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Locomotive Voice and Video Recorder Regulations: SOR/2020-178

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Registration

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RAILWAY SAFETY ACT

P.C. 2020-571 August 23, 2020

Her Excellency the Governor General in Council, on the recommendation of the Minister of Transport, pursuant to section 17.95 ^a, subsection 37(1) ^b and section 40.1 ^c of the *Railway Safety Act* ^d, makes the annexed *Locomotive Voice and Video Recorder Regulations*.

Locomotive Voice and Video Recorder Regulations

General Provisions

Definitions

1 The following definitions apply in these Regulations.

Act means the *Railway Safety Act*. (*Loi*)

conductor means an employee who is in charge of the operation of a movement of railway equipment. (*chef de train*)

controlling locomotive means the railway equipment from which an operating employee controls the movement of the locomotive and any other railway equipment connected to the locomotive. (*locomotive de commande*)

locomotive engineer means an employee who is in control of the locomotive. (*mécanicien de locomotive*)

LVVR system means a locomotive voice and video recorder system. (*système d'EAVL*)

operating employee means an employee who performs the duties of a conductor or locomotive engineer. (*membre du personnel de l'exploitation*)

TSB means the Canadian Transportation Accident Investigation and Safety Board. (*BST*)

Application

2 These Regulations apply to a company that meets at least one of the following criteria:

- (a) the company realized gross revenues of at least \$250 million for the provision of rail services in Canada in each of the two preceding calendar years and operates controlling locomotives on five miles or more of track in Canada;
- (b) the company operates a passenger train service within a municipality or between adjacent municipalities;
- (c) the company has 15 or more operating employees, operates controlling locomotives on 20 miles or more of track in Canada, operates at least one controlling locomotive at a speed of more than 25 miles per hour, and, if the company transports freight, generates more than 10% of its gross ton miles on track in Canada.

Installation of LVVR system

3 (1) A company must ensure that an LVVR system is installed in every controlling locomotive that it operates.

Exceptions

(2) However, a company is not required to ensure that an LVVR system is installed in a controlling locomotive that is a

- (a) steam locomotive;
- (b) heritage locomotive that is used exclusively for tourist railway services that travels no further than a round trip of 150 miles at a speed of no more than 25 miles per hour;
- (c) locomotive in yard service that is used exclusively in switching, marshalling, humping, trimming and industrial switching;
- (d) locomotive that is being used for testing and evaluation purposes; or
- (e) locomotive that the company intends to decommission within 18 months after the day on which these Regulations come into force.

Signage requirement

4 A company must ensure that the interior of every controlling locomotive fitted with an LVVR system has signage, written in both official languages of Canada and in a font that is clear and readable from the furthest point from the signage in the controlling locomotive, that

(a) notifies persons in the controlling locomotive that they are subject to audio and video recording; and

(b) includes the following statements: “It is prohibited by law for any person to do anything, including altering the locomotive voice and video recorder system, with the intent to prevent information from being recorded, collected or preserved.” and “Il est interdit par la loi à quiconque de prendre une quelconque mesure, notamment d’altérer le système d’enregistrement audio et vidéo de locomotive, dans l’intention d’empêcher l’enregistrement, la collecte ou la conservation de renseignements.”

Technical Requirements

LVVR system

5 A company must ensure that an LVVR system

(a) is equipped with at least one crash-protected memory module;

(b) continuously records voice and video data from the time the controlling locomotive engine is turned on until it is turned off;

(c) does not record data when the controlling locomotive engine is turned off;

(d) stores 48 hours of data on at least one crash-protected memory module;

(e) automatically and permanently erases from any crash-protected memory module any data other than the most recent 48 hours of data that was stored by the LVVR system on the module;

(f) is equipped with an alternate power supply or with a controlled shutdown feature that allows for a complete shutdown of the LVVR system in the event of a power interruption; and

(g) restarts automatically when power is restored to the controlling locomotive engine.

Environmental standards

6 A company must ensure that, on installation, an LVVR system meets the environmental criteria respecting vibration, shock, bump and temperature testing set out in standard EN 50155:2017, *Railway applications — Rolling stock — Electronic equipment*, published by BSI Standards Limited, on October 31, 2017, as amended from time to time.

Crashworthiness

7 A company must ensure that a crash-protected memory module

- (a) is installed in a controlling locomotive in the location that offers the most protection; and
- (b) meets, on installation or replacement, the crashworthiness requirements set out in standard 1482.1-2013, *IEEE Standard for Rail Transit Vehicle Event Recorders*, published by the Institute of Electrical and Electronic Engineers on March 6, 2014, as amended from time to time.

Microphones — voice quality

8 (1) A company must ensure that an LVVR system is equipped with one or more microphones that, collectively, are capable of clearly recording

- (a) the voices of the operating employees and their communications; and
- (b) aural warnings in the controlling locomotive, including alarms.

Technical requirements

(2) The company must ensure that every microphone

- (a) has its own recording channel;
- (b) if it is used to record the voices of operating employees, records frequencies from 150 Hz to 3.5 kHz; and
- (c) if it is used to record aural warnings in the controlling locomotive, records frequencies from 150 Hz to 6 kHz.

Placement of microphones

(3) The company must ensure that the microphones are positioned in the controlling locomotive in a manner that allows the recording of

- (a) the voice of the locomotive engineer, clearly and distinctly from the voice of the conductor;
- (b) the voice of the conductor, clearly and distinctly from the voice of the locomotive engineer; and
- (c) safety-related sounds and aural warnings in the controlling locomotive, including alarms.

Cameras — video quality

9 (1) A company must ensure that an LVVR system is equipped with one or more cameras that record at a minimum frame rate of 15 frames per second

- (a) clear video in all lighting conditions;
- (b) video with a resolution sufficient to determine the status of instrument displays in the controlling locomotive; and

(c) video with a resolution sufficient to determine the reactions of the operating employees, including their facial features and expressions.

Placement of cameras

(2) The company must ensure that the cameras are positioned in the controlling locomotive in a manner that allows the recording of

(a) the portion of the interior of the controlling locomotive where the operating employees carry out their work;

(b) an unobstructed view of the instruments and controls required to operate the controlling locomotive; and

(c) an unobstructed view of the faces and upper bodies of operating employees at a distance close enough to discern their facial features and expressions.

Additional cameras

(3) For greater certainty, a company that has satisfied the requirements set out in subsections (1) and (2) may equip an LVVR system with additional cameras that do not meet those requirements.

Coordinated Universal Time

10 (1) A company must ensure that the voice and video data recorded by an LVVR system has accurate date and time stamps that are expressed in Coordinated Universal Time (UTC).

Synchronization requirements

(2) The company must ensure that

(a) the date and time stamps of the voice data that is recorded by each microphone of an LVVR system are synchronized, to the second, with the date and time stamps of the video data that is recorded by each camera of that system;

(b) the date and time stamps of the voice and video data recorded by an LVVR system are synchronized, to the second, with the date and time stamps of

(i) locomotive event recorder data,

(ii) global positioning system (GPS) data, if applicable, and

(iii) the video data recorded by any outward-facing camera.

Playback synchronization

(3) The company must ensure that the voice and video data recorded by an LVVR system is capable of being automatically synchronized on a playback system.

Synchronization testing

(4) The company must carry out a test of each LVVR system at least once every 12 months to verify compliance with the synchronization requirements set out in subsection (2).

Record keeping

(5) The company must keep a record of each test carried out under subsection (4) for a period of six years after the day of the test and provide a copy to the Minister on request.

Test recordings

11 (1) A company must ensure that test recordings are carried out for each LVVR system installed in a controlling locomotive operated by the company to demonstrate that the system meets the requirements set out in section 8, paragraphs 9(1)(b) and (c) and subsections 9(2), 10(3) and 23(1).

Frequency

(2) The test recordings must be carried out in respect of an LVVR system once per year and at each of the following times:

- (a)** on installation of the system in the controlling locomotive, if the company itself installs the system;
- (b)** prior to the company's initial operation of the controlling locomotive, if the company itself did not install the system; and
- (c)** each time a component of the system is repaired, replaced or updated.

Retention of test recordings

(3) The company must keep the test recordings required under subsection (1) for a period of six years after the day on which they are carried out and provide a copy to the Minister on request.

Data Management Requirements

Policy and procedures

12 (1) A company must develop, implement and make available to all employees a written policy that includes

- (a)** a description of the purposes under section 17.91 of the Act for which the company intends to record, collect or preserve voice and video data;
- (b)** procedures for collecting, communicating, accessing and using voice and video data; and
- (c)** procedures for record keeping.

Retention of policy

(2) The company must keep the policy while it is in effect and for a period of six years after the day on which it is replaced and provide a copy to the Minister on request.

Accountable executive

13 (1) A company must designate a member of senior management who is responsible for the operations of the company as the accountable executive to be accountable for meeting the requirements of these Regulations, including implementing the policy referred to in section 12.

Notice to Minister

(2) The company must submit to the Minister, within 30 days after the designation, the name and title of the accountable executive and a statement signed by that person confirming that they accept the responsibilities of the position.

Authorized persons — voice and video data

14 (1) A company must designate the persons it authorizes to take one or more of the following actions and make a record of their names and positions:

(a) collecting voice and video data from a crash-protected memory module or from any other storage location where such data is automatically stored;

(b) communicating voice and video data; and

(c) accessing and using voice and video data for the purposes of paragraph 17.91(1)(a) or (b) or subsection 17.91(3) of the Act, as applicable.

Prohibition

(2) For the purposes of paragraph (1)(c), the company must not designate any person who directly manages operating employees to access or use voice and video data under paragraph 17.91(1)(a) of the Act.

Requirement

(3) A company must ensure that only a person authorized to take the action referred to in paragraph (1)(a), (b) or (c) takes that action.

Record keeping

(4) The company must keep any record required under subsection (1) while it is current and for a period of six years after the day on which it is revised and provide a copy to the Minister on request.

Authorized persons — training

15 (1) A company must provide training on the policy required under section 12 to each person designated under subsection 14(1) before the person takes any actions referred to in paragraphs 14(1)(a) to (c).

Additional training

(2) If the company makes any changes to the policy, the company must provide training on the changes to each person designated under subsection 14(1).

Safeguards — LVVR system

16 (1) A company must ensure that an LVVR system is equipped with physical safeguards that are designed to prevent tampering, including reducing the field of view of the cameras.

Safeguards — voice and video data

(2) A company must ensure that crash-protected memory modules and any other storage locations containing voice or video data that was recorded in a controlling locomotive operated by the company are subject to safeguards that are designed to prevent unauthorized access to the data, including physical safeguards such as locked filing cabinets and restricted access to offices, organizational safeguards such as requiring a continuous chain of custody and technological safeguards such as the use of passwords and encryption.

Clarification

17 For greater certainty, even if a company uses a storage provider operated by a third party to back up or store voice or video data that was recorded in a controlling locomotive operated by the company, the company is responsible for complying with the provisions of the Act and these Regulations in respect of that data.

Virtual storage provider

18 If a company uses a virtual storage provider, including a cloud storage provider, to back up or store voice or video data that was recorded in a controlling locomotive operated by the company, the company must ensure that the provider is accredited under a current internationally recognized standard respecting information security management systems.

Record of data access or download

19 (1) A company must ensure that any technological means it uses to access or download voice or video data from a crash-protected memory module, or any other storage location where such data is automatically stored, automatically generates an unalterable record each time such data is accessed or downloaded.

Contents of record

(2) The record must include the following information:

- (a) an electronic signature that uniquely identifies the person who accessed or downloaded the voice or video data;
- (b) the date and time the data was accessed or downloaded;
- (c) the date and time stamps of the data; and
- (d) the number or other identifier that uniquely identifies the controlling locomotive in which the data was recorded.

Monthly report

(3) The company must, on a monthly basis, make available to all operating employees a report that includes the information referred to in subsection (2) that was generated during the preceding month.

Retention of documents

(4) The company must keep the records and reports described in subsections (1) and (3) for a period of six years after the day on which they are created and provide a copy to the Minister on request.

Communication Requirements

Request from Minister or inspector

20 On receipt of a request to obtain, for use by the Minister under paragraph 17.92(1)(b) or (c) of the Act or for use by a railway safety inspector under subsection 17.93(1) of the Act, voice or video data that was recorded in a controlling locomotive operated by the company, the company must communicate the data to the Minister or the railway safety inspector, as the case may be.

Secure communications

21 If a company communicates voice or video data that was recorded in a controlling locomotive operated by the company, it must communicate the data in a format that prevents unauthorized access.

Communications with TSB

22 (1) If a company communicates to the TSB voice or video data that was recorded in a controlling locomotive operated by the company, it must provide the software and equipment required to use the data, either in advance of or at the time that it communicates the data.

Communications with Minister

(2) If a company is required to communicate voice or video data that was recorded in a controlling locomotive operated by the company to the Minister, the company must transfer the data to the Minister and, on request, provide the software and equipment required to use the data.

Communications with railway safety inspector

(3) If a company is required to communicate voice or video data that was recorded in a controlling locomotive operated by the company to a railway safety inspector, the company must make the data available to the inspector.

Playback of data

23 (1) A company must ensure that voice and video data is capable of being played back in such a way that

- (a)** the communications of the operating employees are understandable; and
- (b)** the voice of each operating employee is identifiable and clearly distinguishable.

Playback system

(2) A company must ensure that any playback system used to review voice or video data allows for an uninterrupted review of the data and includes play, pause, rewind and fast-forward functions.

Accident and Incident Investigations

Accessing and using data — conditions

24 (1) A company must not access or use, for the purpose of paragraph 17.91(1)(b) of the Act, voice or video data that was recorded in a controlling locomotive operated by the company unless it

- (a)** has identified that the controlling locomotive was involved in the accident or incident; and
- (b)** has reason to believe that activities in the controlling locomotive caused or contributed to the accident or incident.

Accessing and using data — types

(2) For the purpose of paragraph 17.91(1)(b) of the Act, the voice and video data that a company may access and use is the data from the controlling locomotive involved in the accident or incident that was recorded

- (a)** during the shift of any operating employee who was present when the accident or incident occurred; and
- (b)** during a shift immediately preceding a shift referred to in paragraph (a) if, prior to accessing or using the data, the company has notified all operating employees who are present on the recording, and any bargaining agents representing those employees, that it intends to use the data.

Clarification

(3) For greater certainty, if, at the time of an accident or incident, a company cannot identify which controlling locomotive was involved, the company must not use voice or video data for the purpose of making that determination.

Data collection

25 On receipt of a request for voice or video data related to an accident or incident for use by the Minister under subsection 17.92(1) of the Act or for use by a railway safety inspector under subsection 17.93(1) of the Act, a company must ensure that, before the data is permanently erased, it is collected from the crash-protected memory module or any other storage location where the data is automatically stored, and preserved in another storage location.

Random Selection

Process

26 (1) To randomly select voice and video data as required by subsection 17.91(2) of the Act, a company must use a random number generator to select, in the following order,

- (a)** the day of the month from which the data will be selected;
- (b)** the controlling locomotives from which the data will be selected; and
- (c)** a maximum of three start times, to the minute, for each of the controlling locomotives.

Random selection

(2) The company must ensure that, when making the selections set out in subsection (1), no day, controlling locomotive or start time has a greater likelihood of being selected than another.

Selecting the day of the month

(3) For the purpose of paragraph (1)(a), the company must use the random number generator during the week preceding the beginning of the month.

Selecting controlling locomotives

(4) For the purpose of paragraph (1)(b), the company must select at least two controlling locomotives from among all of the controlling locomotives that the company is scheduled to operate in Canada on the day selected under paragraph 1(a). The number of controlling locomotives selected must not exceed 10% of the controlling locomotives that the company is scheduled to operate in Canada on that day.

Selecting start times

(5) For the purpose of paragraph (1)(c), the company may include parameters to ensure that the selected start times are chosen from among the times that the controlling locomotives are scheduled to operate.

Obligation to download

(6) A company must download 30 minutes of voice and video data beginning from each selected start time before the data is permanently erased from the crash-protected memory module or any other storage location where such data is automatically stored.

Prohibition — maximum of 30 minutes

(7) A company must not download more than 30 minutes of voice and video data beginning from each selected start time.

Prohibition — repeated selection process

(8) A company must not perform the selections set out in paragraph (1)(a) to (c) more than once in respect of a given month.

Random selection policy

(9) A company must develop and implement a written random selection policy that

(a) identifies the persons in the company who are authorized to perform the selections set out in subsection (1);

(b) ensures that no person who schedules or manages employees performs the selections set out in subsection (1) or influences any person who does; and

(c) identifies and describes the random number generator that the company uses to perform the selections set out in subsection (1).

Use of voice and video data

27 For the purpose of paragraph 17.91(1)(a) of the Act, a company must use all voice and video data selected in accordance with section 26 within 30 days after downloading the data.

Submission of random selection policy to Minister

28 (1) A company must submit a copy of the random selection policy required under subsection 26(9) to the Minister before selecting any voice and video data for the purpose of paragraph 17.91(1)(a) of the Act.

Changes to policy

(2) If a company changes its random selection policy after submitting it to the Minister, the company must submit a copy of the updated policy to the Minister before selecting any voice and video data for the purpose of paragraph 17.91(1)(a) of the Act.

Request by Minister

29 (1) On receipt of a request to obtain, for use by the Minister under paragraph 17.92(1)(a) of the Act, voice or video data that was recorded in a controlling locomotive operated by the company, the company must communicate to the Minister data that

- (a) the company has randomly selected in accordance with any methodology provided by the Minister;
- (b) the Minister has randomly selected; or
- (c) the company has randomly selected for the purpose of paragraph 17.91(1)(a) of the Act.

List of controlling locomotives

(2) For the purpose of paragraph (1)(b), a company must provide to the Minister, on request, a list of its controlling locomotives that are scheduled to be in operation in Canada on any day or in any location selected by the Minister.

Downloading data

(3) A company must download all voice and video data requested under subsection (1) before it is permanently erased from the crash-protected memory module or any other storage location where such data is automatically stored.

Threats to Safety of Railway Operations

Prescribed threats

30 For the purpose of subsection 17.91(3) of the Act, a company may use voice and video data to address the following threats to the safety of railway operations:

- (a) an operating employee who uses a cellular telephone while on duty when normal railway radio communication systems are available, except as provided for in company policies;
- (b) an operating employee who assumes a sleeping position while on duty, except as provided for in company policies;
- (c) an operating employee who uses a personal entertainment device while on duty, except as provided for in company policies;
- (d) the presence of an unauthorized person in the controlling locomotive;
- (e) an operating employee who is consuming or using intoxicants or impairing drugs;
- (f) an operating employee who reads materials not required in the performance of their duties while on duty, except as provided for in company policies; and

(g) operating employees who are within hearing range of each other but who are not verbally communicating, in a clear and audible manner, information they are required to verbally communicate in accordance with rules approved or established by the Minister under sections 19 and 20 of the Act.

Employee access to data

31 If a company identifies a threat set out in section 30 when it is using voice or video data for the purposes of subsection 17.91(1) of the Act, the company must

(a) as soon as possible, notify all identifiable persons present on the recording of the data that the company has identified a threat on that recording;

(b) within 30 days after the notice is provided under paragraph (a), advise any employee the company has deemed responsible for the threat as to whether the data will be used to address the threat;

(c) make the data available to any employee whom the company has deemed responsible for the threat, on request of the employee; and

(d) before the data is made available under paragraph (c), notify any other person referred to in paragraph (a) that the data will be made available to the employee deemed responsible for the threat.

Preservation and Erasure of Voice and Video Data

Erasure of data — storage locations

32 A company must ensure that voice and video data is permanently erased from any storage location where such data is automatically stored, other than a crash-protected memory module, before or at the same time as the corresponding data is permanently erased from a crash-protected memory module in accordance with paragraph 5(e).

Erasure of data — when purpose achieved

33 (1) If a company preserves voice or video data for any purpose set out in sections 17.91 to 17.93 of the Act, the company must permanently erase the data from all storage locations as soon as the data is no longer required for that purpose.

Exception — paragraph 17.91(1)(a) of the Act

(2) Despite subsection (1), if a company uses voice or video data for the purpose of paragraph 17.91(1)(a) of the Act, the company must permanently erase the data from all storage locations within 30 days after downloading the data.

Exception — threat to safety of railway operations

(3) Despite subsections (1) and (2), if a company preserves voice and video data for any purpose set out in subsection 17.91(1) of the Act and uses the data to address a threat to the safety of railway operations set out in section 30, the company must preserve the data for at least two years after the day on which the decision to address the threat was made and permanently erase the data from all storage locations as soon as the following conditions have been met:

- (a) two years have passed since the decision to address the threat was made; and
- (b) the data is no longer required for the purpose for which it was preserved.

Record Keeping

Accessing or using voice or video data

34 (1) Each time a company accesses or uses voice or video data, the company must make a record that sets out

- (a) the name of the person who accessed or used the data;
- (b) the date and time the data was accessed or used;
- (c) the date and time stamps of the data;
- (d) the number or other identifier that uniquely identifies the controlling locomotive on which the data was recorded; and
- (e) the purpose for which the data was accessed or used.

Communication of voice or video data

(2) Each time a company communicates voice or video data to the TSB, the Minister or a railway safety inspector, the company must make a record that sets out

- (a) the purpose for which the data was communicated;
- (b) the date and time the data was communicated;
- (c) the name of the person who communicated the data; and
- (d) the name of any individual who received or, as applicable, viewed the data and the organization they represent.

Record keeping

(3) The company must keep the records referred to in subsections (1) and (2) for a period of six years after the day on which they are created and provide a copy of any record to the Minister on request.

Record of random selection

35 (1) Each time a company randomly selects voice and video data for the purposes of paragraph 17.91(1)(a) or 17.92(1)(a) of the Act, the company must make a record that sets out

- (a) each selection made in accordance with subsection 26(1) or any methodology provided by the Minister under paragraph 29(1)(a), including the full data set from which each selection was made;
- (b) the name and position of the person who performed each selection; and
- (c) the voice and video data that was downloaded.

Record keeping

(2) The company must keep the records referred to in subsection (1) for a period of six years after the day on which they are created and provide a copy of any record to the Minister on request.

Data use — threats to safety of railway operations

36 (1) Each time a company uses voice or video data to address a threat to the safety of railway operations set out in section 30, the company must make a record that sets out

- (a) the purpose for which the data was used under subsection 17.91(1) of the Act;
- (b) the threat to the safety of railway operations that was addressed; and
- (c) the day on which the decision to address the threat was made.

Record keeping

(2) The company must keep the record referred to in subsection (1) for a period of six years after the day on which it is created and provide a copy of any record to the Minister on request.

Erasure of voice or video data

37 (1) Each time a company permanently erases voice or video data in accordance with section 33, the company must make a record that sets out

- (a) the method used to erase the data;
- (b) the date and time the data was erased;
- (c) all storage locations from which the data was erased; and
- (d) the name and position of the person who erased the data.

Record keeping

(2) The company must keep the record referred to in subsection (1) for a period of six years after the day on which it is created and provide a copy of any record to the Minister on request.

Copies kept in Canada

38 The company must keep at its principal place of business in Canada a copy of any record, test recording, policy and report that it is required to keep under these Regulations.

Consequential Amendments to the Railway Safety Administrative Monetary Penalties Regulations

39 Part 1 of Schedule 1 to the *Railway Safety Administrative Monetary Penalties Regulations* ¹ is amended by adding the following after item 7:

Item	Column 1	Column 2	Column 3
	Designated Provision	Maximum Amount Payable (\$) Individual	Maximum Amount Payable (\$) Corporation
7.1	Subsection 17.31(1)	50,000	250,000
7.2	Subsection 17.31(2)	50,000	250,000
7.3	Subsection 17.31(3)	50,000	250,000

40 Schedule 1 to the Regulations is amended by adding the following after Part 5:

PART 6

Designated Provisions of the Locomotive Voice and Video Recorder Regulations

Item	Column 1	Column 2	Column 3
	Designated Provision	Maximum Amount Payable (\$) Individual	Maximum Amount Payable (\$) Corporation
1	Subsection 3(1)	50,000	250,000
2	Section 4	50,000	250,000
3	Section 5	50,000	250,000
4	Section 6	50,000	250,000

5	Section 7	50,000	250,000
6	Section 8	50,000	250,000
7	Subsections 9(1) and (2)	50,000	250,000
8	Subsections 10(1) to (4)	50,000	250,000
9	Subsection 10(5)	5,000	25,000
10	Subsections 11(1) and (2)	5,000	25,000
11	Subsection 11(3)	5,000	25,000
12	Subsection 12(1)	25,000	125,000
13	Subsection 12(2)	25,000	125,000
14	Section 13	25,000	125,000
15	Section 14	50,000	250,000
16	Section 15	25,000	125,000
17	Section 16	50,000	250,000
18	Section 18	50,000	250,000
19	Subsections 19(1) and (2)	50,000	250,000
20	Subsection 19(3)	50,000	250,000
21	Subsection 19(4)	25,000	125,000
22	Section 20	50,000	250,000
23	Section 21	50,000	250,000

24	Subsection 22(1)	50,000	250,000
25	Subsection 22(2)	50,000	250,000
26	Subsection 22(3)	50,000	250,000
27	Subsection 23(1)	50,000	250,000
28	Subsection 23(2)	50,000	250,000
29	Section 24	50,000	250,000
30	Section 25	50,000	250,000
31	Subsections 26(1) to (7)	50,000	250,000
32	Subsection 26(8)	50,000	250,000
33	Subsection 26(9)	50,000	250,000
34	Section 27	50,000	250,000
35	Section 28	50,000	250,000
36	Subsections 29(1) and (2)	50,000	250,000
37	Subsection 29(3)	50,000	250,000
38	Section 31	50,000	250,000
39	Section 32	50,000	250,000
40	Subsection 33(1)	50,000	250,000
41	Subsection 33(2)	50,000	250,000
42	Subsection 33(3)	50,000	250,000

43	Subsection 34(1)	50,000	250,000
44	Subsection 34(2)	25,000	125,000
45	Subsection 34(3)	25,000	125,000
46	Subsection 35(1)	25,000	125,000
47	Subsection 35(2)	25,000	125,000
48	Subsection 36(1)	25,000	125,000
49	Subsection 36(2)	25,000	125,000
50	Subsection 37(1)	25,000	125,000
51	Subsection 37(2)	25,000	125,000
52	Section 38	50,000	250,000

Coming into Force

Second anniversary

41 These Regulations come into force on the second anniversary of the day on which they are published in the *Canada Gazette*, Part II.

REGULATORY IMPACT ANALYSIS STATEMENT

(This statement is not part of the Regulations.)

Executive summary

Issues: The *Locomotive Voice and Video Recorder Regulations* (the Regulations) will provide data about in-cab operating employee actions that are not otherwise available, and will further be useful in providing proactive data to strengthen safety management systems

and prevent accidents and incidents by providing the opportunity to mitigate risks before accidents occur.

Description: The Regulations set out the technical specifications required for the locomotive voice and video recording equipment, including environmental and crashworthiness standards and requirements for voice and video quality, placement of cameras and microphones, and synchronization of data; they also set out the privacy protections for the access and use of the voice and video data, including the requirements for random selection, access controls, collection, communication, and destruction of the data.

Rationale: The Transportation Safety Board (TSB) has been recommending recording devices in locomotive cabs since 2003. The Regulations will impose a total cost of \$76.79 million, most of which will be carried by rail companies for the purchase and installation of the devices. The impacts of the Regulations were evaluated using a break-even analysis approach, which aims to determine the minimum quantified benefit required for the benefits of the Regulations to be equal to or greater than the estimated costs. In the central analysis, a reduction of 4.35% in the annual number of in-scope rail occurrences (e.g. accidents or incidents) will be required for the Regulations to break even.

Issues

Bill C-49, the *Transportation Modernization Act*, which received royal assent on May 23, 2018, amends the *Railway Safety Act* (RSA) to, among other things, require rail companies to fit their railway equipment with recording instruments and to provide the Governor in Council with the authority to make regulations concerning recording instruments.

The Bill C-49 amendments to the RSA were developed in recognition that there are many situations in locomotive cabs where it is difficult or impossible to have objective information, or any information at all, about crew behaviour or activities in the lead-up to an accident or incident without the use of voice and video recorders in locomotive cabs. This information is crucial to understanding the causes and contributing factors of rail occurrences.

Proactive risk management through the use of voice and video data will strengthen the rail safety regime. The locomotive voice and video recorder (LVVR) regime provides the opportunity for lessons learned through the analysis of data that previously would not have been accessible.

The Regulations provide railway companies and local railway companies that meet the scope of application criteria with regulatory provisions that specify what must be done in order to comply with the RSA recording instruments requirement. Making regulations to support the Bill C-49 requirement to install recording instruments is a necessary step in order to implement the *Transportation Modernization Act* and is an important step in making rail transportation safer for Canada and Canadians.

Background

The Transportation Safety Board (TSB) first recommended the use of on-board voice recording devices in locomotive cabs in 2003, and subsequently placed the lack of a requirement for companies to install both voice and video recorders on locomotives on their Watchlist in 2012. The Watchlist is developed by the TSB to identify key issues that the TSB believes need to be addressed to improve the safety of Canada's transportation system.

In 2013, following a VIA Rail train derailment in Burlington, Ontario, in which all 3 operating employees were fatally injured and 45 people sustained various injuries, the TSB recommended that voice and video recording devices be installed on all controlling locomotives operating on main track. In the Burlington investigation report the TSB noted that, in the absence of voice and video recorders, it was not possible for their investigators to identify with certainty the dynamics and interaction between the three operating employees leading up to the accident. The TSB further noted that it was difficult to determine whether any human factors, such as fatigue, had contributed to the derailment.

In the 2016 version of the Watchlist, the TSB noted that "with no requirement for on-board voice and video recorders on locomotives, key information to advance railway safety may not always be available for accident investigations and proactive safety management," and that if permitted, locomotive voice and video recordings "could also provide railways with a means to identify and address operational and human factors issues within a proactive safety management system."

In February 2016, the *Canada Transportation Act* (CTA) Review Report recommended that a formal strategy for the implementation of locomotive voice and video recording technology be developed by 2020.

In September 2016, the TSB issued their report on the joint TSB–Transport Canada (TC) study on LVVR, which concluded that rail safety would be enhanced if the data could be used for proactive safety management. The report noted that the safety benefits of locomotive voice and video recorders extend beyond use for post-accident investigation to also include use for proactive safety management to help identify and mitigate risks before accidents and incidents occur, which could even "reduce the need for reactive investigations."

Bill C-49 amended the RSA to require locomotive voice and video recording equipment in the locomotive cabs of Canada's federally regulated railways.

Bill C-49 also amended the RSA and the *Canadian Transportation Accident Investigation and Safety Board Act* (CTAISB Act) to expand the availability of locomotive voice and video recordings beyond access and use by the TSB for accident and incident investigations. Specifically, the legislative amendments allow for locomotive voice and video recordings to be available to companies and TC for the purpose of determining the causes and contributing factors of a reportable accident or incident that the TSB does not investigate. Further, the legislative amendments allow companies to access and use randomly selected voice and video data to

identify lessons to be learned and implement corrective measures as part of their ongoing safety management, and allow TC to access and use randomly selected voice and video data for policy development purposes, such as trend analysis to inform the rationale for the development of future policies, regulations, or legislation.

While the permitted uses of voice and video data by companies and TC are established in the Bill C-49 amendments to the RSA, the Regulations further set out limits on the collection, access and use of locomotive voice and video recorder (LVVR) data. For example, in the case of the use of LVVR data by companies for accident or incident investigation, the Regulations limit companies to only using data if the company has reason to believe that crew activities in the controlling locomotive caused or contributed to the occurrence. Further, companies will only be allowed to use data from the shift of operating employees present when the accident or incident occurred and, potentially, from the preceding shift, and only from the controlling locomotive involved in the accident or incident. Moreover, in the case of the use of LVVR data by companies to identify safety concerns, companies will be limited to using data that is randomly selected in accordance with the random selection methodology requirements set out in the Regulations.

At the same time, the legislative amendments establish strong privacy protections for locomotive voice and video recorder data, by clearly reinforcing that this data is privileged information under the CTASB Act, meaning it cannot be communicated or used for any other purposes than what is authorized by law, including accident investigation by the TSB. Live streaming of voice and video data or viewing voice and video data in real time is not supported by the RSA for reasons including that such an approach will not satisfy the requirement to randomly select recorded information in accordance with the Regulations, and that using voice and video data for accident and incident investigation is necessarily conducted post-occurrence.

The Bill C-49 amendments to the RSA will come into force on the same day as the Regulations, which will be on a date to be fixed by order of the Governor in Council.

In 2018, the TSB removed locomotive voice and video recorders from its Watchlist in response to the Bill C-49 amendments to the RSA and the development of the Regulations.

Objective

The Regulations will improve rail safety as well as the safety of the Canadian public by (1) providing data about the causes and contributing factors of accidents or incidents, which could include human factors, that is not otherwise available; (2) allowing better and more complete accident investigations by the TSB, TC and rail companies; and (3) providing data for proactive use by TC and rail companies to help identify safety risks, potentially leading to the development of new regulations, rules, policies or procedures to mitigate those risks before accidents occur.

Furthermore, the availability of locomotive voice and video recorder data will contribute to evidence-based regulatory decision-making and allow companies, as part of their safety management systems, to mitigate risks before accidents occur.

Finally, the amendments to the *Railway Safety Administrative Monetary Penalties Regulations* (AMPs Regulations) to incorporate designated provisions for contraventions to the RSA and the Regulations will reinforce privacy protections related to voice and video data by providing the Minister with an efficient means of responding to non-compliance with the new locomotive voice and video recorder regime.

Description

The Regulations require federally regulated railways to install locomotive voice and video recorder systems in the cabs of controlling locomotives, ² no later than two years after the day on which the Regulations are published in the *Canada Gazette*, Part II. Recording equipment must meet specification and configuration requirements. There are also provisions dictating the access and handling of locomotive voice and video recorder data and the communication of data from rail companies to the TSB and TC, including the requirement for rail companies to provide the software and equipment required to use the data to the TSB and, on request, to TC.

Scope of application

The Regulations apply to rail companies that generated gross revenues of at least \$250,000,000 for the provision of rail services in Canada in each of the two preceding calendar years and that operate controlling locomotives on 5 or more miles of track within Canada; to rail companies that operate a passenger train service within a municipality or between adjacent municipalities; or to companies that have 15 or more operating employees and operate controlling locomotives on 20 or more miles of track within Canada, and operate at least one controlling locomotive at a speed of over 25 miles per hour.

There are 11 railway companies and 5 local railway companies within the scope of the Regulations. Freight companies that conduct most of their operations outside of Canada (meaning that at least 90% of their gross ton miles occur outside of Canada) are excluded from the Regulations. This exclusion is being provided to these freight companies as they have a limited operational presence in Canada and would have to equip their entire fleet with the necessary equipment to comply with the Regulations. It is anticipated that this exclusion will not negatively affect rail safety as these excluded American rail companies will need to meet safety objectives under their own legislation and regulations.

Steam locomotives, heritage locomotives operated exclusively for tourist railway services that travel no further than a round trip of 150 miles at a speed of no more than 25 miles per hour, locomotives in yard service used exclusively in switching, marshalling, humping, trimming and

industrial switching, locomotives used for testing and evaluation purposes, and locomotives scheduled to be decommissioned within 18 months of the coming into force of the Regulations are exempted from the requirements.

Downloading accident or incident data

Companies will only be permitted to use voice and video data to investigate an occurrence that the TSB is not investigating if the company can identify which controlling locomotive was involved in the occurrence, and the company has reason to believe that the activities in the controlling locomotive caused or contributed to the occurrence.

Random selection requirements

Prior to randomly selecting locomotive voice and video recordings to identify safety concerns as part of their ongoing safety management, companies will be required to develop a written random selection policy that

- identifies who in the company is authorized to conduct the random selections;
- ensures that there is no influence between the person at the company who conducts the random selection and the person at the company who schedules or manages personnel;
- identifies and describes the random number generator that the company uses to conduct the random selections; and
- has been submitted to TC prior to the company conducting any random selections.

Companies will be required to use a random number generator to select, in the following order, the day of the month from which the data will be selected, the controlling locomotives from which the data will be selected, and the maximum of three start times, to the minute, for each of the controlling locomotives.

When making these selections, companies will be required to ensure no day, controlling locomotive, or start time within a pool from which a selection is made has a greater likelihood of being chosen over another.

Companies will be permitted to randomly select up to 10% of the total number of controlling locomotives that the company is scheduled to operate in Canada on the randomly selected day of the month. Companies will be permitted to randomly select up to three start times from each randomly selected controlling locomotive, and will be required to download no more than 30 minutes of voice and video data beginning from each selected start time.

Companies will be required to submit any changes to their random selection policy in writing to TC prior to undertaking a random selection in accordance with those changes. Companies will not be permitted to conduct random selections more than once per calendar month.

Addressing safety concerns and threats

To prevent companies from arbitrarily determining what is considered to be a threat to the safety of railway operations, the following list of prescribed threats are specifically set out in the Regulations; the companies may address these threats when using voice and video data:

- While on duty, using cellular telephones when normal railway radio communications are available, except as provided for in company policies;
- While on duty, assuming a position of sleep, except as provided for in company policies;
- While on duty, using personal entertainment devices, except as provided for in company policies;
- The presence of a non-authorized person in the controlling locomotive;
- Consuming or using intoxicants or impairing drugs;
- While on duty, reading printed materials not required in the performance of duty, except as provided for in company policies; and
- Operating employees within physical hearing range not verbally identifying to each other, in a clear and audible manner, signals that they are required to verbally identify to one another in accordance with rules approved or established by the Minister under sections 19 and 20 of the RSA.

If addressing a threat, companies will be required to create and maintain records for six years of the original purpose for which the voice and video data was used, the threat that was addressed, and the day on which the decision to address the threat was made.

Privacy protections

In addition to the strong privacy protections set out in the Bill C-49 amendments to the RSA, to further protect employees from unauthorized access or misuse of voice and video data, the Regulations include requirements that companies

- implement safeguards that prevent unauthorized access;
- identify who in the company can collect, communicate, access, and use voice and video data;
- destroy voice and video data as soon as the purpose for which the data was preserved has been completed;
- inform employees of the existence of the recording devices; and
- keep records of access, use, communication and disposal of voice and video data.

The Regulations also require rail companies to provide training to authorized personnel on the handling of this data.

Technical specifications

Companies will be required to ensure that locomotive voice and video recording equipment meets the following technical specifications:

- Recording length
 - Voice and video data recorded continuously from the time that the engine powering the controlling locomotive is turned on until the time that the engine powering the controlling locomotive is turned off, with data recorded and retained for 48 hours before automatic and permanent erasure of recorded data.
- Environmental standards
 - The locomotive voice and video recording system as a whole to meet British Standard EN50155:2017, *Railway applications — Electronic equipment used on rolling stock*, to ensure that physical protections are in place so that the entire recording system is vibration, shock, bump, and temperature tested to railway standards.
- Crashworthiness
 - The crash-protected memory module of the locomotive voice and video recording system must meet the survivability criteria established in the Institute of Electrical and Electronic Engineers (IEEE) crashworthiness standard for rail transit vehicle event recorders, and be strategically installed at a location that provides for its maximum protection. The IEEE crashworthiness standard was chosen for the memory module of the locomotive voice and video recording system, as it is the standard required in the Railway Locomotive Inspection and Safety Rules for the event recorder memory modules of locomotive event recorders.
- Voice quality
 - Microphones of sufficient sensitivity to clearly capture communications between operating employees and be able to discern which operating employee made which communications, and to clearly detect aural warnings including, but not limited to, alarms, to help determine the sequence of events preceding a TSB-reportable occurrence.
- Video quality
 - Cameras of sufficient quality to capture clear video in all lighting environments, with a minimum frame rate of 15 frames per second and a resolution sufficient to determine the status of instrument displays and the reactions of the operating employees, including their facial features and expressions.

- Placement of microphones
 - Microphones positioned in a manner that ensures that, at minimum, the voices of the operating employees are captured clearly and distinctly from one another, and safety-related sounds and aural warnings, including but not limited to alarms, are recorded.
- Placement of cameras
 - Cameras positioned in a manner that ensures that, at minimum, the portion of the interior of the controlling locomotive cab relevant to the operating employees' work is captured, there is a direct view of operating employees' faces and upper body at a distance close enough to discern facial features and expressions, and there is an unobstructed view of the instruments and controls required to operate the controlling locomotive.
- Technical accessibility and encryption
 - An unalterable record of every access or download of voice and video data from the crash-protected memory module or any other storage location on which such data is automatically stored is generated automatically, which includes the date and time stamps of all voice and video data that is accessed or downloaded, the date and time that the data was accessed or downloaded, the number or other identifier that uniquely identifies the controlling locomotive on which the voice and video data that was accessed or downloaded was recorded, and an electronic signature uniquely identifying the authorized person who accessed or downloaded the data.
 - Physical protections in place on all of the recording equipment to prevent tampering.
 - Physical and electronic access to the data on both the crash-protected memory module of the locomotive voice and video recording equipment and on all storage devices or locations containing the voice and video data to be secured and limited to authorized personnel.
- Synchronization
 - Voice and video data to have accurate time stamps synchronized to Coordinated Universal Time (UTC) standard.
 - The date and time of all of the voice and video data internally synchronized to one another to the second.
 - The data and time stamps of the locomotive event recorder (LER) and, if applicable, global positioning system (GPS) data, to be synchronized, to the second, to the date and time stamps of the voice and video data.
 - The voice and video data synchronized, to the second, to the date and time of data recorded on outward-facing cameras, if present.
 - Testing at least once per year to validate the ongoing synchronization of the voice and video data files, both internally and with other recorded data, including LER data and, if

applicable, GPS data, and information recorded on outward-facing cameras.

Record keeping

Companies will be required to keep records of the following for six years after the day on which they are created:

- All downloads of voice and video data;
- All random selections of voice and video data;
- Threats that have been addressed;
- The communication of voice and video data to the TSB or TC; and
- The destruction of voice and video data.

When using voice and video data to address a threat to the safety of railway operations, companies will be required to keep that voice and video data for two years after the decision was taken to address the threat and then securely destroy that voice and video data from all storage locations, provided the purpose for which the data had been preserved has been completed.

Amendments to the Railway Safety Administrative Monetary Penalties Regulations

The amendments to the *Railway Safety Administrative Monetary Penalties Regulations* (AMPs Regulations) are necessary to incorporate designated provisions for contraventions to the new locomotive voice and video recorder regime. Part 1 of Schedule 1 of the AMPs Regulations is amended to designate new provisions of the RSA and add a new Part 6 that will include the designated provisions for the Regulations.

The amendments to Schedule 1 of the AMPs Regulations prescribe the maximum payable amount for an individual and a company for each violation of a designated provision. There are three distinct maximum payable amounts reflecting the level of significance of each designated provision measured by the seriousness of the consequences or potential consequences of the contravention. The three maximum payable amounts reflect low-risk violations of administrative-type provisions, medium-risk safety violations, and major safety violations that pose the highest risk to safety.

The maximum payable amounts for a violation are as follows:

Column 1	Column 2	Column 3
Level of Risk	Maximum Payable Amount (\$) Individual	Maximum Payable Amount (\$) Corporation

Category A: If violation is low-level risk	5,000	25,000
Category B: If violation is medium-level risk	25,000	125,000
Category C: If violation is high-level risk	50,000	250,000

All of the designated provisions of the RSA are in the high safety risk category. The following are all of the designated provisions of the RSA and the maximum payable amounts that will be prescribed for each of those provisions in the amendments to the AMPs Regulations:

Category C: High-level risk

- Subsection 17.31(1): No railway company that meets the prescribed criteria shall operate railway equipment and no local railway company that meets the prescribed criteria shall operate railway equipment on a railway unless
 - (a) the railway equipment is fitted with the prescribed recording instruments; and
 - (b) the company, in the prescribed manner and circumstances, records the prescribed information using those instruments, collects the information that it records and preserves the information that it collects.
 - The maximum payable amount for contravention of subsection 17.31(1) of the RSA is \$50,000 for an individual, and \$250,000 for a corporation.
- Subsection 17.31(2): No company referred to in subsection (1) shall use or communicate the information that it records, collects or preserves under that subsection unless the use or communication is in accordance with the law.
 - The maximum payable amount for contravention of subsection 17.31(2) of the RSA is \$50,000 for an individual, and \$250,000 for a corporation.
- Subsection 17.31(3): No person shall do anything, including alter the recording instruments referred to in subsection (1), with the intent to prevent information from being recorded, collected or preserved under that subsection.
 - The maximum payable amount for contravention of subsection 17.31(3) of the RSA is \$50,000 for an individual, and \$250,000 for a corporation.

The following are examples of designated provisions of the Regulations in the low, medium and high safety risk categories, and the maximum payable amounts that will be prescribed for each of those provisions in the amendments to the AMPs Regulations for each of those categories:

Category A: Low-level risk

- Subsection 11(3): The company must keep the test recordings required under subsection (1) for six years from the day on which they are carried out and provide a copy to the Minister upon request.
 - The maximum payable amount for contravention of subsection 11(3) of the Regulations is \$5,000 for an individual, and \$25,000 for a corporation.

Category B: Medium-level risk

- Subsection 15(1): A company must provide to each person designated under subsection 14(1) training on the policy required under section 12, prior to the person exercising any responsibilities referred to in paragraphs 14(1)(a) to (c).
- Subsection 15(2): If the company makes any change to the policy required under section 12, the company must provide training to each person designated under subsection 14(1) on the changes.
 - The maximum payable amount for contravention of section 15 of the Regulations is \$25,000 for an individual, and \$125,000 for a corporation.

Category C: High-level risk

- Section 18: If the company backs up or stores voice and video data using a virtual storage provider, including in the cloud, the company must ensure that the virtual storage provider is accredited as conforming with a current internationally recognized standard respecting information security management systems.
 - The maximum payable amount for contravention of section 18 of the Regulations is \$50,000 for an individual, and \$250,000 for a corporation.

Administrative-type provisions in the Regulations are classified as a low-level risk subject to the Category A maximum payable amounts for a violation. Provisions in the Regulations that are not administrative in nature, where a contravention is not likely to result in a lack of LVVR data or a risk to privacy, are classified as a medium-level risk subject to the Category B maximum payable amounts for a violation. Finally, provisions in the Regulations where a contravention would result in a lack of voice and video data or would pose a high risk to privacy are classified as a high-level risk subject to the Category C maximum payable amounts for a violation.

Under the RSA, any person served with a notice of violation may request from the Transportation Appeal Tribunal of Canada (TATC) a review of an alleged violation or the amount of the penalty. The Minister or the person served with a notice of violation may appeal the results of the

determination to the TATC for final determination. As a quasi-judicial body, the TATC review process is less formal than court proceedings. Thus, an administrative monetary penalty (AMP) regime is relatively inexpensive to administer within an existing compliance and enforcement program, and it normally results in more timely and effective enforcement than prosecution.

Coming into force

Finally, the Regulations come into force on the second anniversary of the day on which they are published in the *Canada Gazette*, Part II, in order to provide a transition period of two years and to provide time for companies to procure and install the required locomotive voice and video recording equipment.

Regulatory development

Consultation

Impacted stakeholders, including companies, associations, and unions, have been aware of the issue of on-board recordings since 2003, when the TSB first recommended the use of on-board voice recording devices in locomotive cabs.

Impacted stakeholders were further engaged on this issue in 2012, when the Advisory Council on Railway Safety's Locomotive Voice Recorder Working Group, composed of representatives from industry, associations, unions, and Government, was established to explore the concerns expressed by the TSB with respect to the absence of communication recording devices in the locomotive cab involved in the 2012 Burlington VIA Rail derailment.

In May 2015, impacted stakeholders were engaged on this issue again, when TC and the TSB launched a joint study on locomotive voice and video recorders that included representatives from railway companies, the Railway Association of Canada (RAC), and unions, in addition to the TSB and TC.

Railway companies, local railway companies, and the RAC participated in a series of pre-consultation meetings held on October 30, 2017, and November 7, 2017, to discuss the policy proposal for a possible locomotive voice and video recorder regulatory regime. The Western Canadian Short Line Railway Association (WCSLRA) was consulted on the policy proposal at a meeting held on November 14, 2017. These pre-consultation meetings covered the policy for the proposed Regulations, including the policy proposals for the scope of application criteria, privacy provisions, random selection requirements, and technical specifications for the locomotive voice and video recording equipment. The policy for the proposed Regulations was updated based on the input provided by companies at those meetings.

On December 7, 2017, a survey was sent to railway companies, local railway companies, and the RAC to gather information to inform the policy development and potential cost-benefit analysis for a possible locomotive voice and video recorder regulatory regime, with a requested return date for completed surveys by December 21, 2017. To increase the number of completed surveys, on January 16, 2018, the survey was resent to the same stakeholders, with a requested return date of February 2, 2018. In total, TC received 33 completed survey responses from stakeholders. The completed surveys contained information from companies regarding the total number of employees and the number of operating employees that they employ, the total mileage of track on which they operate, the number of locomotives they operate on federal track in Canada, and other information that was used to develop the cost-benefit analysis for the Regulations.

Following royal assent of the Bill C-49 amendments to the RSA on May 23, 2018, formal regulatory consultations were launched. Railway companies, local railway companies and associations were consulted on the proposed locomotive voice and video recorder regulatory regime at meetings held on November 8 and 9, 2018. Companies provided their feedback on the proposed regulatory requirements at those meetings, including comments on the scope of application criteria, the random selection requirements, the prescribed threats to the safety of railway operations, and the technical specifications.

In particular, during the consultations, companies expressed concerns about the usefulness of the random selection requirements, noting that it would be difficult to collect the randomly selected data for use from controlling locomotives dispersed geographically across Canada before the data was automatically and permanently erased. TC responded during the consultations that the Regulations would allow for remote downloading of the data, which could help mitigate those concerns.

Further, companies also expressed concerns during these consultations about start times potentially being selected from times of day when controlling locomotives are not operating, particularly in the case of commuter or tourist rail operations, resulting in no data for those locomotives for that month. TC responded to this concern by updating the regulatory policy to allow companies to randomly select start times from the operating times for the randomly selected controlling locomotives on the randomly selected day of the month, to increase the availability of randomly selected data.

Unions, including representatives from Teamsters, Unifor, and the International Brotherhood of Electrical Workers (IBEW) were also consulted on the proposed regulatory regime at a meeting held on November 13, 2018. The unions provided their feedback on the proposed regulatory requirements at that meeting, including comments about the privacy requirements and the technical specifications for the locomotive voice and video recording equipment.

Manufacturers and other potential suppliers of locomotive voice and video recording equipment were consulted on the proposed regulatory regime at a meeting held on December 17, 2018, and provided their comments on the proposed technical specifications for the locomotive voice and

video recording equipment at that meeting.

Following the formal consultations, the requirements for the new locomotive voice and video recorder regulatory regime were updated to address input received from companies, the unions and manufacturers.

To inform the cost-benefit analysis for the Regulations, a consultation questionnaire was sent to railway companies and the Railway Association of Canada on January 15, 2019, with a requested return date for completed questionnaires of January 31, 2019. The purpose of the questionnaire was to confirm estimated controlling locomotive counts and gather information about the implementation of the random sampling methodology. In total, TC received six completed questionnaires from companies.

An additional consultation questionnaire was sent to manufacturers and other potential suppliers of locomotive voice and video recording equipment on January 16, 2019, with a requested return date for completed questionnaires of January 31, 2019. This questionnaire requested purchase and installation estimates for various locomotive types. In total, TC received one completed questionnaire from a manufacturer.

During the consultations, stakeholders were informed, and are now aware, that the Regulations will be subject to AMPs. Stakeholders are aware of the AMPs Regulations and the associated maximum payable amounts for individuals and corporations for the designated provisions in each of the A, B, and C categories, and did not express any concerns during consultations about AMPs for the locomotive voice and video recorder regime.

TC also met with the TSB throughout the development of the Regulations to ensure that the technical requirements for the locomotive voice and video recording equipment will result in voice and video data that is accessible and useful to the TSB in determining the causes and contributing factors of an accident or incident. During these discussions, the TSB indicated that it will be ready to use voice and video data upon the coming into force of the Regulations.

Officials representing the Office of the Privacy Commissioner (OPC) were also consulted in order to confirm that the Commissioner's comments with respect to privacy and the *Personal Information Protection and Electronic Documents Act* (PIPEDA) have been adequately addressed.

Prepublication in the Canada Gazette, Part I

The proposed Regulations were published in the *Canada Gazette*, Part I, on May 25, 2019, followed by a 60-day comment period ending on July 24, 2019. Twelve submissions were received, including submissions from rail companies, the RAC, unions, a railway equipment manufacturer, and the TSB.

Many of the comments received related to concerns that stakeholders previously raised to TC during the passage of Bill C-49 or during the formal consultations on the proposed Regulations. To the extent possible, these comments were addressed during the Bill process or by updating the

text of the proposed Regulations prior to prepublication in the *Canada Gazette*, Part I.

For example, unions continue to express concerns over the privacy aspects of the proposed Regulations. Many of the union comments received during the 60-day comment period following prepublication were also raised during the passage of the Bill C-49 and during consultations on the proposed Regulations. Specifically, unions requested that further limits be placed on the company use of LVVR data, and also requested increased security protections on the data. These concerns have been addressed to the extent possible in the Regulations. In addition, further clarification on the requirements of the Regulations will be provided through guidance material and should address many of the concerns raised. The Regulations were carefully designed to fall within the parameters of existing privacy legislation and policies, and safeguard the privacy rights of employees, while maximizing the safety benefits.

Overall, the comments received were supportive of the proposed Regulations, and only the following changes were made to clarify the regulatory requirements:

1. Paragraph 2(a): This application criteria was updated to clarify that the \$250,000,000 in gross revenues in each of the two preceding calendar years is for the provision of rail services in Canada, in response to concerns raised by companies that conduct the vast majority of their operations outside of Canada that despite their limited presence in Canada they would have to upgrade their entire fleet to meet the Regulations.
2. Paragraph 2(c): This application criteria was updated to clarify that it excludes freight companies that have at least 90% of their gross ton miles occurring outside of Canada, in response to concerns raised by companies that conduct the vast majority of their operations outside of Canada that despite their limited presence in Canada they would have to upgrade their entire fleet to meet the Regulations.
3. Paragraph 3(2)(b): This exception was updated in response to comments requesting clarification of the term “heritage locomotives” to except heritage locomotives that are used exclusively for tourist railway services that travel 150 miles at a speed of no more than 25 miles per hour from the Regulations.
4. Paragraph 3(2)(e): The list of exceptions was updated to include locomotives that are scheduled for decommissioning within 18 months after the Regulations come into force in response to concerns raised about the costs of installing LVVR equipment in locomotives that will only remain in operation for up to 18 months after the coming into force of the Regulations.

Requiring that this recording equipment be installed on locomotives that would only remain in operation for up to 18 months following the coming-into-force date of the Regulations would place an undue financial burden on some rail companies. Furthermore, it is anticipated that the non-application of the Regulations to the locomotives planned to be decommissioned would not

materially affect rail safety given the small number of affected locomotives (of which there are 21) compared to the total number of locomotives falling within the scope of these Regulations (approximately 2 745).

5. Paragraph 9(1)(a): The proposed phrase “clear video in all lighting environments, including low-light conditions” was replaced with “clear video in all lighting conditions” in response to concerns raised about the meaning of the term “low light.”

6. Subparagraph 10(2)(b)(iii): The proposed requirement to synchronize LVVR data with rail traffic controller (RTC) communications was removed in response to concerns raised about the feasibility of this requirement.

7. Subsection 17(1) and section 22: These provisions were included during the prepublication of these Regulations and would have specified that LVVR data must be stored in Canada and that LVVR data could only be downloaded from within Canada. Following stakeholder feedback about whether these provisions were necessary, TC has decided to remove those provisions. The privacy protection objective underpinning the sections will be achieved through several other provisions contained within the Regulations, specifically subsection 16(2), and sections 18, 34 and 38. Subsection 16(2) and section 18 require companies to protect LVVR data via a number of means, including physical safeguards such as locked filing cabinets and restricted access to offices containing LVVR data, organizational safeguards such as requiring a continuous chain of custody for the handling of LVVR data, technological safeguards such as the use of passwords and encryption for LVVR data, and international accreditation for any cloud storage provider used to virtually store LVVR data. Sections 34 and 38 further protect privacy by enabling Transport Canada to have ready access to the information needed to check if the company is complying with the privacy provisions in the *Railway Safety Act* and in the Regulations respecting collection, communication, preservation, access and use of LVVR data.

8. Section 17: To mitigate potential stakeholder concerns associated with removing subsection 17(1) and section 22, a provision was added to reinforce that a company is always responsible for complying with the requirements in the *Railway Safety Act* and the Regulations in respect of LVVR data, even when the data is transferred to a storage provider operated by a third party for backup or storage.

9. Section 38: To further mitigate potential stakeholder concerns associated with removing subsection 17(1) and section 22, a requirement was added that a company must keep all of the records, test recordings, policies and reports that are required to be kept under the Regulations at its principal place of business in Canada to ensure inspectors have access to the information they require to ensure compliance with the Regulations.

A summary of other key issues raised by stakeholders and Transport Canada’s responses is below.

List of rail companies subject to the Regulations

Some stakeholders inquired whether TC would maintain a public list of the companies who fall within the scope of the Regulations. A list will not be maintained because the responsibility of determining whether a particular technical regulatory requirement related to railway operations is the responsibility of the persons conducting those federally regulated activities. As well, it is a departure from established TC practice to establish an exhaustive list of persons who fall within the scope of a particular TC administered regulation because determining applicability of requirements is the responsibility of the regulated party. Regulated parties can determine whether the scope of application of regulations applies to them by examining the application provision of a set of regulations.

Privacy

Some stakeholders inquired about the purpose of certain data-related requirements. Such requirements were included to maintain personal privacy protections.

In some cases, stakeholders commented that the random selection methodology was prescriptive; however, this prescribed methodology is a principal component of personal privacy protection for employees and is required by the *Railway Safety Act*.

Technical specifications

Given that the Regulations provide technical specifications to support the implementation of the locomotive voice and video recorder regime established in the Railway Safety Act, several comments concerned technical requirements and sought clarification about them. In general, in establishing the technical requirements of this proposal, TC considered stakeholder views, implementation feasibility, and cost-effectiveness, as well as how best to strike a balance between safety objectives and privacy protections. For example, requiring that recorded data be stored in a device that is both durable enough to withstand the high-impact of a railway crash as well as store 48 hours of recorded voice and video data was based on the following criteria: (1) the availability of crashworthy devices capable of storing 48 hours of recorded data; (2) the 2016 TSB-TC study in which the 48-hour period was recommended; (3) the cost of such devices relative to those that can record a greater number of hours; and (4) requiring that information not be stored for a longer period than what is needed to achieve the safety objective.

Cost-benefit analysis

Some stakeholders noted that the cost estimate for the procurement and installation of locomotive voice and video recorder systems seemed lower than expected. The procurement and installation cost estimates in the cost-benefit analysis were developed in consultation with the rail industry and recording equipment providers in early 2019. This information was used to develop an estimated

average incremental cost to install the equipment in accordance with the specifications of the Regulations. The actual cost will, however, vary by company and other variables, such as the locomotive model.

Other stakeholders noted that the time estimates seemed low, in the case of data retrieval, and seemed high, in the case of training. The time required for those activities may vary across the implicated stakeholders; however, the estimates provided in the cost-benefit analysis are average time estimates. With respect to data retrieval, the process would be relatively expeditious when the retrieval is completed by downloading through a remote data storage server. On the other hand, the process may require more time than the average if a person is required to download the information in-person at the location of the cab carrying the recording device. Regarding training, the same is true: depending on the training approach (e.g. in-person or remote), there could be some variability in time such as associated travel time.

In some cases, minor adjustments were made to the cost-benefit analysis to further refine it. For example, one stakeholder noted that the pricing for the signage should include an additional \$50 labour cost for the installation of each in-cab sign. Having reviewed this information, TC revised its estimate to indicate that the posting of signage inside locomotive cabs is \$100: \$50 to make a sign and \$50 for the labour.

Modern treaty obligations and Indigenous engagement and consultation

No modern treaty obligations associated with the Regulations have been identified. Therefore, there were no targeted engagements or consultations with specific Indigenous groups; however, broad consultations with Canadians were conducted through the *Canada Gazette* prepublication process.

Instrument choice

The Standing Committee on Transport, Infrastructure and Communities recommended that TC immediately develop legislation and regulations to mandate the use of locomotive voice and video recorders in its June 2016 report entitled *An Update on Rail Safety*. In the Government's response to this report, the Minister of Transport agreed in principle with this recommendation, and subsequently officially announced on November 3, 2016, his intention to mandate the installation and use of locomotive voice and video recorders.

Further to this commitment, Bill C-49 amended the RSA to require locomotive voice and video recording equipment in the locomotive cabs of Canada's federally regulated railways. To balance the need to improve railway safety while minimizing the impact on the privacy of railway employees, these amendments placed specific legislative limits on the access, use and communication of voice and video data.

These legislative amendments also provided the authority to make regulations that will enhance and clarify requirements aimed at further protecting access to the voice and video data. The details of the locomotive voice and video recorder regime, such as technical requirements and procedures to safeguard the data, are best developed in regulations. The new Regulations specify the details for storage, disposal, and access to locomotive voice and video data, among other privacy protection measures.

Regulatory analysis

Benefits and costs

Locomotive voice and video recorders provide information to rail companies and regulatory safety agencies that enhance the development of railway safety measures that could reduce the frequency and severity of railway accidents and incidents. The presence of in-cab recording equipment will also act as a deterrent against operators engaging in unsafe behaviour.

In the central scenario of this analysis, the total present value costs are \$76.79 million,³ with purchase and installation costs carried by rail companies representing the majority of the costs associated with the Regulations. Recording data will allow the TSB to conduct some of its investigations more efficiently, which will result in a quantified present value benefit of \$0.74 million. Therefore, the total net present value cost of the Regulations, without accounting for safety benefits, is \$76.05 million.

A break-even analysis of the safety benefits of the Regulations determined that the voluntary safety measures adopted by rail companies and the deterrent effect of the recorders would need to reduce the frequency of in-scope occurrences by 4.35%. Occurrences that were deemed in-scope are those that occurred on main track and to which human factors could have contributed — these will be referred to as “in-scope occurrences.”

The information provided in the “Benefits and costs” section is meant to summarize the findings of the analysis. A full cost-benefit analysis report is available upon request.

Analytical framework

The Regulations have been assessed in accordance with the Treasury Board Secretariat (TBS) *Canadian Cost-Benefit Analysis Guide*.⁴ Where possible, impacts are quantified and monetized, and only the direct costs and benefits for stakeholders are considered in the cost-benefit analysis.

In the central analysis, the analytical time frame is 13 years and the discount rate is 7%. The 13-year time frame captures the 2-year transition period beginning on the date of publication in the *Canada Gazette*, Part II, plus the expected useful life of recording equipment installed in the first year of the Regulations coming into force. A 20-year time frame is discussed in the sensitivity

analysis, along with the impacts of different discount rates, costing assumptions, and growth rates. In the sensitivity analysis, altering analytical parameters and assumed values alters the break-even point, and not the determination of the net cost or benefit.

Assumptions and considerations

The cost-benefit analysis is conducted by comparing the differences between two scenarios: the policy scenario in which the Regulations are implemented, and a baseline scenario that reflects current and planned actions of the regulated community in the absence of the Regulations.

In the baseline scenario, it is assumed that rail operators that do not already have locomotive voice and video recorders installed would not do so voluntarily. ⁵ While rail companies are permitted to install locomotive voice and video recorders on their locomotives, section 28 of the CTAISB Act prohibits companies from accessing the voice and video data. The data can only be accessed by TSB investigators in the event of an occurrence. Therefore, rail companies have little to no incentive to install locomotive voice and video recorders.

In the policy scenario, rail companies are assumed to be fully compliant with the Regulations in the compliance year (2022). Rail companies will be permitted access to voice and video data following TSB-reportable occurrences or through random selection, as a result of amendments to the RSA. Quantifiable differences between the baseline and policy scenarios are laid out in the “Costs” and “Benefits” sections below.

Although the Regulations will increase the marginal operating cost for rail companies, which may be passed on to consumers through higher freight rates or ticket prices, the forecast supply and demand for rail service is not expected to be different in the baseline and policy scenarios.

Affected stakeholders

The Regulations will affect a total of 16 rail companies. Fifteen of these companies are Canadian, with 10 privately owned companies and 5 owned by provincial or federal crown corporations or a municipal/provincial transit service (public rail companies). The Regulations would also affect a passenger rail company based in the United States that operates in Canada. The impacts of the Regulations on the U.S. rail company are not included in this analysis, in accordance with the *Canadian Cost-Benefit Analysis Guide: Regulatory Proposals*.

Table 1 shows the assumed number of controlling locomotives that railway companies in scope of the Regulations operated in 2019. This estimate is based on data collected from Statistics Canada as well as in consultation with rail companies.

Table 1: Rail companies and locomotives affected by the Regulations

Type of Company	Number of Companies	Number of Existing Controlling Locomotives
U.S.-based rail companies *	1	17
Canadian private companies	10	2 524
Canadian Crown corporations or municipal/provincial transit services	5	230
Total	16 (15 included in analysis)	2 771 (2 741 included in analysis)

* The impact of the Regulations on U.S.-based rail companies is not included in the cost-benefit analysis.

Costs

The costs associated with the Regulations will be assumed by three groups: rail companies, TC, and the TSB. The estimated total present value cost of the Regulations over the 13-year analytical time frame is \$76.79 million. Rail companies will assume 99.5% of the total cost associated with the Regulations.

Costs to rail companies

Rail companies will assume costs for purchase and installation, maintenance, testing, random selection, and other miscellaneous activities. The total present value cost to rail companies is estimated to be \$76.39 million. Private rail companies account for \$70.75 million of the cost, while public rail companies account for the remaining \$5.65 million.

Purchase and installation of locomotive voice and video recorders

The total present value cost for purchase and installation is \$69.15 million over the 13-year analytical time frame. Private rail companies account for \$64.12 million of the purchase and installation costs, while public rail companies account for the remaining \$5.02 million.

Rail companies in-scope of the Regulations will carry costs associated with the purchase and installation of locomotive voice and video recorders in all controlling locomotives that are not steam locomotives, heritage locomotives used exclusively in tourist excursion train service that travels no further than a round trip of 150 miles (240 km) and does not travel over 25 miles per hour, locomotives in yard service, and locomotives used for testing and evaluation purposes. Based on consultation with industry stakeholders and the opinion of TC officials, the estimated average cost to purchase and install locomotive voice and video recording equipment is \$26,602 per locomotive. Sensitivity analysis on this number was conducted and the results are provided in Table 6 of the “Sensitivity analysis” section.

In the first year of compliance, voice and video recorders will be installed in existing locomotives, with the exception of locomotives scheduled to be decommissioned within 18 months following the coming into force date.

Costs for installing locomotive voice and video recorders in existing fleet will be assumed in the first year of compliance. The cost associated with installing equipment in the new locomotives replacing those expected to be decommissioned within 18 months after the coming into force date will be assumed in the second year of compliance. It is expected that 21 locomotives would be affected by the 18-month exemption.

There would also be costs associated with locomotive fleet turnover in subsequent years. Based on the opinion of TC officials, the estimated lifespan of a controlling locomotive is 40 years, which will amount to a total of 69 new controlling locomotives each year associated with turnover, each requiring voice and video recorders. Due to the minor growth in the locomotive population, there will also be an additional 2 locomotives requiring voice and video recorders per year.

Maintenance

In order to ensure that the locomotive voice and video recording equipment remains functional, there will be ongoing maintenance for installed locomotive voice and video recording equipment, resulting in costs to rail companies. The annual maintenance cost is estimated to be \$375 per locomotive voice and video recorder, per year, based on the opinion of TC officials and consultations with stakeholders. That total can be calculated by multiplying the number of locomotives in service each year by the maintenance cost. It is estimated that rail companies will assume a total present value cost of \$5.38 million to maintain their installed locomotive voice and video recording equipment. Private rail companies account for \$4.93 million of the maintenance costs, while public rail companies account for the remaining \$0.44 million.

Testing

Testing is required upon installation of the locomotive voice and video recording equipment, and then on an annual basis. It is assumed that initial testing will be included in installation costs, while ongoing testing will take on average one hour per locomotive. The testing procedures will also

involve creating and maintaining test recordings, which will take an additional 15 minutes per test. These tasks are assumed to be completed by a technician. Testing will result in an estimated present value total cost of \$0.72 million for rail companies. Private rail companies account for \$0.66 million of the testing costs, while public rail companies account for the remaining \$60,390.

Random selection

The Regulations include a rigorous process that must be followed in order for rail companies to access voice and video data through random selection. Companies must develop a random selection policy (RSP) and submit it to TC. Each rail company will be required to complete these tasks in the first year of compliance. Development of the RSP will require 15 hours and be completed by a technician, while the submission of the RSP is assumed to require 15 minutes and be completed by an administrative employee. It is assumed that all companies in-scope will engage in random selection, with an average rate of 5% of locomotives in the central analysis. The largest cost associated with the RSP is the retrieval of voice and video data from locomotives. It is assumed that some companies will be able to complete this task quickly through cloud technology, while others will need to physically extract the data from individual locomotives. On average, it is assumed the retrieval of voice and video data will take one hour per selection. The estimated cost associated with the retrieval process will be \$0.55 million. Other costs associated with random selection include identifying authorized employees, conducting the RSP each month, record keeping, and providing RSP-accessed voice and video data to the Minister if requested.

The total present value cost to rail companies associated with random selection is estimated to be \$0.58 million. Private rail companies account for \$0.53 million of the random selection costs, while public rail companies account for the remaining \$54,770.

Miscellaneous

The majority of these costs fall under the following four categories: signage, training, creation and maintenance of records detailing voice and video data use, and destruction of voice and video data.

Each locomotive equipped with voice and video recorder technology will be required to have posted signage informing occupants of the presence of the voice and video recorders. It is estimated that this signage will cost \$100 per sign on average, including capital and labour costs, leading to a total present value cost of \$261,665 associated with signage.

Rail companies will be required to provide training to authorized employees on the proper use of the voice and video recorder data. The number of employees requiring this training per company was estimated through stakeholder consultation and the opinion of TC officials. It is assumed that the employees receiving this training will occupy trainmaster roles. The training is assumed to take

7.5 hours per employee and estimated to be initially complete in the first year of compliance, and then every three years on an ongoing basis to account for employee turnover. The total estimated cost to rail companies for this training is \$93,626.

The creation and destruction of voice and video recorder data and accompanying records will result in costs to rail companies. Each of these activities, the creation and the destruction, are assumed to take 15 minutes and be completed by administrative employees. Rail companies will access data through random selection and from TSB-reportable occurrences. The estimated cost for the creation of voice and video recorder data and its accompanying records is \$94,637. The cost for the destruction of this information is estimated to be the same, \$94,637.

The four costs detailed above account for \$0.56 million of the total miscellaneous costs associated with the Regulations. Beyond these four costs, there are also minor costs associated with reporting and maintaining data, as well as with notifying employees and providing them with access to voice and video recorder data upon the identification of a threat. These other minor miscellaneous costs account for \$19,671 of the total cost to rail companies.

The total miscellaneous costs assumed by rail companies are estimated to amount to \$0.57 million. Private rail companies account for \$0.50 million of the miscellaneous costs, while public rail companies account for the remaining \$66,410.

Costs to Transport Canada

Enforcement and regulatory administration

It is estimated that the Regulations will require minor incremental enforcement and regulatory administration time. This time is estimated to be the equivalent of 0.5 full-time employees annually, beginning in the first year of compliance (2022). It is assumed that these tasks will be completed by a senior technical inspector. The estimated total present value cost to TC for enforcement and regulatory administration will be \$0.39 million.

The Regulations do not require that TC review LVVR data for enforcement, investigation or policy development purposes, but TC may choose to do so at the discretion of the Minister. Reviewing voice and video data for policy development purposes will take time and TC will carry costs in these instances. However, just as the benefits of any future regulations developed with the input of voice and video data could not be attributed to these Regulations, neither could the costs.

Compliance promotion

Given the small number of rail companies in-scope of the Regulations and the thorough consultation processes that were undertaken, the compliance promotion costs that TC might carry will be negligible.

Costs to the Transportation Safety Board

The TSB will assume minor costs to update some of its existing hardware. Based on consultations with the TSB, it is assumed that the TSB will require new secured hard drive disks and other miscellaneous hardware upgrades. These present value costs to the TSB are estimated to amount to \$6,122.

Benefits

The Regulations enable the collection of information that will save resources for the TSB and rail companies when investigating occurrences, as well as enhance the identification of risks and the development of railway safety measures. The presence of locomotive voice and video recorders will act as a deterrent against unsafe behaviours by locomotive operators. The adoption of voluntary safety measures by rail companies and the deterrent effect of the cameras will improve railway safety and reduce in-scope occurrences.

Transportation Safety Board resource savings

The TSB has a mandate to conduct investigations into selected transportation occurrences in order to make findings as to their causes and contributing factors. Between 2009 and 2018, the TSB initiated an average of 16 rail investigations per year. Investigations are resource intensive and can span several years. The presence of locomotive voice and video data will enable TSB investigators to complete the examination and analysis phases of some rail occurrences with up to 10% fewer investigator hours. It should be noted that resource savings are not a reduced need for resources. The savings will enable the TSB to shift resources to other investigations. The total present value resource savings for the TSB is estimated to be \$0.74 million.

Railway investigation resource savings

Rail companies also conduct internal investigations after TSB-reportable occurrences. Data will be accessible only after the TSB has informed the rail company that it will not be investigating the occurrence. The presence of voice and video data could save time and resources in these investigative processes. These savings are not quantified due to a lack of available data.

Break-even analysis

As stated above, the total net present value cost of the Regulations, without accounting for safety benefits, is \$75.68 million. The safety benefit was evaluated using a break-even analysis, which aims to determine the percentage reduction of in-scope occurrences resulting from the future safety measures developed using locomotive voice and video recorder data and the effectiveness of recording devices in deterring unsafe operating behaviour.

Locomotive voice and video recorders do not prevent accidents from occurring in the same manner as new braking technology or upgraded barriers at road crossings. However, the information collected by locomotive voice and video recordings could contribute to the

development of new voluntary and regulatory railway safety measures. ⁶ These measures are expected to result in fewer occurrences and improve railway safety.

It is not possible to predict the future safety measures that could only be developed by reviewing locomotive voice and video recordings, and it would not be appropriate to assume what kind of impact they might have. There is a lack of research and literature on the correlation between the presence of voice and video recorders in controlling locomotives and a reduction in accidents or occurrences. Recording systems similar to the locomotive voice and video recording equipment specified in the Regulations have already demonstrated positive safety outcomes. A recent study evaluating the effectiveness of on-board video recorders on public transit buses found that the technology resulted in a 40% reduction in collisions per million miles travelled and a 30% decline in passenger injuries, as well as a 50% reduction in unsafe driving events. ⁷ While this suggested locomotive voice and video recorders could be effective in improving railway safety, the differences in operating public transit buses and trains are too great for this type of occurrence reduction to be applied to this analysis. Therefore, a break-even analysis approach is used to assess the Regulations. This approach is similar to the approach used by the United States Department of Transportation's Federal Railroad Administration to assess the impact of regulations on locomotive event recorders. ⁸

In the central analysis, information collected from locomotive voice and video recorders will have to contribute to a reduction of 4.35% in the annual number of in-scope rail occurrences, which government rail safety experts believe is achievable.

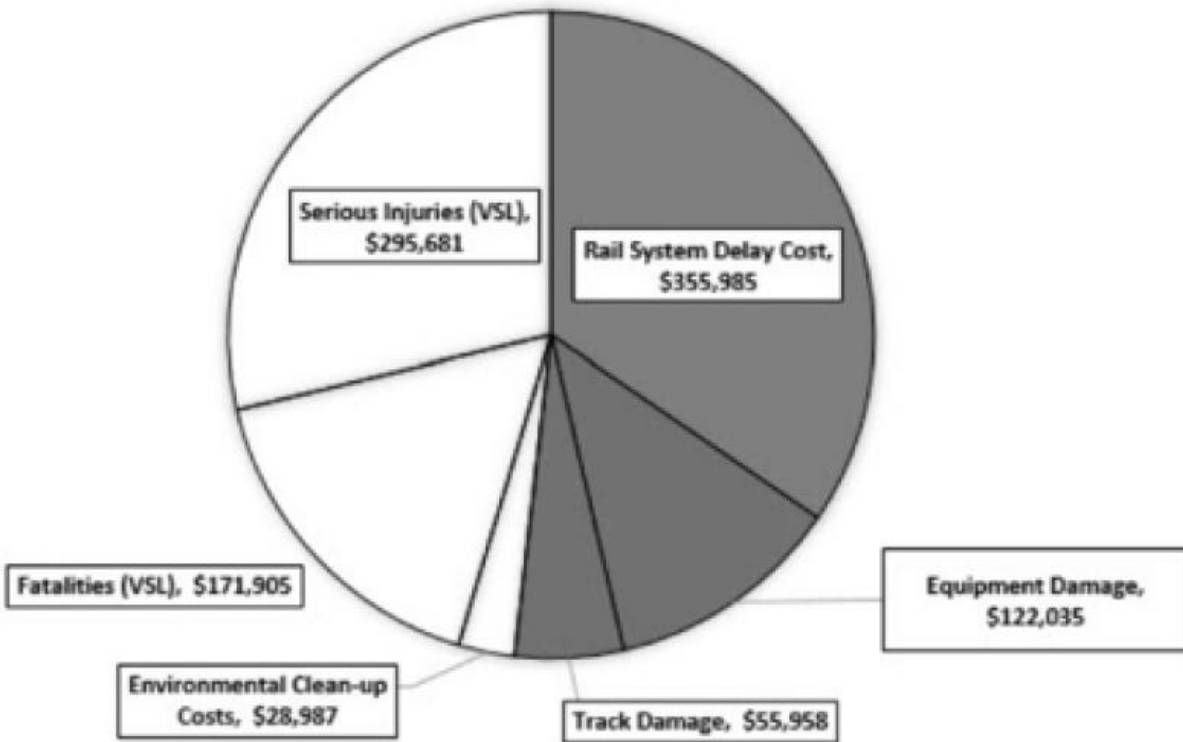
Methodology

To determine the reduction in the number of in-scope rail occurrences required to break even, it is necessary to forecast the number of in-scope occurrences and the average value of avoided cost per occurrence.

Forecast for in-scope occurrences

Since the Regulations apply to controlling locomotives and are intended to provide information relating to human factors and operating crew activities, only main track accidents where human actions could be a factor can be avoided. For example, main track collisions and derailments involving human factors or considered in scope. Accidents involving crossings and trespassers are not in scope. The forecast for the number of in-scope occurrences is based on historic TSB rail transportation occurrence data from the years 2008 to 2018, ⁹ with the straight-line trend extended over the period of analysis. It is estimated that there will be an average of 277 in-scope accidents per year over a 13-year period of analysis.

Figure 1: Average avoided cost per main track accident (\$1.03 million)



► Figure 1 - Text version

Avoided main track accident costs

The average total cost of a main track accident where human actions are a factor is estimated at \$1.03 million. This includes the avoided cost for Canadians (avoided serious injuries, fatalities and damage to the environment) and rail companies (avoided equipment and track damage and avoided cost of delays due to the closure of a section of track).

Avoided fatalities, serious injuries, and equipment and track damage

Canadian data on rail company damage from rail occurrences is limited, so the average number of fatalities and serious injuries, and the average amount of equipment and track damage, per accident, are based on human factor accident data collected by the U.S. Federal Railroad Administration Office of Safety Analysis. ¹⁰ The values used in this analysis are the average annual values per accident between 2010 and 2018.

In the data set, there was an average of 0.02 fatalities and 0.24 serious injuries per accident between 2010 and 2018. These values were then multiplied by the value of a statistical life (VSL) of \$9.33 million for fatalities and a corresponding fraction of the VSL equal to \$1.25 million for serious injuries, ¹¹ respectively. This results in an average avoided fatalities benefit per occurrence of \$171,905 and an average avoided serious injuries benefit per occurrence of \$0.30 million. Rail equipment and track damage values were inflated to 2018 U.S. dollars ¹² and

then exchanged to Canadian dollars. ¹³ When inflated and exchanged, the average cost of equipment damage per occurrence was \$122,035 and the average cost of track damage per occurrence was \$55,956.

Avoided environmental clean-up costs

Environmental clean-up costs are greatest when the train involved is transporting, and releases, dangerous goods. However, the majority of accidents do not involve the release of dangerous goods. In some cases, environmental clean-up costs are relatively low. These proportions are spread across all accidents to give an average cost per accident. In this analysis, the cost of the environmental clean-up is spread over all accidents and is valued at \$28,987 per accident. ¹⁴

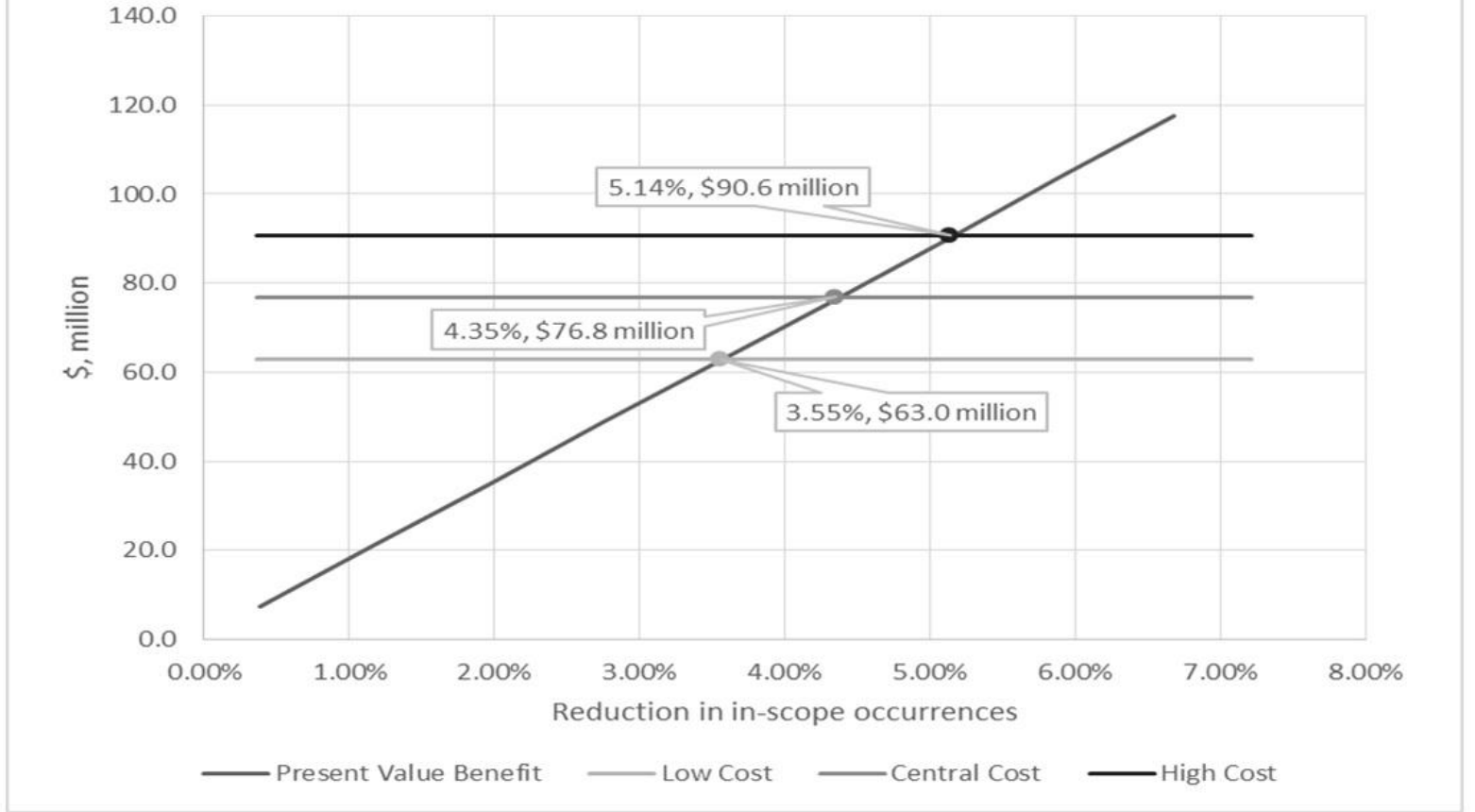
Avoided rail system delay cost

Rail accidents can cause a prolonged closure of a track segment that can disrupt a large portion of a rail network. This can lead to trains being rerouted or sitting idle until the track is reopened. Accidents can also result in a loss of cargo and legal costs. Indirect costs for rail companies are estimated to be twice the direct costs. ¹⁵ For this analysis, the average rail system delay cost is \$0.36 million.

Break-even point

Considering the number of in-scope occurrences and the value of avoided costs per occurrence, it is estimated that a reduction of 4.35% of in-scope occurrences, which amounts to an average reduction of approximately 12 in-scope occurrences per year, is required for the Regulations to break even. As shown in Figure 2, a reduction of 3.55% of in-scope occurrences is required to break even in the low-purchase-and-installation cost scenario, while in the high-purchase-and-installation cost scenario, the annual reduction in in-scope occurrences required to break even is 5.14%. These scenarios are discussed in the sensitivity analysis.

Figure 2: Break-even reduction in in-scope occurrences



► Figure 2 - Text version

Cost-benefit statement

At the break-even point in the central analysis, there would be an average of 4.35%, or an average of 12 fewer in-scope occurrences each year in the policy scenario relative to the baseline scenario.

Tables 2 through 4 shows the monetized costs and benefits expected in the central analysis, and Table 5 shows the estimated safety benefits at the break-even point.

Number of years: 13 (2019–2031)

Base year for costing: 2018

Present value base year: 2019

Discount rate: 7%

Table 2: Summary of the quantified monetized costs

Monetized Costs (x \$1,000)	2019–2021	2022	Average of Intervening Years (2023–2030)	2031	Total	Annualized Value

Costs to private railway companies	0	55,247	1,776	1,296	70,749	10,073
Purchase and installation	0	54,931	1,053	768	64,125	9,130
Maintenance	0	0	565	413	4,933	702
Testing	0	0	76	56	663	94
Random sampling	0	74	52	38	526	75
Miscellaneous	0	242	30	22	503	72
Costs to public railway companies	0	3,903	204	110	5,646	804
Purchase and installation	0	3,871	136	60	5,021	715
Maintenance	0	0	51	38	443	63
Testing	0	0	7	5	60	9
Random sampling	0	9	5	4	55	8
Miscellaneous	0	23	5	3	66	9
Costs to Government	0	58	39	28	395	56
TC enforcement and administration	0	52	39	28	389	55
TSB hardware upgrades	0	6	0	0	6	1

Table 3: Summary of the monetized benefits

Monetized Benefits (x \$1,000)	2019– 2021	2022	Average of Intervening Years (2023–2030)	2031	Total	Annualized Value
Benefits to Government	0	93	73	57	738	105
TSB time savings	0	93	73	57	738	105

Table 4: Summary of monetized costs and benefits

Monetized Costs and Benefits (x \$1,000)	2019– 2021	2022	Average of Intervening Years (2023–2030)	2031	Total	Annualized Value
Monetized costs	0	59,208	2,018	1,435	76,790	10,933
Monetized benefits (no safety benefits)	0	93	73	57	738	105
Net present value	0	(59,115)	(1,945)	(1,378)	(76,052)	(10,828)

Qualitative impacts

Benefits:

- Time saved in internal railway company investigations

Consolidated break-even analysis statement

The reduction in in-scope occurrences that needs to be achieved for the Regulations to break even is 4.35%. The avoided costs if this reduction is achieved are presented in Table 5. These avoided costs are quantified by multiplying the number of estimated avoided in-scope occurrences by the costs per accident then discounting.

Table 5: Monetized benefits at the break-even point

Monetized Benefits at Break-even Point (x \$1,000)	2019– 2021	2022	Average of Intervening Years (2023–2030)	2031	Total	Annualized Value
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Benefits to railway companies	0	5,256	3,913	2,843	39,406	5,611
Avoided equipment damage	0	1,201	894	650	9,006	1,282
Avoided track damage	0	551	410	298	4,130	588
Avoided track delay	0	3,504	2,609	1,895	26,271	3,740
Benefits to Canadians	0	4,888	3,639	2,644	36,646	5,218
Avoided fatalities	0	1,692	1,260	915	12,686	1,806
Avoided injuries	0	2,911	2,167	1,574	21,820	3,107
Avoided environmental damage	0	285	212	154	2,139	305

Sensitivity analysis

A sensitivity analysis is conducted to test the effects on the output of selected independent variables used in the analysis. Uncertainty about these independent variables can be better contextualized through the use of a sensitivity analysis. The following independent variables were analyzed: the locomotive voice and video recording equipment purchase and installation cost, the forecasted locomotive growth rate, the analytical time frame, and discount rates. The results are shown in Table 6 below.

Locomotive voice and video recording equipment purchase and installation cost

The central analysis uses \$26,602 as the purchase and installation cost, but there remains some uncertainty about this figure because the configuration of locomotive cabs can vary widely. Transport Canada was able to establish a range for the locomotive voice and video recording equipment cost and used the middle figure in the central analysis. Results if the minimum or maximum values were used are presented in Table 6.

Locomotive growth rate

In the central analysis, it is assumed that there is minor growth (0.07%) in the population of controlling locomotives in-scope of the Regulations. The results if a 2% growth in the total number of controlling locomotives in-scope was used are presented in Table 6.

Analytical time frame

A 13-year analytical time frame was used for the central analysis to properly represent the expected lifespan of the locomotive voice and video recorder technology. A 20-year time frame was not used for the central analysis, as there are uncertainties about future technological upgrades as well as growth or contraction in the industry.

Core locomotive voice and video recording equipment hardware is expected to last, on average, 10 years, with the assumption that the ongoing maintenance costs will cover repairs over the 10-year period. After the 10-year lifespan is concluded, it is estimated that rail companies will assume costs to completely replace core locomotive voice and video recording equipment hardware. The cost of acquiring and installing this core hardware is estimated to be 20% of the initial locomotive voice and video recording equipment acquisition and installation cost. This cost is not captured by the central analysis, as locomotive voice and video recorder systems will not begin requiring this replacement until 2032, 10 years after the year of compliance of the amendments, while the central analysis only analyzes between 2019 and 2031.

The resulting net present value and break-even point of the 20-year analytical time frame are presented in Table 6.

Discount rate

The central analysis used a 7% discount rate as recommended by the Treasury Board Secretariat. The sensitivity analysis presents the results should a 3% discount rate have been used, as well as if there were no discounting.

Table 6: Sensitivity analysis results

Parameter Changes	Net Present Value with no Safety Benefits	Break-even Annual Occurrences	Break-even (%)
Locomotive voice and video recording equipment purchase and installation cost			
Low — \$21,282	(\$62.22M)	9.79	3.55%
High — \$31,922	(\$89.88M)	14.15	5.14%
Locomotive growth rate			
2% growth	(\$89.04M)	14.08	5.09%
Analytical time frame			

20 years	(\$90.31M)	10.23	3.72%
Discount rate			
Undiscounted	(\$100.92M)	9.79	3.54%
3% discount rate	(\$88.89M)	10.72	3.88%

Distributional impact analysis

As discussed in the “Affected stakeholders” section, there are 16 rail companies in-scope of the Regulations, with 1 based in the United States and, therefore, not included in the analysis. Of the remaining 15 rail companies, 5 are owned by provincial or federal crown corporations or a municipal/provincial transit service (public rail companies), while the other 10 are privately owned. Table 7 provides a breakdown of the costs to publicly and privately owned rail companies.

Table 7: Distributional analysis — Costs by type of rail company

	Number of Companies	Number of Existing Locomotives	Total Cost	Average Cost per Rail Company
Privately owned	10	2 524	\$70,748,548	\$7,074,855
Publicly owned	5	230	\$5,645,765	\$1,129,153

Costs are not distributed evenly among the private rail companies. Two large private rail companies will assume 94.5% (\$66.48 million) of the total cost to private rail companies. Based on publicly available financial information for these two companies, the combined annualized cost of the Regulations will represent roughly 0.025% of the annual revenues of the two companies combined. The other eight private companies will assume the remaining 5.5% of the total cost to private rail companies, which is roughly \$4.27 million. The individual cost over the 13-year analytical time frame per company for these eight companies ranges between \$144,385 and \$1,717,860, with an average of \$533,518.

Small business lens

All of the affected companies are large businesses; no small businesses are affected. In order to facilitate implementation for all businesses, a transition period of two years was included. The coming-into-force date is set at two years from the date of publication in the *Canada Gazette*, Part II. This will provide businesses with a two-year time frame to comply with the Regulations.

One-for-one rule

The one-for-one rule applies because there is an incremental increase in administrative burden on business (rail companies), and a new regulatory title (*Locomotive Voice and Video Recorder Regulations*) is being introduced.

Rail companies will be required to submit their random selection methodology to TC; identify and communicate which individuals are authorized to conduct the random selection and access the data; create and maintain snapshots of each time the random selection methodology is used; communicate to TC the designation of a senior manager as the accountable executive; create and maintain records of when voice and video data is used, communicated, and destroyed; and create and maintain test recordings of locomotive voice and video recorder data. TC estimates the annualized administrative costs to be \$18,972 or \$1,897 per business (2012 Can\$). ¹⁶

The one-for-one rule does not apply to the amendments to the AMPs Regulations, as there is no change in administrative burden.

Regulatory cooperation and alignment

These Regulations enable regulatory alignment with the United States, as committed to under the Joint Action Plan for the Canada-United States Regulatory Cooperation Council. TC consulted the United States Federal Railroad Administration (FRA) in the development of the locomotive voice and video recorder regulatory policy. The video recording component of the Regulations aligns closely with the *Fixing America's Surface Transportation Act* (FAST Act) of the United States, which mandated the promulgation of regulations to require on-board video recording in the locomotives of scheduled passenger or commuter trains.

Below is a comparison of the on-board recording regimes in Canada and the United States.

Comparison of requirements in Canada and the United States

	United States	Canada

<p>Scope of application</p>	<p>Set out in the FAST Act</p> <ul style="list-style-type: none"> Regularly scheduled intercity rail passenger or commuter rail passenger transportation 	<p>Set out in the Regulations</p> <ul style="list-style-type: none"> Rail companies that realized gross revenues of at least \$250,000,000 for the provision of rail services in Canada in each of the two preceding calendar years that operate controlling locomotives on five or more miles of track within Canada Rail companies that operate a passenger train service within a municipality or between adjacent municipalities Companies that have 15 or more operating employees, and operate controlling locomotives on 20 or more miles of track within Canada, and operate at least one controlling locomotive at a speed of over 25 miles per hour, excluding freight companies that conduct most of their operations outside of Canada, meaning that at least 90% of their gross ton miles occur outside of Canada
<p>Equipment</p>	<p>Set out in the FAST Act</p> <ul style="list-style-type: none"> Inward- and outward-facing image recording devices 	<p>Set out in the Regulations</p> <ul style="list-style-type: none"> In-cab locomotive voice and video recorders

<p>Uses by rail companies</p>	<p>Set out in the FAST Act</p> <ul style="list-style-type: none"> • Accident or incident investigation • Verifying crew compliance with applicable safety laws and the rail carrier’s operating rules and procedures • Documenting a criminal act or monitoring unauthorized occupancy 	<p>Set out in the <i>Railway Safety Act</i></p> <ul style="list-style-type: none"> • Determining the causes and contributing factors of a reportable accident or incident that the TSB does not investigate • Use of randomly selected voice and video data to identify safety concerns as part of companies’ ongoing safety management
<p>Technical specifications</p>	<p>Set out in the FAST Act</p> <ul style="list-style-type: none"> • Minimum of 12 hours of continuous recording • Crash and fire protections would be required • Tampering is prohibited and enforceable 	<p>Set out in the Regulations</p> <ul style="list-style-type: none"> • 48 hours of recording • Environmental standard for the locomotive voice and video recorder systems • Crashworthiness standard for the crash-protected memory module <p>Set out in the <i>Railway Safety Act</i></p> <ul style="list-style-type: none"> • Tampering is prohibited

Strategic environmental assessment

In accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*, a preliminary scan concluded that a strategic environmental assessment is not required.

Gender-based analysis plus

Although the majority of the workforce in the rail industry is male, use of the new technology and recordings will apply evenly to employees working in the cabs of controlling locomotives, regardless of gender, culture, socio-economic status, age, geography, ability, sexual orientation, ethnicity, faith, and gender identity. Therefore, no gender-based analysis plus (GBA+) impacts have been identified for these Regulations.

If, during the implementation of this initiative, unanticipated gender or diversity impacts are observed on various demographic groups, further analysis will be conducted as appropriate and according to Treasury Board of Canada Secretariat guidelines. Mitigation measures will be identified and implemented as required.

Rationale

Detection of risk

Rail occurrences are the result of a combination of failures or deficiencies of equipment or human actions. The Regulations will enable rail companies, TC and the TSB to collect data on the human actions that may contribute to rail occurrences and that would not be available otherwise. For example, following the 2012 VIA Rail train derailment in Burlington, Ontario, which resulted in the deaths of the 3 operating employees and the injuries of 45 other people, it was not possible for TSB investigators to determine if the actions taken by the operating crew were in line with existing operating requirements and the extent to which this may have contributed to the accident. The lack of information regarding the actions of locomotive operating crew poses a barrier to implementing effective voluntary and regulatory rail safety measures that could in turn reduce the frequency of rail occurrences and save lives.

Assessment of rail occurrences

Between 2007 and 2017, there was an average 1 356 rail accidents and incidents (i.e. types of rail occurrences) reported to the TSB that resulted in an average of 76 fatalities and 57 serious injuries per year.

Since the voice and video recorders will only be installed in the cabs of controlling locomotives, the Regulations will only reduce the number of occurrences on main tracks where human actions could be a factor and can be avoided. Between 2008 and 2018, there was an average of 279 in-scope occurrences that could have been caused by human actions. It is estimated that there will

be an average of 277 in-scope main track accidents per year over the 13-year period of analysis. Based on data obtained primarily from the Federal Railroad Administration Office of Safety Analysis, the average cost of rail occurrences caused by human factors is around \$1 million.

Stakeholder support

The Regulations were developed in close consultation with all stakeholders, including rail companies that have indicated an eagerness to adopt the technology.

While there is general agreement among impacted stakeholders on the fundamental value of locomotive voice and video data, there are differences of opinion on the appropriate use of the recordings. Unions have long supported the use of voice and video data for post-accident investigations by the TSB only, but have expressed their opposition to the use of voice and video data by companies, including concerns about the potential for abuse of voice and video data by companies and the infringement of their members' privacy rights. Companies have expressed support for installing locomotive voice and video recording equipment provided they are able to access voice and video data for proactive safety management.

The Bill C-49 amendments to the RSA provided for expanded use of this information by companies within a proactive safety management framework. When developing the Regulations, the privacy protections and the provisions around the collection, communication, access and use of voice and video data by companies were carefully crafted with the aim of ensuring that the rights and obligations of all parties are appropriately balanced.

Upholding privacy rights

In order to protect the privacy rights of everyone potentially affected by the new technology, as well as prevent the targeting of employees for any reason, including gender, the following RSA provisions limit the circumstances in which the data could be accessed and used:

Use by the Transportation Safety Board

Post-accident investigation as currently authorized under the CTAISB Act.

Use by railway companies and local railway companies

- Conducting analysis of their railway operations to identify safety concerns through safety management systems; and
- Determining the cause of a railway incident or accident (not being investigated by the TSB).

Use by Transport Canada

- Policy development (trend analysis to inform the development of policies, procedures, regulations and legislation); and
- Determining the cause of a railway incident or accident (not being investigated by the TSB).

To further protect the privacy rights of everyone potentially affected by the new technology, provisions in the RSA prevent TC from using the data as evidence to take enforcement actions that exist under the RSA against an individual, including administrative monetary penalties and prosecution in the event of a non-compliance, other than a contravention of subsection 17.31(3) of the RSA. Rather, voice and video data could be used as evidence to support enforcement action against the company.

In addition to the limitations on using the data mentioned above, the Regulations have been developed to uphold privacy rights and to prevent the targeting of individual employees. For example, the Regulations set out the requirements respecting the random selection methodology that companies and TC will be required to use to access the recordings for safety management purposes and policy development purposes respectively.

Break-even analysis

The Regulations will affect 15 Canadian rail companies, operating an estimated 2 754 controlling locomotives in 2022, which is the expected coming-into-force year. The total present value cost of the Regulations is \$76.79 million, the majority of which will be for the purchase and installation of the recording equipment.

The availability of locomotive voice and video recorder data will provide efficiency savings for the TSB and rail company investigators, but the majority of the benefits will be from the enhanced safety of the rail system, and the subsequent reduction in rail occurrences. A break-even analysis determined that for the present value benefit of the Regulations to be at least as much as the present value cost, the deterrent effect of the cameras and the potential safety measures adopted by rail companies will have to reduce the yearly number of in-scope occurrences by 4.35%, which TC rail safety experts believe is attainable.

Implementation, compliance and enforcement, and service standards

The Regulations come into force two years after publication in the *Canada Gazette*, Part II, for all railway companies and local railway companies that meet at least one of the scope of application criteria. An implementation period of two years provides companies with enough time to purchase and install locomotive voice and video recording equipment or update their existing equipment to bring it into compliance with the technical specifications that will be required by the Regulations.

Voice and video data will be used as evidence by the TSB as part of its existing process of conducting investigations into rail occurrences. There are three phases to a TSB investigation. The first is the field phase, in which an investigator-in-charge is appointed and an investigation team is formed. During the field phase, the investigation team members engage in a number of

activities, including securing and examining the occurrence site, interviewing witnesses, and selecting and removing wreckage for further examination. The voice and video data will be removed at this stage.

The second phase in a TSB investigation is the examination and analysis phase, which is when most of the investigation takes place. The TSB engages in a number of activities at this phase, including examining selected wreckage in the laboratory and testing selected components and systems, creating simulations and reconstructing events, reviewing autopsy and toxicology reports, and identifying safety deficiencies. The TSB also reads and analyzes recorders and other data at this phase, which will include voice and video data from locomotive voice and video recorders.

The third and final phase in a TSB investigation is the report phase, in which the investigation report is drafted, reviewed, and ultimately published.

Under the Bill C-49 amendments to the RSA, TC may use voice and video data to investigate the causes and contributing factors of occurrences that are not investigated by the TSB and use randomly selected voice and video data for policy development purposes. Under the Regulations, once a company receives a request for voice and video data for use by TC, the company will be required to ensure that the requested data is downloaded before it is permanently erased. The company will then be required to make the data available to TC and, on request, provide TC with the software and equipment required to use the data.

To support compliance with the Regulations, TC has developed guidance materials and will make them available to railway companies and local railway companies, for use by companies during the implementation period leading up to the coming-into-force date.

Once the Regulations come into force, in accordance with the Rail Safety Oversight Policy, TC will take a graduated and proportionate enforcement approach to educate, deter, and, when necessary, penalize those who contravene the RSA or its associated regulations. In the event of non-compliance with the Regulations, TC will consider the company's behaviour and willingness to comply before taking appropriate enforcement action, which could range from a letter of warning, to an administrative monetary penalty of up to \$250,000.

Under the RSA, TC has the authority to use voice and video data as evidence to support the issuance of an administrative monetary penalty to a company; the prosecution of a company; or to trigger an inspection, audit or investigation of a company to determine whether there is a non-compliance or the existence of a threat to safe railway operations.

However, the Bill C-49 amendments to the RSA explicitly prohibit TC from using voice and video data as evidence to support any enforcement action against an individual, with the exception of using the recorded information to support a proceeding against an individual tampering with the recording equipment. All enforcement action would be taken against the company.

To support oversight of the regulatory regime, TC will update and enhance inspector and auditor training and tools to ensure oversight is undertaken by properly trained staff with nationally consistent oversight tools.

To ensure that the amendments to the AMPs Regulations with respect to the Regulations are applied in a fair, impartial, predictable and nationally consistent manner, guidance materials will be developed to align with the Rail Safety Directorate's existing compliance and enforcement regime. Training will be provided to rail safety officials within existing programs. Adding this guidance to the existing training program will ensure that departmental officials take a standard approach in similar circumstances to achieve consistent results.

Contact

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Footnotes

a S.C. 2018, c. 10, s. 62

b S.C. 2015, c. 31, s. 31

c S.C. 2012, c. 7, s. 31

d R.S., c. 32 (4th Supp.)

1 SOR/2014-233

2 A controlling locomotive is railway equipment from which an operating employee controls the movement of the locomotive and any other railway equipment connected to the locomotive.

- 3 Present value total benefits and costs are discounted to a base year of 2019 using a 7% discount rate, and presented in 2018 Canadian dollars summed over the analytical period, which, in the central analysis, is between 2019 and 2031.
- 4 *Cabinet Directive on Regulations: Policies, guidance and tools – Policy on Cost-Benefit Analysis* (<https://www.canada.ca/en/treasury-board-secretariat/services/federal-regulatory-management/guidelines-tools/policy-cost-benefit-analysis.html>). [accessed February 26, 2019]
- 5 One affected rail company has already installed voice and video recorders in the cabs or its locomotives. This is reflected in the baseline scenario. This company would only carry costs to upgrade its system to meet the required specifications of the Regulations.
- 6 The benefits of these Regulations only include those resulting from safety measures adopted by rail companies. Any benefits resulting from future regulatory initiatives informed by locomotive voice and video data should be attributed to those future regulations.
- 7 Litschi, M. and Hass, P. Evaluating the Effectiveness of On-board Video Feedback Systems on Reducing Transit Collisions and Injuries. *Journal of Public Transportation*, Vol. 17, No. 3, 2014 86, San Jose State University's Mineta Transportation Institute.
- 8 U.S. DOT/FRA – Office of Safety Analysis. *Notice of Final Rulemaking – Regulatory Impact Analysis – Locomotive Event Recorder* (<https://www.regulations.gov/document?D=FRA-2003-16357-0043>). (2005). [accessed March 10, 2019]
- 9 Transportation Safety Board rail transportation occurrence data (<http://www.bst-tsb.gc.ca/eng/stats/rail/data-5.asp>). [accessed March 7, 2019]
- 10 Federal Railroad Administration Office of Safety Analysis – 3.11 Accident Detail Report (<https://safetydata.fra.dot.gov/OfficeofSafety/Default.aspx>) [accessed March 7, 2019]
- 11 The *Canadian Cost-Benefit Analysis Guide: Regulatory Proposals* requires that a VSL of \$6.11 million (2004 Can\$) be used. This number has been inflated to 2018 dollars using Consumer Price Index, annual average, not seasonally adjusted — table 18-10-0005-01. The serious injuries are valued at 13.42% of the VSL.

- 12 Gross Domestic Product: Implicit Price Deflator
(<https://fred.stlouisfed.org/series/GDPDEF>) [accessed March 7, 2019]
- 13 Bank of Canada annual exchange rates for 2018
(<https://www.bankofcanada.ca/rates/exchange/annual-average-exchange-rates/>)
[accessed March 7, 2019]
- 14 Based on an inflated and exchanged value of €17,500 per derailment found in *Development of the Future Rail Freight System to Reduce the Occurrences and Impact of Derailment (PDF)* (http://d-rail-project.eu/IMG/pdf/DR-D1-2-Report_on_Derailment_Economic_Impact_AssessmentFinal-v1.pdf), D1.2 (2012) [page 4].
- 15 Ibid.
- 16 Results over 10 years and only includes privately owned railway companies.
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