



FOLLOWING RAILWAY SIGNAL INDICATIONS

Train crews do not consistently recognize and follow railway signals. This poses a risk of train collisions or derailments that can have catastrophic consequences.

The situation

The rail transportation system is complex. The defence-in-depth philosophy advanced by safety specialists for complex systems seeks multiple and diverse lines of defence to mitigate the risks of normal human errors. However, for over a century, Canada has relied on a system of visual signals to control traffic on a significant portion of its rail network. These signals convey direction such as operating speed and the operating limits within which a train is permitted to travel.

Train crews are required to identify and communicate the signal indications among themselves, and then take appropriate action in how they operate the train. Sometimes, however, train crews miss (do not observe or react to) a signal indication, which may result in the signals not being followed and a train exceeding its limits of authority. In the absence of physical fail-safe defences, this could result in a collision or a derailment.

How often does this happen?

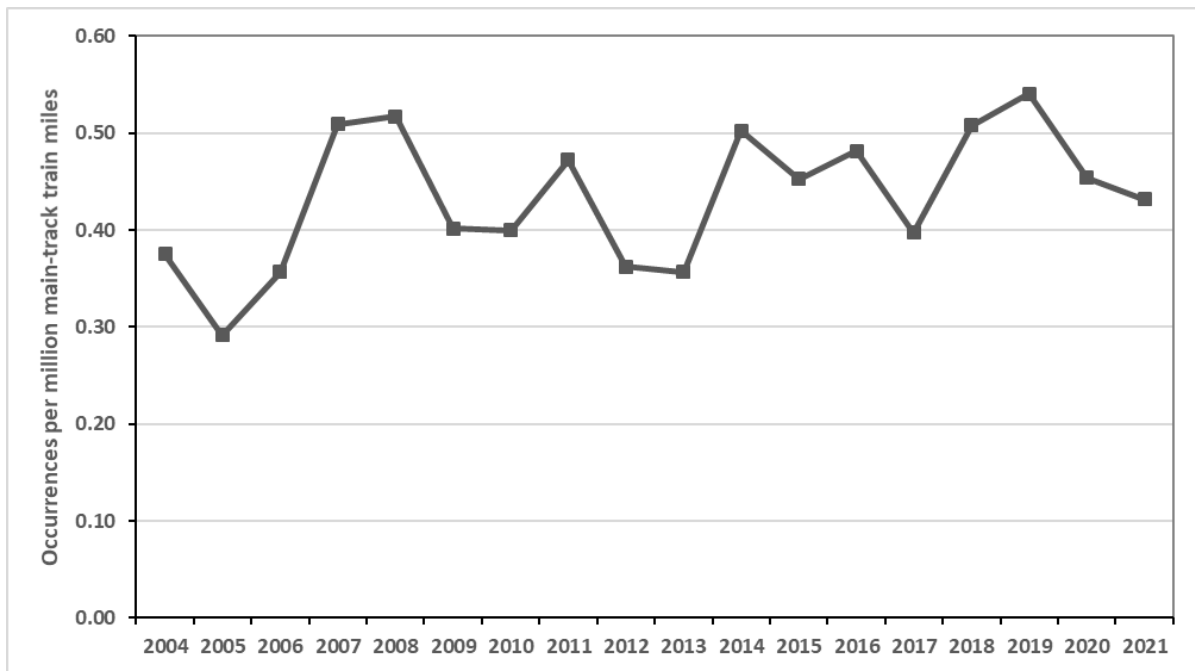
From 2004 to 2021, there has been an annual average of 35 reported occurrences, or 0.43 reported occurrences per million main-track train miles (Figure 1), in which a train crew did not respond appropriately to a signal indication displayed in the field.¹ Although the rate for 2019 showed a slight increase, the rate of occurrences in 2020 and 2021 returned to the long-run average. There is no statistically significant trend in the data.

¹ The data for train crews not responding appropriately to a signal indication displayed in the field have been updated by the Transportation Safety Board of Canada (TSB) to include occurrences that took place while operating on "other than main track" and that resulted in the rolling stock fouling or entering the main track, leading to the risk of a potential main-track collision.





Figure 1. Rail transportation occurrences involving missed signals per million main-track train miles, 2004 to 2021 (Source: TSB)



The risks to people, property, and the environment

This issue has been on the Watchlist since 2012. Although the probability of a missed signal leading to a train collision or derailment may be low, the consequences of such an accident could be catastrophic for people, property, and the environment.

From 1990 to 2021, the Transportation Safety Board of Canada (TSB) investigated 80 occurrences that could have been prevented using a physical fail-safe defence such as enhanced train control (ETC). These occurrences resulted in

- 53 derailments (530 derailed rolling stock);
- 41 train collisions (of which 35 resulted in a derailment);
- 8 fatalities; and
- 318 injuries to employees and passengers.



Active TSB recommendations

Over the years, missed train signals has been cited as a cause or contributing factor in numerous rail investigations conducted by the TSB.² In the United States (U.S.), the National Transportation Safety Board has investigated similar accidents and concluded that additional physical defences were required.³

The TSB has made three recommendations on following railway signal indications,⁴ in 2000, 2013, and 2022. Since 2013, Transport Canada (TC) and the railway industry have been discussing the framework needed to address the issue, yet the work is not sufficiently advanced to indicate when additional physical safety defences will be implemented.

TSB Recommendation [R00-04](#), which recommended the implementation of additional backup safety defences to help ensure that signal indications are consistently recognized and followed, was last reassessed as **Satisfactory in Part** in March 2021 and assigned a Dormant status. It will be reassessed in accordance with TSB Recommendation R13-01, which calls for the implementation of physical fail-safe train controls, beginning with Canada's high-speed rail corridors.

TSB Recommendation [R13-01](#) was last assessed in March 2022 as being **Satisfactory in Part**. The Board stated that while TC has indicated that ETC implementation will target specific corridors under a risk-based approach, specific details remain unknown. The Board strongly encouraged TC and the Railway Association of Canada to accelerate the pace of ETC implementation.

TSB Recommendation R22-04, which calls for expediting the implementation of physical fail-safe train controls on Canada's high-speed rail corridors and all key routes, was issued in August 2022 and has not yet been assessed.

Action taken

Issues on the Watchlist are complex and difficult to solve, requiring action from many stakeholders, including operators and the regulator. Although some steps may have been taken, more needs to be done. These are some of the steps that have been taken to date.

Some railways in Europe have train control systems such as ETC that will generate an alarm in the locomotive cab if the train crew does not respond appropriately to a signal. Such a system still relies

² TSB rail transportation safety investigation reports [R19W0002](#), [R18D0096](#), [R16T0162](#), [R16E0051](#), [R15D0118](#), [R15V0183](#), [R14T0294](#), [R13C0049](#), [R12T0038](#), [R11E0063](#), [R10Q0011](#), [R10V0038](#), [R09V0230](#), [R07E0129](#), [R99T0017](#), and [R98V0148](#).

³ U.S. National Transportation Safety Board accident reports RAB-06-07, RAR-07-01, RAR-09-01, RAR-16-03, RAB-17-04, RAB-17-08, and RAB-19-02.

⁴ TSB recommendations R00-04, R13-01, and R22-04.



on the train crew for compliance but can include “a static display of track infrastructure, speed limits and operating restrictions, and provide a dynamic display of current train location”⁵ with audible or visual alarms but without positive enforcement. Positive train control (PTC),⁶ where the system will stop a train if the train crew does not respond appropriately to a signal, has been fully implemented in the U.S. since 31 December 2020, including on U.S. trackage owned by the Canadian National Railway Company (CN) and Canadian Pacific Railway Company (CP). Both CN and CP have equipped their locomotives with on-board systems and route miles with the required PTC equipment.

In Canada, although there are no ETC systems in use by federally regulated freight or passenger railways, ETC technology has been implemented by many commuter rail services. In 2016, the final report issued by a joint TC–industry working group on train control concluded that a targeted, risk-based, corridor-specific implementation of train control technologies would be the best option for Canada.⁷

On 05 February 2022, TC published a Notice of Intent in the *Canada Gazette*, Part I outlining a risk-prioritization approach for the implementation of ETC in Canada, beginning with higher-speed mixed traffic corridors. Work is also being progressed to develop in-cab warning systems, to establish a National Technical Specification on interoperability and to understand the radio spectrum needs for ETC. Despite this ongoing work and the increased awareness of the need for additional backup safety defences, no interim measures have been implemented to address the ongoing risk.

Action required

This issue 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.

⁵ *Train Control Working Group Final Report Presented to the Advisory Council on Railway Safety* (September 2016), p. 1, at https://www.tc.canada.ca/sites/default/files/migrated/train_control_working_group_final_report.pdf (last accessed on 25 August 2022).

⁶ PTC is a communication-based train control system in the U.S. mandated by the implementation of the *Rail Safety Improvement Act of 2008*. The system monitors train movements and intervenes to stop a train if a train crew is not responding appropriately in order to prevent main-track train collisions, overspeed train derailments, the operation of a train through an improperly lined switch, and the incursions of a train into working limits. (Source: U.S. Department of Transportation, “Positive Train Control (PTC)” at <https://railroads.dot.gov/train-control/ptc/positive-train-control-ptc> (last accessed on 25 August 2022).

⁷ *Train Control Working Group Final Report Presented to the Advisory Council on Railway Safety* (September 2016), p. 4, at https://www.tc.canada.ca/sites/default/files/migrated/train_control_working_group_final_report.pdf (last accessed on 25 August 2022).