



TSB Recommendation R13-01

Physical fail-safe train controls

The Transportation Safety Board of Canada recommends that the Department of Transport require major Canadian passenger and freight railways implement physical fail-safe train controls, beginning with Canada's high-speed rail corridors.

Rail transportation safety investigation report	R12T0038
Date the recommendation was issued	10 June 2013
Date of the latest response	January 2023
Date of the latest assessment	March 2023
Rating of the latest response	Satisfactory in Part
File status	Dormant

Summary of the occurrence

On 26 February 2012, VIA Rail Canada Inc. (VIA) passenger train No. 92 (VIA 92) was proceeding eastward from Niagara Falls to Toronto, Ontario, on track 2 of the Canadian National Railway Company Oakville Subdivision near Burlington, Ontario. VIA 92, which was operated by 2 locomotive engineers and a locomotive engineer trainee, was carrying 70 passengers and a VIA service manager. After a stop at the station at Aldershot, Ontario (Mile 34.30), the train departed on track 2. The track switches were lined to route the train from track 2 to track 3, through crossover No. 5 at Mile 33.23, which had an authorized speed of 15 mph. At 1525:43 Eastern Standard Time, VIA 92 entered crossover No. 5 while travelling at about 67 mph. Subsequently, the locomotive and all 5 coaches derailed. The locomotive rolled onto its side and struck the foundation of a building adjacent to the track. The operating crew was fatally injured and 45 people (44 passengers and the service manager) sustained various injuries. The locomotive fuel tank was punctured and approximately 4300 litres of diesel fuel was released.

The Board concluded its investigation and released report R12T0038 on 10 June 2013.

Rationale for the recommendation

In order to assure safety, modern transportation systems need robust defences to effectively prevent accidents. Defences can be administrative or physical. Administrative defences for example are regulations, operating procedures, supervision and training. Physical defences could include alarms and warnings in the cab, or a physical means of stopping the train.

The concept of “defence in depth” has been prevalent in the safety world for many years. Layers of defences or redundancy have proven to be a successful approach in many industries, including the nuclear industry, to ensure a single-point failure does not lead to catastrophic consequences. In the rail industry, in addition to administrative defences and wayside signals in centralized traffic control (CTC) system territory, some railways have long since been equipped with additional physical fail-safe train control defences. These additional defences have the ability to alert the operating crew members if they do not correctly read or respond appropriately to a signal or other restriction and some can intervene to slow or stop the train.

Transport Canada (TC) and industry should move forward with a strategy that will prevent accidents like the one at Aldershot, Ontario, by ensuring signals, operating speeds and operating limits will always be followed. Therefore, the Board recommended that

the Department of Transport require major Canadian passenger and freight railways implement physical fail-safe train controls, beginning with Canada's high-speed rail corridors.

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Previous responses and assessments

September 2013: response from Transport Canada

Transport Canada (TC) accepts the recommendation. TC proposes that the Advisory Council on Rail Safety (ACRS) establish a working group with representatives from the railways, the unions and TC to study the issue of fail-safe train control systems for Canada's railways, with a special focus on the high-speed rail corridors and to provide TC with options and recommendations as to how to address this issue in a written report by April 30, 2014.

October 2013: TSB assessment of the response (Satisfactory in Part)

This recommendation is related to the TSB Watchlist issue of “Following railway signal indications” which sets out the risk of serious train collision or derailment if railway signals are not consistently recognized and followed.

TC has accepted the recommendation and will request a study and a written report by the ACRS. TC has indicated that the ACRS will be given a very specific mandate and timeline. The Board expects that the Department will provide a strong mandate with clear outcomes so that this process will guide the railway industry towards action to mitigate this deficiency.

However, the effect of TC's initiative cannot be fully known until the ACRS report has been filed, the options and recommendations are made public, and a decision to move forward with concrete actions is announced by TC. At this time, TC's response does not provide a clear plan to mitigate the safety deficiency. Therefore, the Board considers the response to Recommendation R13-01 to be **Satisfactory in Part**.

March 2014: response from Transport Canada

TC has formed a working group under the auspices of ACRS to focus on options with regard to train control systems. The first meeting of the working group was held on 15 January 2014 to review the draft terms of reference for the project.

The working group held another meeting at the end of February to discuss the scope of work, including a research component with TC's Railway Research Advisory Board (RRAB). This work will include an environmental scan of existing technologies. A progress report, including a work plan with timelines, will be presented at ACRS in spring 2014.

April 2014: TSB assessment of the response (Satisfactory in Part)

This recommendation is related to the TSB Watchlist issue of "Following railway signal indications", where there is a risk of serious train collision or derailment if railway signals are not consistently recognized and followed. It is also linked to Recommendation R00-04, in which the Board recommended that the railway industry implement additional backup safety defences to help ensure that signal indications are followed.

The working group has begun a process that may lead to positive safety action. However, the process may take significant time to produce any positive results. The original response called for options and recommendations in a written report by 30 April 2014, and the latest response only undertakes to provide a work plan with timelines and gives no projected date for further action. The risk of a serious train collision or derailment occurring in the absence of physical fail-safe train controls continues. Therefore, the Board considers the response to Recommendation R13-01 to be **Satisfactory in Part**.

February 2015: response from the Railway Association of Canada

A framework for working groups must be established by ACRS for the Train Control Working Group to address confidentiality concerns. Nonetheless, RAC and industry are actively working with this working group. The RAC and industry are also active in research to advance technology in this area, including research by the Railway Research Advisory Board. VIA is moving forward on various initiatives with its rail and union partners and continues to develop and implement its technological support and controls for its GPS Train Safety System program.

Industry believes that Locomotive Voice and Video Recorders (LVVR) will provide an important safety defence with regards to this issue and is actively working with the TSB and TC to have them remove the hurdles that would prevent this from being used effectively. RAC has

completed consultation on a rule addressing the handling of LVVR if the system is used by industry.

February 2015: response from Transport Canada

The ACRS Working Group will study the issue of fail-safe train control systems for Canada's railways, with a special focus on the high-speed rail corridors and will provide TC with options and recommendations as to how to address this issue in a written report.

Three research projects were initiated in 2014: an evaluation of the cognitive and human factors aspects of signal recognition and following, including cognitive vulnerabilities of the task and an overview of mitigating strategies and their effectiveness; a literature review of existing technologies including their capabilities, vitality and miles of use in revenue service; and a literature review of the human factors considerations of train control automation in the cab including an analysis of accidents where train control technology did not successfully prevent the occurrence.

The findings from these studies will be included in the final Working Group's report, which is expected to be presented to ACRS in the fall of 2015.

March 2015: TSB assessment of the responses (Satisfactory in Part)

This recommendation is related to the TSB Watchlist issue of "Following railway signal indications", where there is a risk of serious train collision or derailment if railway signals are not consistently recognized and followed. It is also linked to Recommendation R00-04, in which the Board recommended that the railway industry implement additional backup safety defences to help ensure that signal indications are followed.

The ACRS Working Group will provide TC with a written report on options and recommendations to address this issue by the fall of 2015. Action has been initiated to study the deficiency which could yield an appropriate solution in the long term. However, while the issue is being studied, there are no short-term plans to address the risk of serious train collision or derailment in the absence of physical fail-safe train controls.

The Railway Association of Canada (RAC) indicates that locomotive voice and video recorders will provide an important safety defence with regards to this issue. Although there will be safety benefits with these recorders, the Board cautions that the defence in-depth concept of system safety design cannot be satisfied solely through additional layers of crew monitoring. It is only through the use of additional layers of physical defences that the risk of serious train collision or derailment can be effectively mitigated. Therefore, the Board considers the responses to the recommendation to be **Satisfactory in Part**.

January 2016: response from the Railway Association of Canada

The RAC and industry are actively working with the ACRS working group. The RAC and industry are also active in research to advance technology in this area, including research by the Railway

Research Advisory Board. VIA is moving forward on various initiatives with its rail and union partners and continues to develop and implement its technological support and controls for its GPS Train Safety System program. Industry believes that LVVR will provide important information on why such incidents occur, as well as serve as a safety defence with regards to this issue. Industry is actively working with the TSB and TC on the LVVR Safety Study.

January 2016: response from Transport Canada

In 2014, 3 research projects had been initiated by the working group under the auspices of the Advisory Council on Railway Safety (ACRS) to focus on options with regard to train control systems: 1) An evaluation of the cognitive and human factors aspects of signal recognition and following including cognitive vulnerabilities of the task and an overview of mitigating strategies and their effectiveness; 2) A literature review of existing technologies including their capabilities, reliability and miles of use in revenue service; and 3) A literature review of the human factors considerations of train control automation in the cab including an analysis of accidents where train control technology did not successfully prevent the occurrence.

In 2015, the working group completed the first two phases of its work plan which consisted of a field study of missed signals by rail crews and two literature reviews (i.e., Technical Overview of Existing Technologies and Human Factors Literature Review). The third phase (i.e., Generating and evaluating options) and the fourth phase (i.e., Preparing recommendations and the final report) are underway. The final report from the working group will be presented to ACRS in spring 2016.

March 2016: TSB assessment of the responses (Satisfactory in Part)

This recommendation is related to the TSB Watchlist issue of “Following railway signal indications”, where there is a risk of serious train collision or derailment if railway signals are not consistently recognized and followed. It is also linked to Recommendation R00-04, in which the Board recommended that the railway industry implement additional backup safety defences to help ensure that signal indications are followed.

The ACRS Working Group will provide TC with a written report on options and recommendations to address this issue. This work is now scheduled to be completed by spring 2016. Although action has been initiated to study the deficiency which could yield an appropriate solution in the long term, there still remains no short-term plans to address the risk of train collision or derailment in the absence of additional backup safety defences.

The RAC indicates that locomotive voice and video recorders will provide a safety defence with regards to this issue. Although there may be safety benefits from the use of these recorders relating to following signal indications, the Board cautions that any defence in-depth concept of system safety design cannot be satisfied solely through additional layers of crew monitoring. Additional layers of physical defences are still required so that the risk of serious train collisions or derailments can be effectively mitigated.

As it is too early to assess the results of the working group study on options and recommendations, the Board considers the responses to the recommendation to be **Satisfactory in Part**.

February 2017: response from Transport Canada

This recommendation is linked to TSB Recommendation R00-04.

Transport Canada established a Train Control Working Group under the auspices of the Advisory Council on Railway Safety (ACRS) to study train control technologies and their suitability for Canada's railway operations with a special focus on the high-speed rail corridors. The impetus for the establishment of the Working Group was the TSB's recommendation that TC *"require major Canadian passenger and freight railways implement physical fail-safe train controls, beginning with Canada's high-speed rail corridors"* (R13-01).

The Working Group concluded its mandate and presented its findings to the Advisory Council on Railway Safety (ACRS) on 20 September 2016. The final report of the Working Group recommends a targeted, risk-based and corridor-specific implementation of enhanced train control (ETC) technologies as the best option for Canada.

To build on this recommendation, Transport Canada and the Railway Association of Canada hosted a workshop on 25 January 2017 entitled "Understanding Enhanced Train Control Systems and the State of the Art for existing Enhanced Train Control Systems Implementations". The workshop brought together experts from Canada and the United States.

Coming from the workshop was an agreement that Transport Canada will continue working with stakeholders in industry and labour to further study options to define an enhanced train control application and implementation concept for Canada, taking into consideration the conclusions and recommendations of the working group report.

The next phase of work will be conducted by the Canadian Rail Research Laboratory (CaRRL) for Transport Canada. Building upon the output of the Working Group, CaRRL will:

- Conduct a more-in depth analysis of RODS data to determine the number of occurrences where the likelihood or impact of the occurrence could have been reduced had existing ETC technology or ETC technologies under development, been in place. CaRRL will seek further information from the individual railway companies in order to clarify the occurrences where data is not supported with sufficient detail.
- Develop risk-prioritization criteria and a recommended application methodology which can be applied to risk rank corridors in the Canadian Rail Network.
- Develop a methodology for conducting a cost-benefit analysis.
- Apply these methodologies to conduct a case study of a particular Canadian rail corridor and produce a corridor-specific analysis.
- Prepare a final report summarizing the results of the data analysis conducted and the conclusions drawn from the corridor-specific case study.

March 2017: response from the Railway Association of Canada

The RAC and industry worked with the ACRS train control working group providing written reports and recommendations to Transport Canada. As a result of the recommendations, a task force has been established. The RAC and industry are actively working with this new task force.

The RAC and industry are also active in research to advance technology in this area; by individual companies, by the Railway Research Advisory Board, and with academic institutions such as CaRRL.

VIA has completed the proof of concept of a GPStrain in Q4 2016 which demonstrated that the system was effective to mitigate human factors.

Industry believes that locomotive voice and video recorders (LVVR) will provide an important safety defence with regards to this issue.

March 2017: TSB assessment of the responses (Satisfactory in Part)

This recommendation is related to the TSB Watchlist issue of “Following railway signal indications,” where there is a risk of serious train collision or derailment if railway signals are not consistently recognized and followed. It is also linked to Recommendation R00-04, in which the Board recommended that the Department of Transport and the railway industry implement additional backup safety defences to help ensure that signal indications are consistently recognized and followed.

The Working Group concluded its mandate and presented its findings on train control technologies to the ACRS on 20 September 2016. The final report of the Working Group recommended a targeted, risk-based and corridor-specific implementation of enhanced train control (ETC) technologies as the best option for Canada. On 25 January 2017, TC and the RAC hosted a workshop that was focused on understanding ETC systems and on the status of existing ETC implementations. The workshop brought together experts from Canada and the United States.

Building on the output of the Working Group, TC has scoped out the next phase of work, which will be conducted by the CaRRL. This work will include more in-depth analysis of relevant occurrence data, development of a methodology for risk prioritization and ranking corridors in the Canadian rail network, and a case study to apply the methodology on a particular rail corridor.

The Board is encouraged that VIA has successfully completed a proof of concept system (GPStrain) that demonstrates the effectiveness of this technology to mitigate human factors. In addition, the Board is encouraged that TC will continue working with stakeholders in industry and labour to further study options to define an ETC implementation concept for Canada, taking into consideration the conclusions and recommendations of the Working Group report. However, despite the significant work on these research initiatives, there still remains no

short-term plan to address the risk of train collision or derailment in the absence of additional backup safety defences.

With respect to LVVR technology, the Board cautions that any defence in-depth concept of system safety design cannot be satisfied solely through additional layers of crew monitoring. Additional layers of physical defences are still required so that the risk of serious train collision or derailment can be effectively mitigated.

The Board considers the responses to the recommendation to be **Satisfactory in Part**.

January 2018: response from the Railway Association of Canada

RAC and industry are continuing to participate in the TC sponsored research by the Canadian Rail Research Laboratory (CaRRL) to evaluate enhanced train control for Canada. An in-depth analysis of relevant occurrence data has been completed by the Canadian Rail Research Laboratory (CaRRL). In their next phase of work, using the conclusions of their in-depth data analysis, they are developing a methodology for risk prioritization. They are preparing a Canadian rail network case study to apply the methodology on a particular rail corridor.

VIA completed the proof of concept of a GPStrain in Q4 2016 which demonstrated that the system was effective in mitigating human factors. In 2017, VIA defined the scope and timeline of the next phase of the project, obtained funding, and in Q4 they initiated the next phase. In 2018, VIA plans to develop a production prototype of GPStrain to be in used onboard two (2) locomotives – F40 and GPA30H types - that will be in used between Quebec and Ottawa.

February 2018: response from Transport Canada

Transport Canada established a Train Control Working Group under the auspices of the Advisory Council on Railway Safety (ACRS) to study train control technologies and their suitability for Canada's railway operations with a special focus on the high-speed rail corridors. The impetus for the establishment of the Working Group was the TSB's recommendation that TC "require major Canadian passenger and freight railways implement physical fail-safe train controls, beginning with Canada's high-speed rail corridors" (R13-01).

The Working Group concluded its mandate and presented its findings to ACRS on 20 September 2016. The final report of the Working Group recommends a targeted, risk-based and corridor-specific implementation of enhanced train control (ETC) technologies as the best option for Canada. The report of the Working Group has been posted on Transport Canada's web site and is available at <http://www.tc.gc.ca/eng/railsafety/train-control-working-group-final-report.html>.

To build on this recommendation, Transport Canada and the Railway Association of Canada hosted a workshop on 25 January 2017 entitled "Understanding Enhanced Train Control Systems and the State of the Art for existing Enhanced Train Control Systems Implementations". The workshop brought together experts from Canada and the United States.

Coming from the workshop was an agreement that Transport Canada will continue working with railway stakeholders in industry and labour to further study options to define an enhanced train control application and implementation concept for Canada, taking into consideration the conclusions and recommendations of the Working Group report.

This next phase of work is being conducted by the Canadian Rail Research Laboratory (CaRRL) for Transport Canada. Building upon the output of the Working Group, CaRRL's mandate is to:

- Conduct a more-in depth analysis of RODS data to determine the number of occurrences where the likelihood or impact of the occurrence could have been reduced had existing ETC technology or ETC technologies under development, been in place. CaRRL will seek further information from the individual railway companies in order to clarify the occurrences where data is not supported with sufficient detail;
- Develop risk-prioritization criteria and a recommended application methodology which can be applied to risk rank corridors in the Canadian Rail Network;
- Develop a methodology for conducting a cost-benefit analysis;
- Apply these methodologies to conduct a case study of a particular Canadian rail corridor and produce a corridor-specific analysis; and
- Prepare a final report summarizing the results of the data analysis conducted and the conclusions drawn from the corridor-specific case study.

As of January 2018, CaRRL has completed the analysis of the data from the TSB's Rail Occurrence Data Base and the results of the work are under review prior to publication by March 2018. Work continues on the risk-prioritization criteria methodology and its application to specific corridors. This work is also expected to be completed by March 2018.

The analysis continues to illustrate the complexity of train control implementation which would require the installation of hardware on locomotives, new signals and communications equipment and software to control the complete system – all of which must be interoperable to ensure that trains can operate on another railway's network. In addition, the US PTC experience is also demonstrating that, as with any new technology deployment of this magnitude, significant testing, validation and employee training are required to ensure reliability before full system roll-out is possible.

To be the most effective, train control technology must meet the needs and operational realities in Canada such as operational challenges posed by remote track locations and more extreme environmental conditions. Train control technologies adopted in Canada must be compatible with technology being deployed in the US so as not impact the efficient movement of trains across borders.

Therefore, regarding next steps, TC will bring together stakeholders in other levels of government, the private sector and academia at the next Advisory Council on Rail Safety (ACRS) likely in April 2018 to examine the results of the work completed by CaRRL, to take stock of various train control initiatives in Canada and abroad - including a comprehensive update on

PTC implementation lesson learned in the US. The ultimate goal of this work is to define a train control roadmap for Canada.

March 2018: TSB assessment of the responses (Satisfactory in Part)

This recommendation is related to the TSB Watchlist issue of “Following railway signal indications,” where there is a risk of serious train collision or derailment if railway signals are not consistently recognized and followed. It is also linked to Recommendation R00-04, in which the Board recommended that the Department of Transport and the railway industry implement additional backup safety defences to help ensure that signal indications are consistently recognized and followed.

Following the January 2017 workshop, TC contracted with the CaRRL to work on defining an ETC application and implementation concept for Canada. The specific work consisted of:

- conducting a more-in depth analysis of data from TSB's Rail Occurrence Database System (RODS) to determine the number of occurrences where the likelihood or impact could have been reduced had ETC technology been in place;
- developing risk-prioritization criteria and a recommended application methodology to rank corridors with respect to risk;
- developing a methodology for conducting a cost-benefit analysis;
- applying these methodologies to conduct a case study for a rail corridor; and
- preparing a final report.

As of January 2018, the analysis of the RODS data was completed, and work was continuing on developing the methodology for risk-prioritization. In April 2018, TC will bring together stakeholders, including other levels of government, the private sector and academia, for the next ACRS to examine the results of the work completed by CaRRL, and to take stock of various train control initiatives in Canada and abroad. The ultimate goal of this work is to define a train control roadmap for Canada.

The RAC has continued to participate in the TC-sponsored research to evaluate ETC for Canada. In 2017, VIA initiated the next phase of its GPStrain project. In 2018, VIA plans to develop a production prototype of GPStrain to be used on board 2 locomotives – F40 and GPA30H types – between Québec and Ottawa.

The Board is encouraged by the progress made by VIA on its proof of concept system (GPStrain). The Board is also encouraged that work is finally underway to define an ETC application and implementation concept for Canada. However, there are still no specific plans to address the risk of train collision or derailment in the absence of additional backup safety defences. The Board considers the responses to the recommendation to be **Satisfactory in Part**.

February 2019: response from the Railway Association of Canada

RAC and industry have established a technical working group to further advance the work required to implement an enhanced train control application. In partnership with Canadian Rail

Research Laboratory (CaRRL), the working group is developing the recommended application methodology to assess corridors and define the minimum functionalities required to address the identified risk levels. In addition, the working group has commenced work to establish the industry standards required to enable interoperability across railways. The working group is developing a common Concept of Operations in order to identify the system requirements and standards required for interoperability. This work will establish a multi-year roadmap of the work required in order to safely and efficiently implement an enhanced train control application.

VIA has continued to make progress on its GPS train. VIA has established a technical partner to lead the design, development and required testing of the system. Having defined the required functionalities, integration and user testing will be completed prior to piloting the system on non-revenue trains in late 2019. In addition, VIA is working with the industry in order to put the required foundation pieces in place to be able to verify interoperability. These initiatives will assist the Working Group in developing the common industry architecture and standards that will be required.

There are also other railways who are advancing the assessment of comparative systems for field applications.

February 2019: response from Transport Canada

Transport Canada has made a considerable amount of progress to date developing a Canadian approach to enhanced train control (ETC). A joint Transport Canada-industry train control working group under the Advisory Council on Railway Safety (ACRS) concluded that a targeted, risk-based, corridor-specific implementation of train control technologies would be the best option for Canada. The report of the Working Group is available at <http://www.tc.gc.ca/eng/railsafety/train-control-working-group-final-report.html>.

Additionally, in January 2017, TC co-hosted a workshop with the Railway Association of Canada, where experts from Canada and the United States discussed lessons learned while implementing Positive Train Control in the U.S. Participants reviewed the issues Canada could face as we put train control technology in place across our rail sector.

Building on work from the ACRS working group, TC collaborated with the Canadian Rail Research Laboratory (CARRL) at the University of Alberta to:

- comprehensively review the potential impact that various train control approaches could have had on past occurrences on the Canadian rail network, and
- study the feasibility of implementing various levels of train control in Canada.

The key findings of the report completed by CARRL, which highlighted that an ETC system may have prevented between 3.5% (Level 1) and 6% (Level 4) of all RODS occurrences are available at <https://www.tc.gc.ca/eng/railsafety/canadian-rail-research-laboratory-report-enhanced-train-control.htm>

The 2018 *Railway Safety Act* Review report recommendation No.5 stated that “...*Transport Canada, in partnership with industry, develop a Canadian approach to enhanced train control (ETC) technologies and establish a technology road map for implementing ETC in a staged and cost-effective manner*”.

Transport Canada will continue to engage stakeholders as we work to implement each of the Report's 16 recommendations. To further support the implementation of recommendation 5 specifically, Canadian National, Canadian Pacific Rail and VIA Rail have communicated to the department that they are supportive of the *Railway Safety Act* Review Panel's recommendation and wish to work with TC to establish how ETC can be deployed in Canada. Until a technology solution is introduced, Transport Canada continues to administer its Risk-Based Oversight Program and monitor for safe and compliant railway operations. Since the AMPS regime has been implemented in 2015, TC has been closely monitoring Movements Exceeding Limits of Authority and as such as issued Letters of Warning, and has served Notices of Violations, including monetary penalties to railway companies for not complying to applicable rules such as Rule 439 of the *Canadian Rail Operating Rules*. Notices of Violation are publically on TC's website.

As we know, train control technology must meet the needs and operational realities in Canada such as challenges posed by remote track locations, more extreme environmental conditions, and compatibility with technology being deployed in the US so as not impact the efficient movement of trains across borders.

Therefore, Transport Canada will work with industry and other stakeholders to establish the parameters for train control implementation in Canada via a roadmap.

March 2019: TSB assessment of the responses (Satisfactory in Part)

This recommendation is related to the TSB Watchlist issue of “Following railway signal indications,” where there is a risk of serious train collision or derailment if railway signals are not consistently recognized and followed. It is also linked to Recommendation R00-04, in which the Board recommended that the Department of Transport and the railway industry implement additional backup safety defences to help ensure that signal indications are consistently recognized and followed.

Based on the earlier work (2016-2017) from the ACRS working group, TC collaborated with the CaRRL at the University of Alberta to

- comprehensively review the potential impact that various train control approaches could have had on past occurrences on the Canadian rail network, and
- study the feasibility of implementing various levels of train control in Canada.

The CaRRL report, completed in early 2018, highlighted that an ETC system may have prevented between 3.5% (Level 1) and 6% (Level 4) of all RODS occurrences. TC is continuing its work with industry and other stakeholders to establish the parameters for train control implementation in Canada via a roadmap.

This issue was also highlighted in the 2018 *Railway Safety Act* Review report, as it was recommended that “...*Transport Canada, in partnership with industry, develop a Canadian approach to enhanced train control (ETC) technologies and establish a technology road map for implementing ETC in a staged and cost-effective manner.*” Canadian National Railway Company, Canadian Pacific Railway Company and VIA have indicated that they are supportive of this recommendation and will work with TC to establish how ETC can be deployed in Canada.

The RAC and industry have established a technical working group to further advance the work on ETC. This working group is developing a common concept of operations to help identify the system requirements and standards to ensure interoperability across railways. In addition, VIA has continued to make progress on its GPStrain project. Integration and user testing has been ongoing. Piloting of the system on non-revenue trains is planned for late 2019.

TC continues to administer its Risk-Based Oversight Program and monitor for safe and compliant railway operations. In particular, TC has been closely monitoring movements exceeding limits of authority. As necessary, TC has issued Letters of Warning and Notices of Violations (including monetary penalties) to railway companies for not complying with applicable rules such as Rule 439 of the *Canadian Rail Operating Rules*.

The Board acknowledges the progress on VIA's GPStrain project and the ongoing work to define an ETC application and implementation concept for Canada. However, as there are no specific plans and timelines to address the risk of train collision or derailment in the absence of additional backup safety defences, the Board considers the responses to Recommendation R13-01 to be **Satisfactory in Part**.

December 2019: response from Railway Association of Canada

As previously reported, the Railway Association of Canada (RAC) and industry have established a technical working group to further advance the work required to implement an enhanced train control (ETC) application. The working group already developed a risk framework that will be used to prioritize ETC implementation on corridors based on their level of risk. Furthermore, a preliminary ETC roadmap is being developed, and in 2020 the RAC and industry will be working with TC to progress this file. In parallel, the working group is advancing the development of industry standards required to enable interoperability across railways.

December 2019: response from Transport Canada

Transport Canada has undertaken significant foundational work, together with the railway industry, academia and other government partners, toward the implementation of enhanced train control (ETC) technologies which will respond to recommendations R00-04 and R13-01. This work has been led by the Advisory Council for Railway Safety (ACRS). Further details on the work of ACRS can be found on Transport Canada's website at <https://www.tc.gc.ca/eng/railsafety/publications.htm> under the Train Control Working Group.

ACRS's approach is supported by the 2018 *Railway Safety Act* Review Recommendation No.5 and Transport Canada's response agreeing to continue to lead work with industry partners and other government colleagues to chart a roadmap for ETC adoption in Canada, which will:

- take a corridor approach by emphasizing priority on the highest-risk corridors, such as the Quebec City/Windsor corridor and other locations, where the risk is higher due to mixed passenger and freight service and train operation in areas of higher population density;
- define interoperability standards that serve all operators on the rail network; and
- facilitate the assessment of telecommunication options necessary for successful ETC implementation.

The ETC roadmap will meet the needs of passenger and freight service providers and will allow for innovative ETC solutions. In 2019 Transport Canada further engaged with railways to understand their progress in development of innovative technology designed to ensure that signal aspects are recognized and that crews follow their indication.

In addition as part of the ongoing risk-based oversight of railway companies, Transport Canada continues to analyze and monitor missed signals occurrences which remain consistently low, in order to take appropriate enforcement action as required.

February 2020: TSB assessment of the responses (Satisfactory in Part)

This recommendation is related to the TSB Watchlist issue of "Following railway signal indications," where there is a risk of serious train collision or derailment if railway signals are not consistently recognized and followed. It is also linked to Recommendation R00-04, in which the Board recommended that the Department of Transport and the railway industry implement additional backup safety defences to help ensure that signal indications are consistently recognized and followed.

TC is continuing to lead the work with industry partners, including the RAC and other government colleagues (i.e., Innovation, Science and Economic Development Canada, Public Safety Canada, and Privacy Council Office), to chart a roadmap for ETC adoption in Canada. TC believes that the ETC roadmap will meet the needs of passenger and freight service providers and will allow for innovative ETC solutions. This work is based on:

- taking a corridor approach by emphasizing priority on the highest-risk corridors, such as the Québec/Windsor corridor and other locations, where the risk is higher due to mixed passenger and freight service and train operation in areas of higher population density;
- defining interoperability standards that serve all operators on the rail network; and
- facilitating the assessment of telecommunication options necessary for successful ETC implementation.

In 2019, TC further engaged with railways to understand their progress in the development of innovative technology designed to ensure that signal aspects are recognized and that crews follow their indication.

As part of the ongoing risk-based oversight of railway companies, TC continues to analyze and monitor occurrences involving missed signals in order to take appropriate enforcement action as required.

Although there has been ongoing work to define a roadmap for ETC adoption, the Board is concerned that no specific plan or timelines have been established for implementation. In addition, other than enforcement action (as required), no specific strategies are being used to address the risk of train collision or derailment in the absence of additional backup safety defences.

The Board considers the responses to Recommendation R13-01 to be **Satisfactory in Part**.

January 2021: response from the Railway Association of Canada

As previously reported, the Railway Association of Canada (RAC) and industry have established a technical working group to further advance the work required to implement an enhanced train control (ETC) application. The working group completed the development of a risk framework and the participating railway completed the risk assessment for all their corridors.

The working group also completed the development of an industry standards for Operational Concepts. A multiyear plan for the implementation of ETC has also been developed and pursued. Other Interoperability and System standards are under development. The RAC is working collaboratively with TC on this initiative and they are kept abreast of the progress through regular recurring meetings and discussions.

The complexity of the ETC system in Canada requires partnership and cooperation from all railways. The rail environment in Canada for passenger rail is typically a tenant on host infrastructure. Interoperability is key along with the securement or communication bandwidth from TC to support this. The industry is working to avoid issues noted with PTC and want to ensure the best solution for Canada particularly in the high-speed Quebec City Windsor Corridor.

February 2021: response from Transport Canada

Transport Canada continues to work actively with interdepartmental and industry partners to advance the development of an Enhanced Train Control (ETC) implementation roadmap, which will respond to recommendations R00-04 and R13-01, and address a recommendation of the *Railway Safety Act Review*.

Grounded in a corridor-specific and risk-based approach, Transport Canada has developed a proposed way forward, including timelines and milestones to support the adoption of

technologies that will assist train crews to identify signals and react accordingly, as well as provide for automatic protection in cases where crews might not react in time.

Key milestones include:

- Define and develop the parameters of a corridor-specific and risk-based approach (April – Dec 2021);
- Identify options for seeking access to secure and scalable wireless spectrum solutions to assist with roll-out of enhanced train control (April – Dec 2021);
- Develop guidelines on interoperable telecommunication protocols for train control operations (Oct 2021 – June 2022); and
- Review and update regulations and standards to address gaps (e.g. CROR may need to be updated to introduce performance-based engineering standards) (May 2022 – April 2024)

In parallel, Transport Canada continues to actively analyze and monitor railway occurrences data collected and published by the Transportation Safety Board of Canada (TSB) which remain consistently low. Transport Canada understands the importance and the repercussions of missed signals, therefore the department continuously conducts inspections of railways and appropriate enforcement actions are taken when required. For instance, three notice of violations (fines) were given over the last year for violations to Rule 439 of the *Canadian Rail Operating Rules*.

March 2021: TSB assessment of the responses (Satisfactory in Part)

This recommendation is related to the TSB Watchlist 2020 key safety issue of “Following railway signal indications,” where there is a risk of serious train collision or derailment if railway signals are not consistently recognized and followed. It is also linked to Recommendation R00-04, in which the Board recommended that “the Department of Transport and the railway industry implement additional backup safety defences to help ensure that signal indications are consistently recognized and followed.” Since 2004, there has been an annual average of 31 reported occurrences in which a train crew did not respond appropriately to a signal indication displayed in the field, and the number of occurrences each year is on the rise. The years 2018 and 2019 have the highest number of occurrences, 40 and 38 respectively.

TC is working on a roadmap with partners from industry and other departments to advance the development of ETC. According to TC’s proposed way forward, between April and December 2021, TC will be defining and developing a corridor-specific and risk-based approach to ETC implementation in Canada and the identification of solutions to assist with its rollout. Between October 2021 and April 2024, TC will develop guidelines on interoperable telecommunication protocols for train control operations, followed by the review and update of the regulatory provisions to address gaps related to ETC.

TC also continues to analyze TSB data regarding railway occurrences related to missed signals. Three notice of violations (fines) were given over the last year for violations to Rule 439 of the *Canadian Rail Operating Rules*.

Furthermore, the technical working group established by the RAC and industry to advance implementation of ETC recently completed a risk framework, and a risk assessment was completed by participating railways for all of their corridors. A multiyear plan for the implementation of ETC has also been developed and pursued, and other interoperability and system standards are under development.

The Board acknowledges that TC's proposed way forward includes milestones related to its ongoing work towards the adoption of ETC. The Board also notes that TC's plan includes reviewing and updating regulatory provisions to address identified gaps by April 2024. However, other than enforcement action (as required), the Board is very concerned that there are still no specific strategies in place to address the risk of train collision or derailment in the absence of additional backup safety defences.

Since 2000, when the TSB issued Recommendation R00-04 for implementing additional train control defences, the TSB has conducted 33 investigations that were determined to be ETC-preventable.

Since 2014, in the time it took TC and industry to strike the Train Control Working Group (TCWG), study the issue, produce the TCWG Final Report, sub-contract a follow-on report from the CaRRL and study the CaRRL results, Positive Train Control (PTC) has been fully implemented in the U.S. on all of the high-hazard trackage required by the U.S. *Rail Safety Improvement Act of 2008*. This equates to 57 535.7 miles of track, which is about 41% of the nearly 140 000 route-miles of the U.S. rail network.

The Board strongly encourages TC and the RAC to accelerate the pace of ETC implementation and considers the responses to Recommendation R13-01 to be **Satisfactory in Part**.

November 2021: response from the Railway Association of Canada

As previously reported, the Railway Association of Canada (RAC) and industry has established an Enhanced Train Control program (ETC Program) with the objective of developing industry interoperability standard, interface control documents to allow for interoperability, related safety assurance processes and documentation, and agreements between the major Canadian railway operators as to what constitutes ETC, what it will do, and how that will be accomplished.

Prior to 2021, this work was conducted at a high level with a small group of experts. This group was able to develop Operational Concepts and Functional Level ETC requirements.

Early in 2021, the ETC Program significantly expanded to include multiple subcommittees and a significant number of Subject Matter Experts. This includes the following technical committees: Safety & Risk Committee (SRC), Back-office Committee (BOC), Wayside Committee (WC),

Onboard Committee (OC) and Communications & Security Committee (CSC). These committees are supported by a Program Management Office (PMO) and external technical expertise for development of ETC system interoperable Standards and Interface Control Documents (ICDs) according to established IEEE processes. The first phase of work for the BOC, WC, and OC committees is to evaluate existing standards from other jurisdictions for reuse, develop agreement upon common architecture elements, and develop segment level requirements. The CSC is currently reviewing communications requirements to determine which communications technologies are feasible for use in Canada and to form the basis of an interoperable ETC system. These results will be used to develop proposals for the Government of Canada to provide communications spectrum. The SRC is developing the fundamental safety assurance plans, documentation, and processes to ensure that the development of ETC system(s) (including underlying standards, ICDs and functions) will result in the planned safety improvements. This first phase of work is estimated to be complete by the end of 2022.

The ETC Program has engaged through RAC with Transport Canada on their “Cognitive Impacts of In-Cab Warning Systems” study with Volpe (US DOT). Transport Canada has been provided with relevant details of the ETC system for the study, in order to identify critical unknowns and questions from ETC that the study could define and answer. Quarterly meetings are also being held with the Rail Safety Directorate of Transport Canada to provide progress updates.

The ETC Program continues to develop subsequent phases of work from writing of the subsystem requirements and standards through to the testing of components and interoperability between systems. The scope of work of future phases will be based on the results of the current phase; timelines and deliverables will become more certain as the first phase of work is completed.

December 2021: response from Transport Canada

Transport Canada reaffirms its full agreement with this recommendation, and continues to work with government and industry partners to support the national rollout of Enhanced Train Control (ETC), which helps to ensure that signal indications are consistently recognized and followed by train crews. This work includes jointly-agreed upon parameters of a corridor-specific and risk-based approach to the implementation of ETC in Canada and developing an understanding of the complexities of implementing train control to ensure a seamless roll-out in Canada.

Implementing ETC is a complex, national undertaking involving coordination among governments, railways, and equipment suppliers. It will require investments by railways to geo-map track including all the assets on the right-of-way (e.g., grade crossings, switches, signals), investments in communications towers and corridors (including power to be brought to some dark territory), hardware to be installed on thousands of locomotives, back-office systems to be implemented to manage communications between trains and the wayside equipment, and extensive testing and training. To ensure interoperability, these systems must be implemented with common communications protocols and standards.

As part of the input to the reassessment process in 2020, TC described a roadmap with a series of planned implementation streams and initiatives. Implementation of ETC is a priority for TC, and in 2021 the department has made significant progress:

- **Risk-based and corridor specific approach:** In Spring 2022, Transport Canada will publish a Notice of Intent informing stakeholders Transport Canada is implementing policy direction to require railway companies to develop and adhere to amended rules respecting safe railway operations to ensure that railway signals are consistently recognized and followed. This Notice of Intent will confirm Transport Canada's vision for ETC in Canada, applying a risk-prioritization approach, by first promoting its implementation on higher-speed mixed traffic tracks (passenger and freight services). Publication of the NOI will describe TC's vision for the risk-based approach to ETC implementation and will allow TC to engage with stakeholders against concrete timelines. Work is already underway with respect to this risk-based approach, and the department receives regular progress reports from the RAC and its members regarding work undertaken by industry to assess individual corridor risk as per their established risk assessment framework and to undertake system standards development.
- **Research and spectrum access:** Complementing this work, Transport Canada's Innovation Centre has embarked on a research partnership with the Volpe Institute in the U.S. to conduct research in the area of cognitive impacts of in-cab warning systems. The conclusions of this work will assist in developing guidance for industry on the proper implementation of indicators in locomotive cabs. This will also provide valuable information toward establishing the regulatory framework in support of ETC. Transport Canada continues to work with Innovation, Science and Economic Development Canada to understand spectrum needs for ETC.
- **Review and update regulations/standards:** In October 2021, Transport Canada entered into a Memorandum of Understanding with the Standards Council of Canada (SCC) to develop a National Technical Specification on Interoperability. On November 24, 2021, the SCC issued a request for proposals to bidders (standards developing organizations) to develop, publish and distribute a Technical Specification that will provide guidance and best practices on interoperability principles necessary for the implementation of enhanced train control (ETC) technologies on Canada's rail network. The delivery of the Technical Specification is expected by March 2023. This Technical Specification will be essential for ETC implementation, ensuring that critical information such as train position and train speed can be communicated reliably and securely between railways, notwithstanding the chosen train control technology.
- **Data analysis and investigations:** Transport Canada took immediate action following a collision of two CN trains near Prescott, Ontario in September 2021 by requesting from companies a description of current operating practices and system safeguards, procedures and special instructions in place to ensure that no conflicting movements are operating within a controlled block. Transport Canada is assessing this information in light of the occurrence to determine if there are gaps in company procedures. The results of this analysis will determine the department's short-term actions which could include issuing a safety bulletin, guidance or may determine a rule change is required.

Information from all available sources, including this occurrence will be used to inform ETC implementation in Canada including TSB's investigation report with a full analysis of the causes and contributing factors of this occurrence.

Building on this progress, in 2022/23, the department will continue to advance this important work by:

- Publishing the Notice of Intent (Spring 2022) and working with the Standards Council of Canada to finalize the National Technical Specification on Interoperability (March 2023);
- Developing options for improving safeguards that prevent conflicting movements operating within a controlled block (Fall 2022); and
- Conducting a targeted safety management system audit of railway traffic controllers to ensure knowledge management and other processes are effective in their implementation, and launching an inspection blitz focused on missed signals (2022).

Ultimately, the deployment of ETC systems across Canada's rail network is a highly complex undertaking spanning over several years, which aligns with the *Transportation 2030* strategic plan. To ensure that risks continue to be mitigated, Transport Canada continues to actively analyze railway occurrences data collected and published by the Transportation Safety Board of Canada, particularly as they relate to missed signals, which remains consistently low. The department conducts inspections of railways and appropriate enforcement actions are taken when required (e.g., in 2021, one notice of violation (fine) was issued for a violation to Rule 439 of the *Canadian Rail Operating Rules*).

March 2022: TSB assessment of the responses (Satisfactory in Part)

This recommendation is related to the TSB Watchlist 2020 key safety issue of "Following railway signal indications," where there is a risk of serious train collision or derailment if railway signals are not consistently recognized and followed. It is also linked to Recommendation R00-04, in which the Board recommended that "the Department of Transport and the railway industry implement additional backup safety defences to help ensure that signal indications are consistently recognized and followed." Since 2004, there has been an annual average of 35 reported occurrences in which a train crew did not respond appropriately to a signal indication displayed in the field, and the number of occurrences in recent years has been on the rise. There were 42 occurrences reported in 2018 and the year 2019 had the highest number of occurrences, 45. In 2020, there were 34 such occurrences, and in 2021, there were 32. Although the 2021 data (as well as the 2020 data) indicate a reduction in the number of such occurrences as compared to previous years, it is unknown what influence the impact of COVID-19 on the transportation industry and other disruptions in service may have had.

TC continues to work with other government agencies and industry for the rollout of ETC in Canada. The project involves extensive coordination between other government departments, railways, and equipment suppliers. ETC will involve the development and installation of new communications systems and assets on the right-of-way, as well as some new software and

hardware in the locomotive fleets. The implementation of the system will first target specific corridors under a risk-based approach. TC states that some significant progress was made towards ETC's implementation in 2021. For the year 2022/2023, the roadmap includes the following activities:

- On 05 February 2022, TC published a Notice of Intent in the *Canada Gazette*, Part I to signal its intent to implement ETC in Canada using a risk-prioritization approach beginning with higher-speed mixed traffic tracks.
- TC's Innovation Centre has developed a research partnership with the Volpe Institute in the U.S. to conduct research on cognitive impacts of in-cab warning systems. This work will help develop guidance for the development of in-cab warning systems. Work is also continuing with Innovation, Science and Economic Development Canada to understand the radio spectrum needed for ETC.
- In October 2021, TC entered into a Memorandum of Understanding with the Standards Council of Canada (SCC) to establish a National Technical Specification on Interoperability. A request for proposal was issued by SCC, with delivery of the Technical Specification expected by March 2023.

Following the collision between 2 Canadian National Railway Company trains near Prescott, Ontario, in September 2021, TC requested from companies a description of current system safeguards, instructions, and procedures to avoid operation of conflicting movements in a controlled block. TC initiated the collection and assessment of information in relation to the Prescott collision and is evaluating short-term actions, which would be reflected in a safety bulletin, rule change, and/or guidance by fall 2022.

Since 2000, when the TSB issued Recommendation R00-04 for implementing additional train control defences, the TSB has conducted 36 investigations that were determined to be ETC-preventable.

Since December 2020, positive train control has been fully implemented in the U.S. on all of the high-hazard trackage required by the U.S. *Rail Safety Improvement Act of 2008*. This equates to 57 535.7 miles of track, which is about 41% of the nearly 140 000 route-miles of the U.S. rail network.

The Board strongly encourages TC and the RAC to accelerate the pace of ETC implementation. However, until TC provides further details on ETC implementation in Canada, the Board considers the responses to Recommendation R13-01 to be **Satisfactory in Part**.

Latest response and assessment

December 2022: response from Transport Canada

The Department continues to work towards the 2030 implementation of Enhanced Train Control (ETC) technologies, in conjunction with government and industry partners, to ensure that signal indications are consistently recognized and followed by train crews.¹

The Notice of Intent (NOI) published in February of 2022 sent a strong signal of TC's commitment to the deployment of Enhanced Train Control (ETC) on the Canadian rail network and made clear that the highest risk corridors must be equipped with fail safe, automatic train protection by 2030. Feedback from stakeholders supported the risk-based and corridor-specific implementation which ensures investments in safety improvements on a given corridor are tailored to the safety risk of that corridor.

TC continues to move forward with the necessary building blocks for regulating ETC in Canada, with emphasis on the methodology to assess individual corridor risk and a framework for ensuring interoperable train operations.

As outlined in the NOI, implementing a corridor risk assessment methodology that is robust and consistently applied across Canada will require the principles of the risk-prioritization criteria and methodology to be set out in the regulatory framework and subject to TC approval. To support regulatory development, TC is developing a corridor risk assessment methodology to be completed by September 2023 that will incorporate key risk factors, such as train speed, presence of dangerous goods, passenger traffic, and population density. The factors will serve to identify higher risk corridors and guide priority implementation of ETC across the Canadian rail network.

TC has entered into an agreement with the Standards Council of Canada to have the Canadian Standards Association (CSA) develop a National Technical Specification on Interoperability by September 2023. The CSA, as a standards development organization, has the expertise to bring industry and other stakeholders together to develop this essential building block for ETC. This will ensure that information, such as train position and train speed, can be communicated reliably and securely between railways, notwithstanding the chosen train control technology.

The development and deployment of ETC is a complex and capital-intensive undertaking. As discussed in the NOI, consideration will need to be given to other important elements such as telecommunications needs, access to spectrum, and how to ensure the regulation fosters innovative and evolving technology. TC is working diligently with stakeholders to advance these elements in order to meet our commitment of implementing ETC on the highest risk corridors by 2030.

¹ All responses are those of the stakeholders to the TSB in written communications and are reproduced in full. The TSB corrects typographical errors in the material it reproduces without indication but uses brackets [] to show other changes or to show that part of the response was omitted because it was not pertinent.

In parallel with advancing ETC, the department has continued to strengthen the rail safety regulatory regime and has taken measures that address safety risks identified in this investigation report. These measures include new *Locomotive Voice and Video Recorder Regulations*, which ensures crucial information is available to help determine the cause of an accident and to prevent future accidents. The *Duty and Rest Period Rules for Railway Operating Employees*, informed by the latest fatigue science, will reduce the occurrences of fatigue in railway operations by placing new limits on the length of a duty period and increasing the length of the minimum rest period between shifts. Strengthening of the *Track Safety Rules* and *Key Trains and Key Routes Rules* will reduce the likelihood of a derailment of a train carrying dangerous goods.

While regulatory development work is underway, TC continues to conduct inspections and audit of rail companies to address the risk of occurrences caused by human error. In 2021/2022 TC conducted two effectiveness audits looking at processes related to how they are addressing movements exceeding limits of authority, of which missed signals is one type of occurrence. In 2022/23, the department will be auditing one company's SMS processes related to rail traffic control operations and how they prevent conflicting movements operating within a controlled block. While work is not yet complete to assess options for improving safeguards to prevent this type of occurrence, this audit will inform this work.

January 2023: response from the Railway Association of Canada

On February 5, 2022 a Notice of Intent (NOI) on ETC was published in the *Canada Gazette*, Part I. The RAC provided comments in response to the NOI.

The RAC also provided the TSB with comprehensive details on the ETC program and status in late 2022 and plans to provide updates to the TSB in 2023.

March 2023: TSB assessment of the responses (Satisfactory in Part)

This recommendation is related to the TSB Watchlist 2022 key safety issue of "Following railway signal indications," where there is a risk of serious train collision or derailment if railway signals are not consistently recognized and followed. It is also linked to the following recommendations:

- Dormant Recommendation R00-04, in which the Board recommended that "the Department of Transport and the railway industry implement additional backup safety defences to help ensure that signal indications are consistently recognized and followed."
- Active Recommendation R22-04, in which 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."

From 2004 to 2022, there has been an annual average of 35 reported occurrences in which a train crew did not respond appropriately to a signal indication displayed in the field. Although the number of occurrences in 2020 and 2021 was close to this average (34 and 32,

respectively), the number of occurrences in 2022 increased to 50, exceeding the previous high of 45 reported occurrences in 2019.

In conjunction with government and industry partners, Transport Canada (TC) continues to work towards the adoption of physical fail-safe train controls through the implementation of enhanced train control (ETC) technologies. The Notice of Intent published by TC in February 2022 specified that the highest-risk corridors must be equipped with fail-safe, automatic train protection by 2030.

To identify highest-risk corridors, TC is developing a methodology to assess individual corridor risk, to be completed by September 2023; it will incorporate key risk factors, such as train speed, presence of dangerous goods, passenger traffic, and population density.

Interoperability is an essential building block for ETC. TC has stated that it will ensure that information, such as train position and train speed, can be communicated reliably and securely between railways, notwithstanding the chosen train control technology. TC has entered into an agreement with the Standards Council of Canada to have the Canadian Standards Association (CSA) develop a National Technical Specification on Interoperability by September 2023.

The Board notes that the development and deployment of ETC is a complex and capital-intensive undertaking, and that consideration will need to be given to other important elements such as telecommunications needs, access to spectrum, and how to ensure the regulation fosters innovative and evolving technology. It also notes that TC has continued to improve the rail safety regulatory regime, with the new *Locomotive Voice and Video Recorder Regulations* and *Rest Period Rules for Railway Operating Employees*, and the strengthening of the *Railway Track Safety Rules*² and the *Rules Respecting Key Trains and Key Routes*.³ TC also continues to conduct inspections and audits of rail companies to address the risk of occurrences caused by human factors to support the assessment of options for improving existing safeguards to prevent such occurrence.

The Board is encouraged that TC has committed, in conjunction with government and industry partners, to develop a corridor risk assessment methodology and a National Technical Specification on Interoperability by September 2023. This action is a positive step toward the implementation of physical fail-safe train controls on Canada's high-speed rail corridors and on all key routes. However, until TC provides further clarification on which corridors will require ETC, the Board considers the response to Recommendation R13-01 to be **Satisfactory in Part**.

File status

The TSB is monitoring progress on the development and implementation of the ETC roadmap for Canada. This recommendation is also linked to dormant Recommendation R00-04, which

² The revised *Rules Respecting Track Safety* came into effect on 01 February 2022.

³ The revised *Rules Respecting Key Trains and Key Routes* came into effect on 22 August 2021.

identified the underlying safety deficiency over 20 years ago. It is also linked to active Recommendation R22-04 against which progress will be monitored and reported.

This deficiency file is **Dormant**.