Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

REASSESSMENT OF THE RESPONSE TO TSB RECOMMENDATION R00-04

Consistent recognition of signals

Background

On 11 August 1998, at approximately 1810 Pacific daylight time, Canadian Pacific Railway (CP) train No. 463-11 (train 463) collided with the rear-end of CP train No. 839-020 (train 839) at Mile 78.0 of CP's Shuswap Subdivision, near Notch Hill, British Columbia. One car on train 463 and two cars on train 839 derailed. There were no injuries.

The Board identified safety deficiencies related to ensuring accurate signal interpretation by train operating crew members.

The Board concluded its investigation and released report R98V0148 on 01 February 2001.

TSB Recommendation R00-04 (February 2001)

The Board recognizes the concerted effort by the railway company and the regulatory body to address the issue related to the communication of signals between crew members. Railway company programs such as the "Rule of the Week" are positive steps towards the reduction of risks associated with the communication of signals. The Board looks forward to the results of TC's review of the current state of compliance to Rule 34, and this program will likely heighten awareness of this issue amongst crews. However, the Board is concerned that the effectiveness of the program will likely be both temporary and incomplete. The current practice suggests that many crews do not consider compliance with Rule 34 to be necessary for safe operation. The widespread practice of not calling signals effectively removes the backup safety defence available from the second crew member in ensuring accurate signal interpretation, thus increasing the risk of accidents.

Various measures could be considered to address this safety deficiency. One option would involve a shift to a non-verbal recordable electronic means of communicating signals which would also provide a record of crew actions, thereby facilitating company or regulatory monitoring. An additional option would involve replacement of the current rule with another more suitable backup defence that could alert crew members if their actions are not consistent with the signal indication. A wide-ranging review of both the extent of the problem and various potential solutions could achieve a significant improvement in rail transportation safety.

Canada

Therefore, the Board recommends 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.
>
> **TSB Recommendation R00-04**

Transport Canada's response to Recommendation R00-04 (April 2001)

TC indicated that they support the intent of this recommendation.

TC responded that they, in conjunction with the Railway Association of Canada (RAC) and the railways, have continued to study new technologies which could provide additional backup safety defences to help ensure that signal indications are consistently recognized and followed by train crews.

TC reported that they monitored studies undertaken by the Canadian Pacific Railway (CP) on improved radio and locomotive cab communication which involved the use of headsets. In addition, TC reported that they monitored technologies such as the Communication-Based Train Control (CBTC), also referred to as Positive Train Control Systems (PTC), which enables communication between trains and could provide the required additional backup to help prevent such accidents from occurring.

TSB assessment of Transport Canada's response to Recommendation R00-04 (March 2002)

The response indicated that TC, in conjunction with other stakeholders, monitored several new technologies which could provide backup safety defences. Although these efforts were positive, there was an absence of specificity and timing with respect to action to ensure that additional defences were put into place. In consideration that TC continued participation in the studies of new technologies, but had not initiated action to implement additional backup safety defences to ensure that signal indications are consistently recognized and followed, the response to the recommendation was assessed as **Satisfactory Intent.**

Additional response from TC to Recommendation R00-04 (June 2004)

TC advised that they had no new information at this time. TC considered the recommendation open.

TSB reassessment of Transport Canada's response to Recommendation R00-04 (September 2005)

TC provided no new information, nor proposed dates, as to when or if a backup safety defence would be implemented to ensure consistent recognition of signal indications. As such, TC's response was reassessed as **Unsatisfactory.**

TSB reassessment of Transport Canada's response to Recommendation R00-04 (August 2006)

TC provided no new information, nor proposed dates, as to when or if a backup safety defence would be implemented to ensure consistent recognition of signal indications. As such, TC's response continues to be **Unsatisfactory.**

Transport Canada's response to Recommendation R00-04 (January 2010)

TC indicated that they are stepping up their vigilance and monitoring of the railways' Performance Monitoring and Rules Compliance (PMRC) program. The results of this monitoring will be forwarded to TC's new Audit/Risk Assessment group for further review.

Canadian Pacific Railway's response to Recommendation R00-04 (July 2010)

CP has initiated the following Safety Action:

> A CTC [1] Signal Record checklist was established as a standard operating procedure to aid in the detection, identification, communication and documentation of signals. The checklist is intended to ensure compliance with the Rules, and reduce the opportunity for crew distraction.
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> CROR Rule 34 has been enhanced to include: Each signal affecting their movement must be called out by the conductor and must be acknowledged by the person responsible for controlling the locomotive 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.

A System Special Instruction to Rule 34(b) has been developed, stating: In CTC (or at any other signal which is an advance signal to a signal in CTC), except as otherwise indicated in special instruction, the conductor must complete the applicable portions of the CTC Signal Record form immediately after the leading end of the movement has passed each signal. The checklist requires:

- signal location, signal name, time, other than signal restrictions verification, radio broadcast confirmation, and job briefing confirmation;
- signal detection and identification;
- intra-cab communications; and
- inter-cab communications.

Additional Crew Resource Management principles have been developed to improve intra-cab communications. New requirements in the Rules have been integrated and communicated to crews with the intent of allowing the person controlling the Locomotive to focus on the task of doing so safely.

An on board checklist process has been developed that requires (in part) conductors to record the number of axles communicated to the crew by a hot box detector after passing each hot box

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[1]   CTC - Centralized Traffic Control: A system of railroad operation by means of which train movements over designated sections of track are directed by signals controlled from a central point.

detector location. This process is intended to provide a conductor with a running written record of a train's axle count and any defects that may be communicated by the detector.

System Special Instruction to CROR Rule 142(b) has been enhanced, stating: Crew members within physical hearing range are required to remind one another of the restrictions contained in GBO and clearances in sufficient time to ensure compliance. This communication must be initiated by the conductor and must be acknowledged by the person responsible for controlling the locomotive.

CROR Rule 121 Positive Identification has been enhanced, stating: The person initiating a radio communication and the responding party must establish positive identification. The initial call must commence with the railway company initials of the person being called. When calling a movement, other than when specifically required by the rule, the initial call must be directed to the Conductor of the movement.

TSB reassessment of the responses to Recommendation R00-04 (September 2010)

Between 2007 and July 2010, the Board has investigated five collisions (3 CP and 2 CN) and a main track train derailment (VIA) in CTC territory. In 5 of these cases, signal identification and response were causal elements in the accidents. This clearly demonstrates that consistent signal recognition by train crews continues to be problematic which increases the risk for these types of accidents to occur.

TC has stepped up its compliance monitoring of activities surrounding signal recognition, and has indicated that its Audit/Risk Assessment Group will assess the results of the monitoring activities to determine possible further action. This action on its own does not constitute an additional backup safety defence to ensure consistent recognition of signal indications as contemplated by the recommendation. However, it does make reference to possible further action.

CP has implemented a number of new administrative defences to help ensure that signal indications are consistently recognized and followed. While these steps may be positive, the administrative nature of the defences may also add to the cognitive workload of train crews and create additional distraction. Furthermore, these defences only apply to CP and are not utilized throughout the industry. While no additional physical safety defences have been engineered into CTC to ensure consistent recognition and response to signal indications, the administrative changes made by CP demonstrate development in this area and may have a positive result. Therefore, the Board reassesses the response to Recommendation R00-04 as **Satisfactory In Part.**

Transport Canada's response to Recommendation R00-04 (October 2011)

TC advises that the industry is exploring the use of positive train control technology which would help protect against human factors type issues with signal recognition and/or distractions.

TSB reassessment of Transport Canada's response to Recommendation R00-04 (February 2012)

The additional information does not reveal sufficient safety action to change the assessment category. The underlying deficiency which needs to be addressed still remains, as is evidenced by TSB occurrences R12T0038, R11Q0011, R11E0063, R10V0038, and R09V0230. Therefore, while

some action has been taken, more is required. The Board reassesses the response to Recommendation R00-04 to remain as **Satisfactory In Part.**

Transport Canada's response to Recommendation R00-04 (January 2013)

Transport Canada (TC) has discussed with industry the possibility of adapting existing on-board computer systems to assist in train control. Since then, TC has been advised that General Electric (GE) and some of the railways have met to discuss a "wish list" of programming changes to GE's Trip Optimizer computer system. CN has mentioned that they have discussed with GE the possibility of adding work zones (Track Occupancy Permit (TOP), CROR Rule 42 etc.) as well as air brake control and signal recognition to the future capabilities of the Trip Optimizer. TC is following up on these issues with CP and CN.

TSB reassessment of Transport Canada's response to Recommendation R00-04 (February 2013)

The issue of signal recognition was added to the TSB Watchlist in 2012, highlighting those issues that pose the greatest risk to Canadians.Transport Canada and the railways are exploring the potential for current locomotive fleet computer systems to include signal recognition and air brake control capabilities. However, to date there has been no formal strategy developed to adapt either emerging technology or existing on-board computer systems to provide fail-safe physical train control defences. Therefore the Board reassesses the response to Recommendation R00-04 to remain **Satisfactory In Part.**

Transport Canada's response to Recommendation R00-04 (January 2014)

Transport Canada has formed a working group under the auspices of the Advisory Council on Railway Safety (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 2014 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.

TSB reassessment of Transport Canada's response to Recommendation R00-04 (April 2014)

This recommendation is related to Recommendation R13-01, in which the Board recommended that major Canadian railways implement physical fail-safe train controls, beginning with Canada's high-speed rail corridors.The working group formed by TC under the auspices of the ACRS has commenced. However, the work has not sufficiently advanced to evaluate progress on the outstanding deficiency. Therefore, the Board reassesses the response to Recommendation R00-04 to remain as **Satisfactory in Part**.

Canadian Pacific Railway's response to Recommendation R00-04 (September 2014)

In November 2011, CP had implemented a CTC Signal Record Form across its Canadian network. The principal intent of the form was to reinforce the critical behavior expected of both locomotive engineers and conductors to recognize, communicate to one another, agree upon

and comply with fixed signal indications. Following a detailed review of the application of the Signal Recognition Form in this critical process, it was concluded that the expected benefit of increased focus on the critical tasks of signal recognition, communication and reaction had been achieved. Furthermore, the form itself was found to be no longer adding benefit to the process and in fact was becoming an unnecessary distraction. For this reason, the requirement for conductors to complete the Signal Recognition Form was rescinded on 30 May 2013.

Railway Association of Canada's response to Recommendation R00-04 (February 2015)

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 [2] 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.

Transport Canada's response to Recommendation R00-04 (February 2015)

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, reliability 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.

TSB reassessment of the responses to Recommendation R00-04 (March 2015)

This recommendation is related to the TSB Watchlist issue of "Following signal indications", where there is a risk of serious train collision or derailment if railway signals are not

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[2]   The GPS Train Safety System uses GPS-based technology to monitor and control certain train movements. Locomotive engineers will use an interactive touchscreen to respond to and monitor information pertaining to their train. This technology is focused on reducing both mental workload and the risk of human error, as well as, mitigating the consequences of errors that do occur.

consistently recognized and followed. It is also linked to Recommendation R13-01, in which 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.

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 additional backup safety defences.

The Railway Association of Canada 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 defense 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 defenses that the risk of serious train collision or derailment can be effectively mitigated. Therefore, the Board considers the response to the recommendation to be **Satisfactory in Part**.

Transport Canada's response to Recommendation R00-04 (January 2016)

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.

Railway Association of Canada's response to Recommendation R00-04 (January 2016)

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.

TSB reassessment of the responses to Recommendation R00-04 (March 2016)

This recommendation is related to the TSB Watchlist issue of "Following 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 R13-01, in which the Board recommended that the Department of Transport require that major Canadian passenger and freight railways implement physical fail-safe train controls, beginning with Canada's high-speed rail corridors.

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 Railway Association of Canada (RAC) indicates that locomotive voice and video recorders will provide a safety defense with regards to this issue. There may be safety benefits from the use of these recorders relating to the consistent recognition of signals. However, the Board cautions that any defense in-depth concept of system safety design cannot be satisfied solely through additional layers of crew monitoring. Additional layers of physical defenses are still required so that the risk of serious train collision or derailment 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 response to the recommendation to be **Satisfactory in Part**.

Transport Canada's response to Recommendation R00-04 (February 2017)

This recommendation is linked to TSB Recommendation R13-01.

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.

Railway Association of Canada's response to Recommendation R00-04 (March 2017)

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.

TSB reassessment of the responses to Recommendation R00-04 (March 2017)

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 R13-01, in which the Board recommended that the Department of Transport require that major Canadian passenger and freight railways implement physical fail-safe train controls, beginning with Canada's high-speed rail corridors.

The Working Group concluded its mandate and presented its findings on train control technologies to the Advisory Council on Railway Safety (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 Canadian Rail Research Laboratory (CaRRL). This work will include

more in-depth analysis of relevant occurrence data, development of a methodology for risk priorization 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. 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 response to the recommendation to be **Satisfactory in Part**.

Transport Canada's response to Recommendation R00-04 (February 2018)

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.

Railway Association of Canada's response to Recommendation R00-04 (January 2018)

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.

TSB reassessment of the responses to Recommendation R00-04 (March 2018)

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 R13-01, in which the Board recommended that the Department of Transport require that major Canadian passenger and freight railways implement physical fail-safe train controls, beginning with Canada's high-speed rail corridors.

Following the January 2017 workshop, TC contracted with the Canadian Rail Research Laboratory (CaRRL) to work on defining an enhanced train control application and implementation concept for Canada. The specific work consisted of:

- Conducting a more in-depth analysis of data from the 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.
- Preparing a final report.

As of January 2018, the analysis of the RODS data had been 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 Advisory Council on Rail Safety (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 Railway Association of Canada (RAC) has continued to participate in the TC-sponsored research to evaluate enhanced train control 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 in used onboard two (2) locomotives – F40 and GPA30H types - that will be in used between Quebec and Ottawa.

The Board is encouraged with 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 enhanced train control 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 response to Recommendation R00-04 to be **Satisfactory in Part**.

Transport Canada's response to Recommendation R00-04 (February 2019)

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 has 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 available 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.

Railway Association of Canada's response to Recommendation R00-04 (February 2019)

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.

TSB reassessment of the responses to Recommendation R00-04 (March 2019)

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 R13-01, in which the Board recommended that the Department of Transport require that major Canadian passenger and freight railways implement physical fail-safe train controls, beginning with Canada's high-speed rail corridors.

Based on the earlier work (2016 – 2017) from the ACRS working group, Transport Canada (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 CARRL report, completed in early 2018, highlighted that an enhanced train control 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, Canadian Pacific Rail and VIA Rail have indicated that they are supportive of this recommendation and will work with TC to establish how ETC can be deployed in Canada.

RAC and industry have established a technical working group to further advance the work on enhanced train control. 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 on-going. Piloting of the system on trains in non-revenue service 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 on-going work to define an enhanced train control 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 response to Recommendation R00-04 to be **Satisfactory in Part**.

Transport Canada's response to Recommendation R00-04 (December 2019)

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 recommendatations 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 ongong 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.

Railway Association of Canada's response to Recommendation R00-04 (December 2019)

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.

TSB reassessment of the responses to Recommendation R00-04 (February 2020)

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 R13-01, in which the Board recommended that the Department of Transport require that major Canadian passenger and freight railways implement physical fail-safe train controls, beginning with Canada's high-speed rail corridors.

Transport Canada (TC) is continuing to lead work with industry partners, including the Railway Association of Canada and other government colleagues (i.e., Innovation, Science and Economic Development Canada, Public Safety Canada and Privacy Council Office), to chart a roadmap for enhanced train control (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 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;
- 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 development of innovative technology designed to ensure that signal aspects are recognized and that crews follow their indication.

As part of the ongong 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 R00-04 to be **Satisfactory in Part**.

Next TSB action

The TSB will continue to monitor progress on the development and implementation of the ETC roadmap for Canada.

This deficiency file is **Active.**