting signal indication was clear and expected the next signal to become permissive for their movement.
- The emergency brakes on train CN 376 were applied when the train was travelling at 26 mph above the maximum speed permitted by the Restricting signal indication. Train CN 376 was unable to stop in time and struck the tail end of EXO 1212 at approximately 32 mph

4.2.1 Physical fail-safe train controls

The Canadian railway system relies primarily on administrative defences, such as regulations, instructions, and procedures, to ensure the safety of operations. These administrative defences depend on train crews complying with the rules. In situations where a train crew misperceives, misinterprets or fails to comply with a signal indication, all of these defences fail.

As demonstrated by this occurrence and other recent occurrences[57] involving failure to obey signal indications, when an administrative defence fails and there is no additional physical defence built into the system, a preventable accident can occur. This occurrence took place on a subdivision considered a key route for commuter, passenger, and freight trains, some of which carry dangerous goods. There was no automatic intervention to stop

[57] TSB railway transportation safety occurrences R24D0070, R24T0064, R24C0020, R23V0205, R23E0079, and R23H0006.

train CN 376 after it exceeded the allowable speed in the block before colliding with the tail end of train EXO 1212.

Since December 2020, the United States has made it mandatory to use positive train control (PTC), an automatic control system that can intervene to stop a train if it fails to comply with train operating requirements, thereby preventing collisions, derailments, and other accidents.

In Canada, the TSB made 2 recommendations in 2000 and 2013 (R00-04 and R13-01, respectively) urging TC to adopt physical, fail-safe defences. Although several initiatives and projects were launched to design and develop such a system in Canada, few meaningful steps have been taken. In 2022, following its investigation into a collision between 2 CN trains in 2019 near Portage la Prairie, Manitoba, the TSB recommended that

> the Department of Transport require major Canadian railways to expedite the implementation of physical fail-safe train controls on Canada's high-speed rail corridors and on all key routes.
>
> **TSB Recommendation R22-04**

On 17 April 2024, following 3 other occurrences under investigation, the TSB sent a letter to the Minister of Transport regarding the absence of physical fail-safe controls for trains operating in Canada. In its letter, the TSB urged the Minister of Transport to accelerate the implementation of such a system in Canada's high-speed rail corridors and on all key routes across the country. As of the release of this report, the TSB had not yet received a response.

In February 2022, TC issued a notice of intent indicating that it intended to require Canada's most at-risk corridors to be equipped with an automatic train protection system (known as enhanced train control, or ETC) in accordance with the objectives of its strategic plan entitled *Transportation 2030: A Strategic Plan for the Future of Transportation in Canada* (*Transportation 2030* strategic plan). In December 2024, TC announced that it planned to draft regulations in 2025 for publication in Part I of the *Canada Gazette* in 2026. However, details regarding the specific rail corridors and routes that would require an ETC system and the final configuration of such a system have not yet been determined, and safety regarding rail traffic in Canada continues to rely solely on administrative defences.

As a result, if train control systems rely solely on administrative defences, trains cannot be automatically stopped in the event of non-compliance with signal indications, which increases the risk of accidents.

Given recent events involving crews not following signal indications that continue to occur in Canada, the TSB urges TC to expedite efforts to adopt fail-safe physical defences for trains, particularly on high-speed corridors and key routes, to better protect passengers, property, and the environment.

Accordingly, the TSB is reiterating Recommendation R22-04.

4.2.2 Additional interim measures

In response to Recommendation R22-04 and other TSB recommendations regarding fail-safe physical defences, TC developed the ETC concept and reported that it had begun working with industry partners on several measures to advance its implementation. In February 2022, TC published a notice of intent outlining the next steps for implementing ETC technologies in Canada.

In 2023, a risk assessment methodology to guide the implementation of ETC in Canada was developed, and consultations on this issue were undertaken. This methodology assesses various factors, including passenger service, annual gross tonnage, and the status of key routes. The same year, guidelines for the interoperability of ETC applications were published by the Canadian Standards Association (CSA).

According to TC, draft regulations for the implementation of ETC technologies in Canada are expected to be pre-published in the *Canada Gazette*, Part I, in 2026. TC also stated that the ETC implementation schedule will depend on the development of regulations.

Current administrative defences rely solely on train crews recognizing and complying with signal indications. However, numerous TSB investigations have identified various circumstances in which these administrative defences have failed. As highlighted in Rail Safety Advisory 01/24 and the letter to the Minister of Transport, the risks associated with failure to comply with signal indications remain high, and it is unlikely that the level of risk will be significantly reduced before physical fail-safe defences are implemented.

However, in recent years, several railway companies operating in Canada have, on their own initiative, introduced measures to partially compensate for the absence of such regulations by TC. Some companies have added additional administrative defences, while at least one other has integrated satellite geolocation technology (GPS).

For example, in order to reduce and eliminate distractions when a movement approaches a safety-critical situation, VIA Rail Canada Inc. and Canadian National Railway Company (CN) have each implemented the CFZ. This is a set of special procedures to be applied when crew vigilance is of the utmost importance. When a CFZ is in effect, employees in the cab of a controlling locomotive must cease all communication and other tasks not related to the immediate operation of the train.

Following this occurrence, CN extended CFZ conditions to include situations where trains are required to operate at restricted speed. To be effective, however, CFZs require team members to recognize the conditions that place them in these situations. CFZs are therefore subject to the same limitations as other administrative defences in place.

CN also introduced a new special instruction under CROR Rule 411.[58] From now on, freight trains must reduce their speed by 10 mph below the maximum allowable speed when approaching a Clear to Stop signal, starting before passing the signal.

For its part, the QNS&L Railway has implemented a combined administrative and physical defence system, introducing proximity detection devices (PDDs) in 1997. PDDs are equipped with GPS to determine the position, direction, and speed of locomotives and maintenance vehicles equipped with these devices. They are configured to receive alerts of approaching movements. The conductors of both movements must confirm on a screen that they have acknowledged the alert and must communicate with each other by radio to verify their respective positions. A penalty brake is automatically applied to the locomotive of a train whose crew has not acknowledged receipt of the alert. Despite this technology, a PDD will not prevent a collision if the train crew acknowledges receiving an alert without reducing speed or stopping the train in time.

These examples of initiatives implemented by some railway companies are a step in the right direction pending the implementation of the ETC, which TC has stated it intends to implement in accordance with the objectives of its *Transportation 2030* strategic plan.

As of the release of this report, TC had not yet completed many of the necessary steps to implement the ETC in Canada, including corridor risk assessments. Given the scope and complexity of some of these critical actions, it is unlikely that such a system will be developed and implemented within the next few years. If train control systems rely solely on administrative defences, there will be no automatic intervention to stop trains if train crews fail to follow signals or misinterpret them, increasing the risk of accidents.

Pending the implementation of the ETC in Canada, no interim measures are required or planned by TC to reduce the risk of train collisions. Consequently, in the coming years there will be few or no regulatory physical defences to stop a train when a crew fails to follow a signal indication.

The Board therefore recommends that

> the Department of Transport immediately implement additional interim measures to mitigate the risks associated with train crews not complying with railway signal indications, such as collisions between trains, until adequate and permanent physical fail-safe defences are implemented.
>
> **TSB Recommendation R25-01**

58 Rule 411: Clear to Stop - Proceed, preparing to stop at next signal.

This report concludes the Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 04 June 2025. It was officially released on 16 September 2025.

Visit the Transportation Safety Board of Canada's website (www.tsb.gc.ca) for information about the TSB and its products and services. You will also find the Watchlist, which identifies the key safety issues that need to be addressed to make Canada's transportation system even safer. In each case, the TSB has found that actions taken to date are inadequate, and that industry and regulators need to take additional concrete measures to eliminate the risks.

APPENDICES

Appendix A — Sequence of events

Table A1 summarizes the sequence of events.

Time*	Occurrence
1636:24	Train CN 376 leaves Dorval Station, heading east. The locomotive engineer (LE) and conductor had relieved the previous train crew.
1717 (approx.)	Train EXO 1212 leaves Mascouche Station, heading south on the Mascouche and St-Laurent subdivisions to Ahuntsic Station.
1729:07	Train CN 376 arrives at CN Rivière-des-Prairies Yard.
1804:24	The CN 376 train crew informs the rail traffic controller that it is ready to depart from the Rivière-des-Prairies Yard.
1813:30	Train EXO 1212 passes the RDP Nord (Rivière-des-Prairies Nord) controlled location.
1814 (approx.)	Train EXO 1211 leaves Ahuntsic Station, heading north on the St-Laurent and Mascouche subdivisions to Mascouche Station.
1817:35	Train CN 376 passes the RDP Nord controlled location southbound on the east track with a Clear to Stop indication on signal 1321E.
1820:41	The Stop indication on signal 1333E at the RDP Sud controlled location (Rivière-des-Prairies Sud) changes to a Clear to Stop indication.
1821:48	Train CN 376 reaches 50 mph near Mile 134.0.
1822:52	Southbound train EXO 1212 stops at the Saint-Léonard–Montréal-Nord station platform on the east track. The train's automatic brakes are applied.
1823:55	Speed of train CN 376 is reduced to 4.5 mph approximately 100 feet before intermediate signal 1349E displaying a Restricting indication.
1825:08	Signal 1363E at the Montréal-Nord controlled location is visible to the CN 376 crew in the distance. It is displaying a Stop indication.
1826:21	Northbound train EXO 1211 stops at the Saint-Léonard–Montréal-Nord Station platform on the west track. The intensity of the lead locomotive headlight had been reduced earlier before reaching the locomotive of train EXO 1212.
1826:25	The throttle handle on the lead locomotive of train CN 376 is moved to position 8.
1826:27	The intensity of the lead locomotive headlight on train CN 376 is reduced.
1826:38	The lead locomotive headlight on train EXO 1211 is switched off.
1826:56	Signal 1363E at the Montréal-Nord controlled location changes to a Clear indication.
1826:57	Train CN 376's lead locomotive reaches train EXO 1211's locomotive.
1826:58	Train CN 376 lead locomotive headlight is restored to full power.
1827:01	Emergency braking on train CN 376 is activated. The train is travelling at 41 mph.

Time*	Occurrence
1827:09	The LE of train CN 376 activates the locomotive horn as the train collides with the tail end of train EXO 1212. Train CN 376 is travelling at 32 mph.
1827:10	A train-initiated emergency brake application occurs on train EXO 1212.
1827:18	The 2 trains come to rest about 150 feet south of the point of impact.
1828 (approx.)	The LE of train EXO 1211 makes an emergency call.
1834:37	First responders arrive on the scene.

* Events for which the exact time or circumstances could not be verified are indicated by "approx."