Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

RAIL TRANSPORTATION SAFETY INVESTIGATION REPORT R17V0220

MAIN-TRACK TRAIN COLLISION WITH TRACK EQUIPMENT

Canadian Pacific Railway
Freight train 868-078
Mile 68.4, Mountain Subdivision
Fraine, British Columbia
31 October 2017

Canada

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Summary

On 31 October 2017, at about 0600 Pacific Daylight Time, Canadian Pacific Railway freight train 868-078 was proceeding eastward on the Mountain Subdivision at 15 mph when it collided with a backhoe equipped with a hi-rail cart just west of Mile 68.4 near Fraine, British Columbia (BC). The backhoe operator was transported to hospital with serious injuries. The backhoe sustained damage to the boom and windshield. The train crew members were not injured. The lead locomotive sustained minor damage.

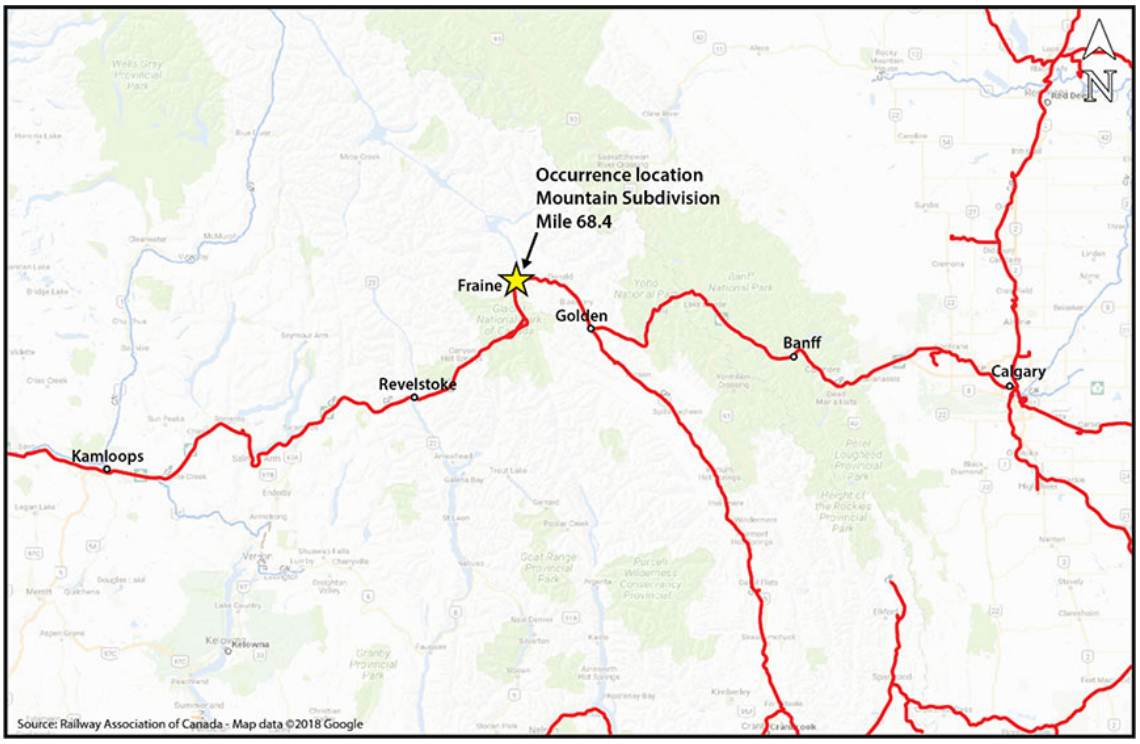
1.0 FACTUAL INFORMATION

1.1 The accident

On 31 October 2017 at 0352,[1] Canadian Pacific Railway (CP) freight train 868-078 departed eastward from Revelstoke, BC, en route to Golden, BC (Figure 1). The train consisted of 2 head-end locomotives, 1 mid-train remote locomotive, 1 tail-end remote locomotive, and 152 empty cars. It weighed 3290 tons and was 8363 feet in length. The train crew consisted of a locomotive engineer and a conductor. The crew members were qualified for their respective positions, were familiar with the territory, and met established rest and fitness requirements.

[1] All times are Pacific Daylight Time.

Figure 1. Map of the occurrence location (Source: Railway Association of Canada, Canadian Railway Atlas, with TSB annotations)



Between Mile 66 and Mile 69 on the Mountain Subdivision, track work was under way, including the installation of a new switch panel.[2] At this location, there are 2 main tracks, with the north main track designated the Connaught track and the south main track designated the Macdonald track (Figure 2). The work was being conducted mainly on the Connaught track under the protection of *Canadian Rail Operating Rules* (CROR) Rule 42 (Planned Protection).[3]

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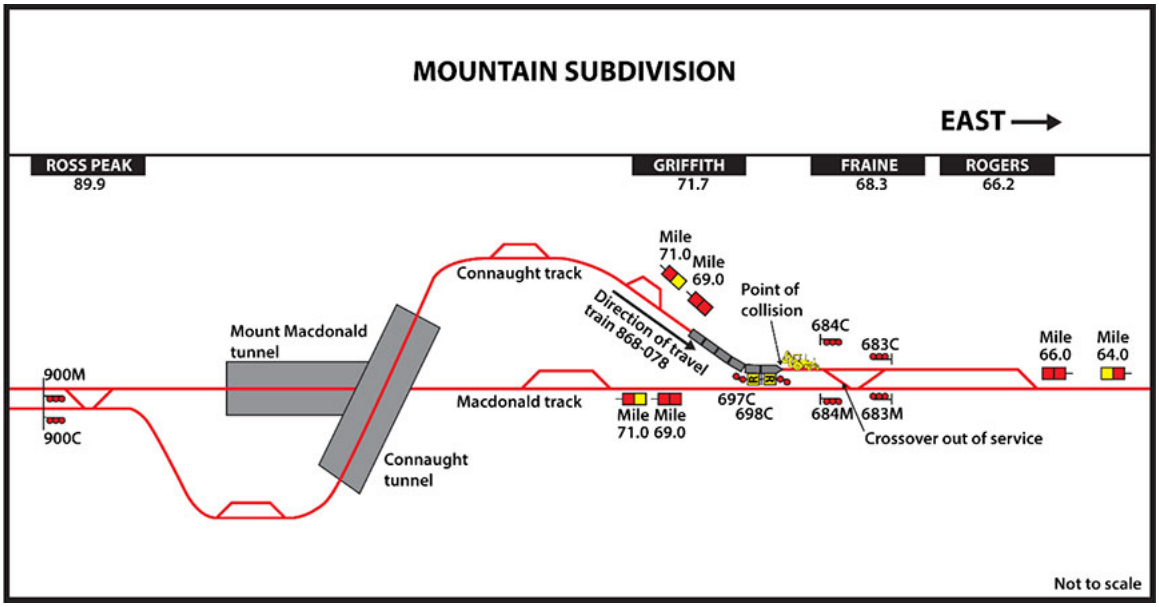
2 A switch panel is a pre-built section of railway track, including ties, spikes, anchors, and switch points that move laterally to direct a train from one track to another.

3 When it is known in advance that track work must be performed and the protection of track work activities from train operations will be required, *Canadian Rail Operating Rules* Rule 42 (Planned Protection) is often applied. Rule 42 defines a process by which planned track work and employees can be protected from train operations to ensure safety.

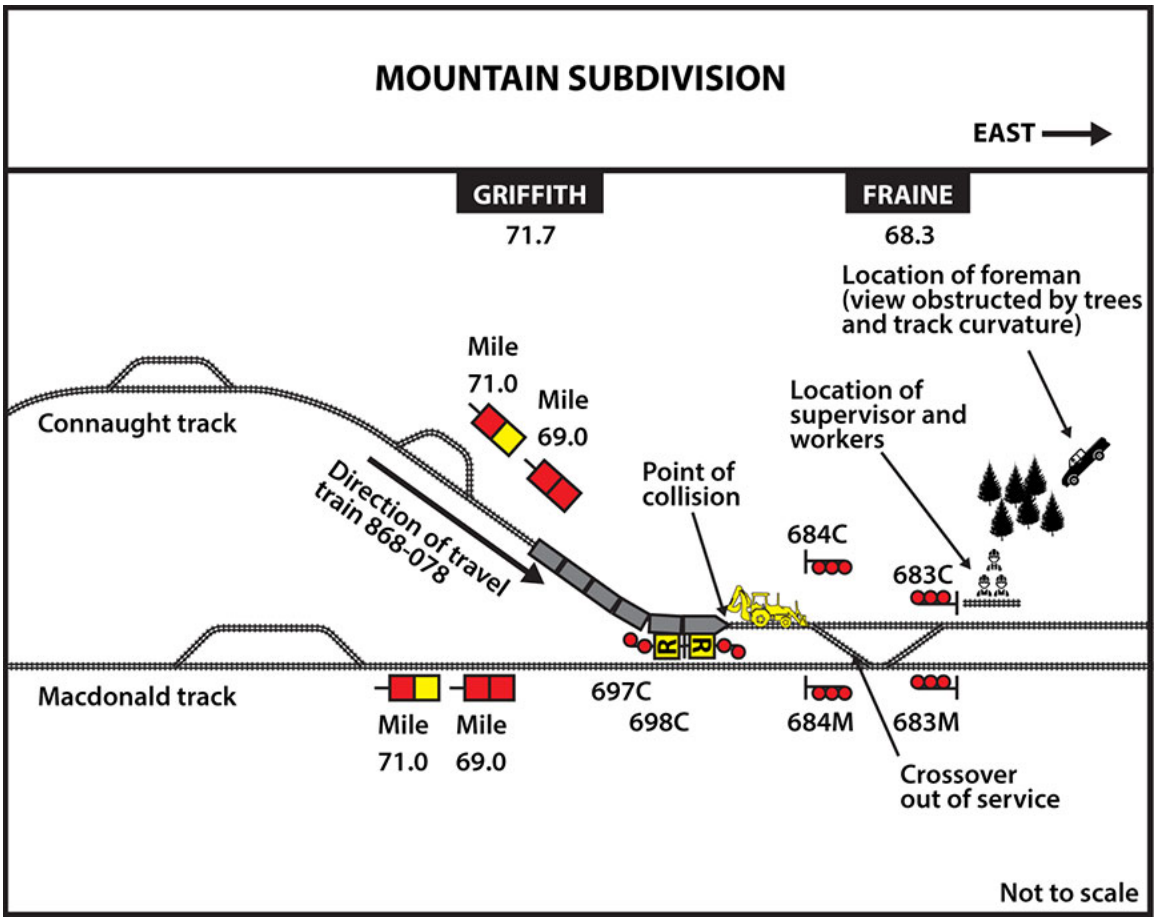
Figure 2. Occurrence site diagram



At 0545, as the train approached Mile 71 on the Connaught track, the train crew called the foreman to request permission to operate through the work limits, as required by Rule 42. The foreman contacted the track workers who were working directly under his supervision; the sub-foreman, who was protecting track workers under delegated protection authority from the foreman; and the supervisor. Upon being told that everyone was clear of the Connaught track, the foreman gave permission to the train crew to proceed on the Connaught track through the work limits with no restrictions.

The foreman was in his truck at the crossing northeast of the location where the supervisor and his crew were working on the switch panel. Although able to observe most of the employees who were working off the tracks, the foreman could not see the work activities on the main tracks west of signal 683C (where the backhoe was working) (Figure 3).

Figure 3. Location of workers at time of accident



At about 0600, as the train was travelling at 25 mph and exiting a 1° right-hand curve near the work site, the train crew observed a backhoe on the track. The crew applied the train brakes in emergency, but the train could not be stopped before striking the backhoe. The backhoe operator was transported to hospital with serious injuries. The backhoe sustained extensive damage and the lead locomotive of the train sustained minor damage. There was no track damage.

At the time of the occurrence, it was dark. It was raining lightly and the temperature was 0 °C. The closest construction lighting apparatus was approximately 600 feet east of the backhoe and south of the Macdonald track. The headlight on the backhoe was pointing east, and the rear working lights were pointing west. The supervisor could see the light from the backhoe, but not its location on the track. The foreman could not see the backhoe's light or position. The backhoe operator was facing the train while working.

1.2 Mountain Subdivision

The Mountain Subdivision extends westward from Field, BC (Mile 0.0), to Revelstoke, BC (Mile 125.7). In the vicinity of the occurrence, the track consisted of double main tracks descending toward the east at about 1%. There was a 1° right-hand curve in the direction of travel. Given the ascending grade to the west on the Connaught track, westbound trains are

typically operated on the Macdonald track and eastbound trains are typically operated on the Connaught track.

Train movements on this subdivision are governed by the centralized traffic control system, as authorized by the CROR and supervised by a rail traffic controller (RTC) located in Calgary, Alberta.

The daily traffic on this portion of the Mountain Subdivision was typically 28 freight trains. In the vicinity of the occurrence, the track was designated Class 2 in accordance with Transport Canada's *Rules Respecting Track Safety*.

1.3 *Canadian Rail Operating Rules* Rule 42 (Planned Protection)

At the work location, CROR Rule 42 was in effect on 17 of the preceding 20 days from 0200 to 1100 on both main tracks (Appendix A). A Rule 42 foreman (the foreman) oversaw track worker protection to ensure that all employees,[4] contractors, and sub-foremen[5] were clear of the track before trains were permitted to operate through the work limits. A CROR-qualified supervisor (the supervisor) was on site to oversee the work.

Some of the track workers were on contract from PNR RailWorks (PNR) or Talarico Excavating Ltd (Talarico). The track workers included welders, surfacing crew operators, and operators of various track equipment (such as backhoe and excavator). The welders on site were directly protected by the foreman. The surfacing crew (operators for the ballast regulator and tamper) had sub-foreman protection from the foreman. These track workers were qualified for their respective positions, were familiar with the territory, and met established rest and fitness requirements.

The supervisor had informally assumed responsibility for the protection of many of the contract workers (including the backhoe operator, the excavator operator, a utilities crew, and surveyors). Although the supervisor did not have sub-foreman protection from the foreman, the foreman was aware that the supervisor had informally assumed the sub-foreman duties.

During the job briefings before starting to work, the track workers were informed of the anticipated routing arrangements. Before starting work that day, the foreman had discussed with the RTC that trains needed to be routed on the Macdonald track from either direction through the work limits. The RTC had not applied track blocking on the track display to

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4 In the *Canadian Rail Operating Rules*, "employee" is defined under "occupational terms" as a "person qualified to regulatory and company standards employed by the company. Applies to contract employees and employees of other companies and railways operating and/or performing other rules related duties on the host railway trackage."

5 Railway engineering instructions permit a Rule 42 foreman to grant "sub-foreman" protection so that other foremen may perform work within the Rule 42 limits. Those instructions require the foreman to ensure that all sub-foremen are clear of the work limits before authorizing a train to pass.

support this arrangement. Before the occurrence that morning, 2 westbound trains had operated through the work limits on the Macdonald track.

About 1 hour before the occurrence, after accessing the track display on his laptop computer, the foreman noted that eastbound train 868-078 was being routed toward the work limits on the Connaught track. The foreman told the employees under his immediate supervision, the employees who had been granted sub-foreman protection, and the supervisor that the eastbound train would be routed through the work limits on the Connaught track.

Before authorizing the eastbound train through the work limits on the Connaught track, the foreman verified with and received confirmation from the employees under his immediate supervision, from the sub-foreman, and from the supervisor that all workers and track equipment had been cleared off the track. It was dark, and from his location, the foreman was not in a position to see all the track equipment, including the backhoe.

The supervisor said that he did not recall receiving a follow-up call from the Rule 42 foreman or confirming that the Connaught track was clear. However, other employees on site said that they recalled overhearing this conversation. These conversations were not recorded.

1.4 Track worker and rail traffic controller information

1.4.1 Rule 42 foreman

The foreman was familiar with the territory and was qualified for his position. Over the previous 5 years, the foreman had been in charge of Rule 42 planned protection at various locations on CP's western network on 5 shifts. This work assignment was the first time he was working on the Mountain Subdivision as a Rule 42 foreman, and he was replacing the regular foreman. The previous week, the foreman had worked on this project as a machine operator and had observed the supervisor clearing contractors.

1.4.2 Supervisor

The supervisor was familiar with the territory and was qualified for his position. For the 2 weeks preceding the occurrence, the supervisor had been working with 2 other foremen who were responsible for Rule 42 planned protection. The supervisor had overall responsibility for ensuring that the track work was completed safely and on time.

1.4.3 Backhoe operator

The backhoe operator was employed by Talarico. In the previous 12 years, he had been working as an operator of various types of heavy equipment, including the backhoe. As a contractor, the backhoe operator had experience working on track projects at various locations for both Canadian National Railway Company (CN) and CP.

During the 2 weeks preceding the occurrence, the backhoe operator had been working under Rule 42 with the same supervisor between Fraine and Rogers, BC, on the Mountain Subdivision.

1.4.4 Rail traffic controller

The RTC was familiar with the territory and was qualified for his position. He had worked as an RTC for almost 10 years and had supervised the Mountain Subdivision for at least 225 shifts. In the preceding 2 weeks, he had worked the Mountain Subdivision while the Rule 42 had been in effect.

1.5 Actions of the backhoe operator

Working under the direction of the supervisor, the backhoe operator was performing clean-up duties along and between the tracks about 1000 feet west of the crossovers. The backhoe was attached to a hi-rail–equipped cart to facilitate movement of the machine on the track (Figure 4).

Figure 4. Similar backhoe with attached hi-rail–equipped cart

Just before the arrival of the eastbound train, the supervisor instructed the backhoe operator to move the backhoe off the Connaught track to permit several other machines to

pass. Shortly after that, the supervisor gave the backhoe operator permission to return the backhoe to the Connaught track and to continue the work activities.

The foreman was not aware that the backhoe operator had been instructed to work on the Connaught track or that the backhoe operator had been instructed to resume work after clearing the track to allow the other machines to pass.

Upon returning to the track, the backhoe operator heard on the designated engineering standby radio channel that the eastbound train was approaching, but did not hear on which track the train would be operating. The backhoe operator was aware from the initial job briefing that trains would be operating on the Macdonald track. Earlier that morning, the backhoe operator had observed a number of westbound trains operate through the work limits on the Macdonald track. He was not contacted by the supervisor or instructed to clear the Connaught track for the eastbound train.

When the backhoe operator observed the approaching eastbound train, believing that the train was on the Macdonald track, he got out of the backhoe with the intention of inspecting the train as it passed. Then, realizing that the train was on the Connaught track, the backhoe operator immediately got back into the backhoe to try to move it from the track to avert the collision. The operator was able to lift the stabilizers and place the backhoe in gear. However, before the backhoe could be moved, the train struck it.

1.6 Summary of events

Table 1 provides a summary of relevant events for this occurrence.

Table 1. Summary of occurrence events

Time (approximate)	Event
0001	At Revelstoke, the supervisor completed and printed the on-track safety job briefing form.
0005	The supervisor conducted a job briefing* with the utilities crew, the surfacing crew, and the backhoe operator.
0007	The foreman obtained a track occupancy permit to place flags on the main track east of the Rule 42 limits.
0107	The foreman obtained a track occupancy permit to place flags on the main tracks west of the Rule 42 limits near Griffith.
0211	After arriving at Fraine, the supervisor conducted a job briefing with the foreman. The job briefing included the following information: • The supervisor requested that trains operate on the Macdonald track. • The Connaught track will be available for work until 0600. • Five different work groups will be present and working under Rule 42. • Only the contract workers (PNR) will work directly under the foreman.
0213	The supervisor conducted a job briefing with the surveyors.
0214	The supervisor conducted a job briefing with the excavators.
0215	The supervisor conducted a job briefing with the PNR welders, who were told to call the foreman to obtain direct protection.

Time (approximate)	Event
0232	The foreman contacted the RTC to establish that trains from either direction would be routed through the Rule 42 work limits on the Macdonald track.
0233	The RTC confirmed that the Macdonald track would be used for routing trains, leaving the Connaught track available for work activities. The RTC did not establish track blocking** to protect the routing arrangements.
0240	As instructed by the supervisor, the backhoe operator began clearing material from between the Macdonald and Connaught tracks just east of the crossovers.***
0251	A member of the surfacing crew obtained sub-foreman protection from the foreman to occupy the Connaught track.
0352	Train 868-078 departed Revelstoke eastward on the Mountain Subdivision.
0400	From the RTC track display on his laptop, the foreman noted that eastbound train 868-078 was lined on the Connaught track toward his Rule 42 limits.
0405	The foreman was contacted by the operating crew of 2 consecutive westbound trains requesting permission to operate through the Rule 42 limits on the Macdonald track. The foreman instructed the workers under his direct protection, as well as the sub-foreman and the supervisor, to clear the track.
0410	The supervisor instructed the backhoe operator and other contract workers to clear the track for the approaching westbound trains.
0416	The foreman received confirmation from the sub-foreman and from the supervisor that the Macdonald track was clear.
0417	The foreman told the RTC that the 2 westbound trains could be operated over the Macdonald track.
0418	The RTC routed the 2 westbound trains over the Macdonald track.
0418	The foreman authorized the 2 westbound trains through the work limits on the Macdonald track.
0432	After being instructed by the supervisor to continue his work, the backhoe operator started to clear material north of the tracks, about 1000 feet west of the crossovers.
0438	The foreman called the RTC to enquire about the plan for eastbound train 868-078. The foreman was told that the train would be held at Griffith, west of the work limits.
0440	The foreman told some of the workers (including the supervisor) that eastbound train 868-078 was lined toward the work limits on the Connaught track.
0500	Train 868-078 broadcast the home signal at Glacier.
0530	The PNR welders reported that they were clear of the tracks. They also told the foreman that they had finished work for the day.
0536	The backhoe operator cleared the track to allow the surfacing crew and the excavator to pass.
0541	The crew of eastbound train 868-078 requested permission to operate through the work limits on the Connaught track.
0543	The foreman contacted the employees under his immediate direction, as well as the supervisor and the sub-foreman, to say that an eastbound train had requested permission to travel through the work limits. The foreman received confirmation that the track was clear.
0543	The supervisor instructed the backhoe operator to return to the Connaught track and resume clearing material from the track.

Time (approximate)	Event
0544	The foreman authorized train 868-078 through the work limits on the Connaught track with no restrictions.
0559:45	The backhoe operator observed the light of the approaching train and got out of the backhoe with the intention of inspecting the eastbound train.
0600:01	Upon realizing that the eastbound train was on the Connaught track, the backhoe operator —got back into the backhoe with the intention of removing it from the track.
0600:05	The train crew observed the backhoe ahead on the track and applied the train brakes in emergency.
0600:30	After initiating an emergency brake application, train 868-078 collided with the backhoe while travelling at about 15 mph.

* The job briefings were conducted verbally and were not recorded by the employees.

** Track blocking can be applied by RTCs to prevent the routing of trains toward a particular track location or track limit, such as the work limits of a Rule 42.

*** The main-track crossovers at Fraine comprise 2 short tracks connecting the 2 main tracks. The crossover tracks are oriented to accommodate the movement of a train from 1 track to the other approaching from either direction on either track.

1.7 Certification of third-party contractors

Part 1, section 26 of the *Railway Safety Management Systems Regulations, 2015* states:

> 26. A railway company must ensure that any person, other than an employee, who is authorized by the railway company to access the railway and whose activities may affect the safety of railway operations has knowledge of
>
> (a) the requirements of the instruments referred to in subsection 10(1) that the person needs to know to carry out his or her activities safely;
>
> (b) any federal legislation that may affect railway safety and that the person needs to know to carry out his or her activities safely; and
>
> (c) any of the railway company's procedures — including any procedure referred to in this Part — standards, instructions, bulletins or other internal documents that may affect railway safety and that the person needs to know to carry out his or her activities safely.[6]

The backhoe operator possessed CP eRailSafe credentials. He had received this certification on 08 February 2016, and it was valid for 3 years. He also held valid eRailSafe credentials from CN.

eRailSafe Canada is a workforce compliance system for the Canadian railway industry. Railways, employees, and contractors use the service to ensure compliance with industry safety/security requirements. At CP, after completing eRailSafe training, third-party contractors are not required to be CROR-qualified unless the work they will be doing requires CROR qualification.

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6 Transport Canada, SOR/2015-26, *Railway Safety Management Systems Regulations, 2015* (last amended 01 April 2015), Part 1: Railway Companies, section 26.

In comparison, at CN, third-party contractors operating hi-rail equipment where track occupancy is involved must be CROR-qualified (Appendix B), even after completing the eRailSafe training.

At CP, to work on the tracks within Rule 42 work limits, third-party contractors are usually protected by a qualified CP foreman or sub-foreman. However, contractors who are CP CROR-qualified may be granted sub-foreman protection. At CN, to work on the tracks within Rule 42 limits, third-party contractors are required to be qualified in CN CROR and are usually granted sub-foreman protection directly. This does not preclude contractors at CN from working under the protection of a qualified foreman or sub-foreman.

1.8 Safety requirements for Canadian Pacific Railway employees working near the track

At CP, employees who perform maintenance-of-way activities are required to be CROR-qualified. These employees must perform their work in compliance with company rules, standards, and instructions.

The CP *Rule Book for Engineering Employees* (RBEE) sets out procedures for track worker protection (clearing employees) before authorizing a movement through work limits. The RBEE also sets out procedures for providing and documenting instructions to the movement, and for the conditions that must be met when establishing foreman or sub-foreman protection.

Section 4.3 of the RBEE states in part:

> **Clearing employees**
>
> (a) Prior to providing instructions to a movement(s) within protected limits, all affected employees must:
>
> (i) be made aware of the route to be used and work stopped;
>
> (ii) vacate their track units unless it is unsafe to do so; and
>
> (iii) have machines, material etc. in place of safety and remain clear of the track on which the movement is to operate.
>
> […]
>
> **Providing Instructions to a movement**
>
> […]
>
> (d) Prior to providing instructions to a movement, on the portion of track to be used, the foreman must:
>
> […]
>
> (iv) Confirm from the written record that all sub-foreman have reported clear or have cancelled;
>
> (v) Record the number of sub-foreman being protected in the #SF [sub-foreman] column of the movement instructions; and

> (vi) Advise the movement of the status of sub-foreman.
>
> (e) When a specific track is to be used, the instructions must specify the track on which the instructions apply.[7]

Section 7 of the RBEE states in part:

> (b) In order to use the protection held by a foreman, the employee(s) must:
>
> (i) not be in a different trade within engineering; and
>
> (ii) be a regular member of the crew.
>
> Other employees must receive sub-foreman or separate protection.
>
> (c) Within track renewal, the leading and trailing track units must receive sub-foreman protection from the foreman.[8]

CP had also developed and implemented an *Engineering On Track Safety/Task Assessment Booklet*. This booklet provides direction to workers regarding pre-trip planning and work assignments, on-track safety briefings at work sites (as required), and task assessments. The booklet includes a pre-printed form to be filled out before work commenced. The booklet states in part:

> An on track safety briefing must be conducted before any employee fouls any track to perform work. All information related to on track safety must be provided in the briefing to every employee who will foul the track to perform work.
>
> The minimum on track safety information must include:
>
> - Designation of the employee in charge
> - Type of track authority
> - Track limits of track authority
> - Time limits of the track authority
> - Track(s) that may be fouled
> - Protection on adjacent tracks, as applicable, including
> - Identification of machines that will foul adjacent track
> - Instructions on the nature of work to be performed by the machine
> - Characteristics of the work location in relation to the adjacent track
> - Procedure to arrange for on track safety of other tracks, if necessary
>
> Follow-up OTS [on track safety] briefing must be conducted whenever:

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7 Canadian Pacific Railway, *Rule Book for Engineering Employees* (effective 14 October 2015), section 4.3: Providing Instructions to Movements within Protected Limits (updated 01 October 2017 by a summary bulletin issued to all track workers).

8 Ibid., section 7: Protecting Track Units and Track Work on Main and Other Signalled Tracks, p. 23.

- Working conditions or procedures change
- Other workers enter the working limits, or
- Track authority is changed, extended, or about to be released.

The OTS briefings will be recorded in writing by the employee in charge and/or other employees as required. Duplicate form copies may be utilized for larger work groups. Immediate work location groups may utilize track protection forms for recording and briefing requirements.[9]

CP's OTS job briefing form (Appendix C), which was provided to employees, did not contain fields to record details of employees working within the limits or the tasks to be performed. The job briefing form that the supervisor filled out (Appendix D) did not record details of the employees working within the limits or the tasks to be performed. There was no requirement to record how many employees were being protected or the names of these employees. The railway considered that it was not practicable to do so, particularly with large groups of employees. There was also no requirement for signatures on either of the OTS job briefing forms.

On the morning of the occurrence, 5 job briefings were conducted at different locations and at different times with different employees and contractors. However, only 1 OTS job briefing form had been completed by the supervisor. The track workers and contractors did not have copies of the completed OTS briefing form, nor were they required to have them.

During the initial job briefing, it was stated that all trains were to operate on the Macdonald track only. When the Rule 42 foreman and the supervisor later discussed that an eastbound train would operate on the Connaught track, the backhoe operator was not informed of the change. In addition, when the routing for the eastbound train was changed, a job briefing was not conducted with all track workers.

1.9 Minimum safety requirements for Canadian Pacific Railway contractors

CP required all contractors working on railway property to complete the eRailSafe course. The contractors were required to pass the test to verify proficiency with the material. Contractors were also required to comply with other specific requirements as set out by the railway.

At CP, contractors were required to operate in compliance with CP's *Minimum Safety Requirements for Contractors Working on CP Property in Canada*.[10] This document identifies the responsibilities of contractors working on CP property, including the following:

3 Contractor Compliance & Responsibilities

3.1 General Compliance

---

9 Canadian Pacific Railway, *Engineering On Track Safety / Track Assessment Booklet*.

10 Canadian Pacific Railway, *Minimum Safety Requirements for Contractors Working on CP Property in Canada* (effective 15 September 2010), section 12: Railway Track Protection, pp. 12–15.

3.1.1 Contractor shall be fully and solely responsible for ensuring the safety and health of Contractor Personnel and for ensuring that its Work and other activities do not compromise the health and safety of CP Personnel or any other party, the protection of the environment, the protection of CP's property and those of any other party, and do not interfere with the safety of CP's railway operations.

[…]

5 Safety Training

5.1 Minimum Training & Qualifications

5.1.1 At its sole cost and expense, Contractor shall ensure that all Contractor Personnel be fully trained and qualified for the Work they will be performing. Contractors and Contractor Personnel shall meet, or exceed, all Applicable Legislation requirements relating to training and qualification.

5.1.2 Additionally, Contractor Personnel training and qualification shall meet or exceed all applicable industry standards.

[…]

7 Safety Job Briefing

7.1.1 Contractor Personnel shall attend all Job Briefings as and when conducted. Contractor Personnel shall be solely and fully responsible for understanding the content of the Job Briefing, and at a minimum shall:

(a) have an understanding of the scope of Work to be performed and an appreciation of the nature of the location, environment, and conditions where such Work is to be performed;

(b) be aware of specific or unusual hazardous condition, existing or potential and the control measures required to protect against, control, mitigate, or where possible, avoid said hazard; and

(c) have an emergency response plan/evacuation procedures.

7.1.2 Where Co-Mingled Work is being performed, job briefings must include both CP Personnel and Contractor Personnel, and any other third parties. The job briefing shall identify nature and extent of the interaction between the Work being performed by Contractor Personnel, and those performed by CP Personnel or other third parties. Contractor Personnel shall inform CP Personnel, and any other third parties of known or potential unsafe conditions and hazards that may be created by, resulting from, or inherent in their Work and the corresponding preventative, mitigation, and/or control measures at all job briefings prior to commencing Work, or as soon as Contractor Personnel becomes aware of such conditions.

[…]

12 Railway Track Protection

[…]

12.2 50 Feet Clearance Requirement

[…]

12.2.2 Unless authorized by CP, Contractor Personnel, equipment, and vehicles are not permitted to be within 50 feet of the closest track centerline.

12.2.3 In the event Work must be carried out within 50 [feet] of the closet [*sic*] track centerline, written authorization must [be] obtained from the Manager in Charge, and Contractor Personnel must still remain at the maximum practicable distance from all railway tracks at all times.[11]

1.10 Adaptations to rules or standard operating procedures

An adaptation can be defined as a planning failure in which a deliberate decision to act against a rule or plan has been made. Routine adaptations occur every day as people modify or do not strictly comply with work procedures, often in an effort to improve productivity or efficiency. In the analysis of error, an adaptation can be categorized as an unsafe act when the adaptation takes place before an accident. The TSB defines an unsafe act as an error or deliberate deviation from prescribed operating procedures, which, in the presence of a potential unsafe condition, leads to an occurrence or creates occurrence potential. The TSB defines an unsafe condition as a situation or condition that has the potential to initiate, exacerbate, or otherwise facilitate an undesirable event, including an unsafe act.

People rarely follow rules or instructions precisely, for reasons and in ways that make sense to them given their circumstances, knowledge, and goals.[12]

While policies and standard operating procedures are prescribed by a company to set boundaries for safe operations, individuals may experiment with the boundaries to become more productive or obtain some other benefit. This experimentation leads to adaptations of procedures and to a shift beyond the prescribed boundaries described in the standard operating procedures, toward unsafe practices.[13] Without intervention, the communication of successful adaptations between crew members tends to lead to their spread throughout an organization.

Such adaptations are unlikely to be recognized as deviations by those within the group employing them. The adaptations slowly become normal behaviour, and the risk associated with them is unlikely to be recognized.[14] This tendency has been described as the normalization of deviance.[15]

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11 Canadian Pacific Railway, *Minimum Safety Requirements for Contractors Working on CP Property in Canada* (effective 15 September 2010).

12 S. Dekker, *The Field Guide to Understanding Human Error* (Ashgate Publishing, 2006).

13 J. Rasmussen, "Risk management in a dynamic society: a modeling problem," *Safety Science*, Vol. 27, Issue 2/3 (1997), p. 197.

14 S. Dekker, *Drift into Failure* (Ashgate Publishing, 2011), p. 111.

15 D. Vaughan, *The Challenger Launch Decision: Risky Technology, Culture, and Deviance at NASA* (University of Chicago Press, 1997).

Without regular supervision, education, and enforcement of the expected boundaries, individuals are likely to continue to adapt procedures and "cut corners" until the actual unsafe boundary is found through a minor or major accident.

In this occurrence, the supervisor assumed the role of a sub-foreman without being granted formal sub-foreman protection. The supervisor believed that he was in a better position to observe the activities of the contractors because some of them were not in the foreman's line of sight. This adaptation had likely occurred on previous occasions without adverse consequences. In addition, the supervisor believed that he did not require formal sub-foreman protection to exercise the role of a sub-foreman.

1.11 Situational awareness

Maintaining situational awareness is a 3-stage process in which the operators take in information from their environment, understand its significance on the current situation, and project into the future to assist in planning.[16]

Working memory has a limited capacity, and information stored can be easily replaced by other information in a dynamic operational environment. In this way, working memory represents a significant limitation on an individual's ability to maintain situational awareness. Overcoming this limitation involves developing systems that minimize reliance on working memory for critical information: "System designs that necessitate people remember information, even in the short term, increase the likelihood of [situational awareness] error."[17]

For instance, in this occurrence, there was no location on the Rule 42 form to note the location or times on and off the track for individual employees or track equipment that were not provided with sub-foreman protection, nor was this information required to be noted. As a result, the foreman used a variety of improvised tools (such as a separate notepad and adhesive notes on the vehicle dashboard) to keep track of where employees were working within the limits of their protection.

In addition to situational awareness at the individual level, people working in groups must develop shared situational awareness (where 2 or more team members have a common understanding of the situation) and team situational awareness (which represents the shared understanding of the whole team).[18]

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16 M. R. Endsley, "Situation awareness," in: G. Salvendy (ed.), *Handbook of Human Factors and Ergonomics*, 3rd edition (John Wiley & Sons, 2006), pp. 529–530.

17 Ibid., p. 533.

18 P. M. Salmon, N. A. Stanton, G. H. Walker, and D. P. Jenkins, *Distributed Situation Awareness: Theory, Measurement and Application to Teamwork* (Ashgate, 2009), p. 23.

Among the factors that are known to affect a team's ability to develop shared situational awareness are effective team processes for sharing relevant information and the ability to monitor the activities of other team members without verbal communication. Common understanding of team roles, responsibilities, and expectations is critical to carrying out this monitoring function effectively.[19] Consistent use of standard operating procedures and effective team briefings are important tools for building a common understanding of team roles and responsibilities.

This common understanding, also called a shared mental model, allows team members to understand team roles, anticipate information requirements, and effectively anticipate the needs of other team members.[20]

1.12 Efficiency testing

To ensure compliance with railway operations, railway officials periodically conduct efficiency testing. CP used an efficiency test manual to provide guidance to supervisors on the procedure to follow to conduct each test and to evaluate the results. For Rule 42, there were 7 related efficiency tests for engineering employees. No tests specifically required the foreman or sub-foremen to account for contractors when clearing the track for an approaching train, since contractors are included within the CROR definition of "employee."

All CP employees are to be tested at least once every 3 months. An employee receives a mark of pass or fail for each test. When an efficiency test is conducted, immediate feedback is given to the employee in both pass or fail situations.

If the employee does not pass, he or she is provided with verbal coaching, at a minimum, to improve the employee's knowledge of and respect for the rule. In more serious cases, the employee may be required to conduct a rules review and rewrite, and/or may receive disciplinary action. All employees who fail the test must be re-tested, typically within 7 days of the initial failure. However, if a contractor fails an efficiency test, CP does not require a retest, given that in many cases the contractor does not return to the property.

In the 3 years preceding the accident, the RTC was not tested or audited on Rule 42, and there was no requirement to do so.

1.13 Previous TSB rail safety advisory on Rule 42 (Planned Protection)

On 05 November 2015, CP train 246-04 was inadvertently routed into the exclusive limits of track workers on the south track of CP's Galt Subdivision. Before lining the train, the RTC and the foreman did not discuss any routing arrangement changes.[21]

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19 Ibid., pp. 24–25.

20 Ibid., p. 25.

21 TSB Rail Occurrence R15T0258.

On 11 December 2015, the TSB issued Rail Safety Advisory 16/15 to Transport Canada (TC), indicating that, to properly protect an evolving situation, routing arrangements need to be clear, concise, and consistent among all parties involved. The safety advisory stated that, given the risk to track workers from trains operating through Rule 42 limits, TC may wish to review the work procedures and training provided to RTCs relating to Rule 42 limits involving multiple tracks, and to review how routing arrangements are communicated to all track workers.

On 30 May 2016, TC responded to the safety advisory:

- CP's engineering employees completed a Dynamic Safety Review on sub-foreman protection and multi-track requirements, by reviewing procedures in CP's special instructions and reviewing incidents with an emphasis on the application of the rules;
- CP will continue to conduct efficiency tests on Rule 42 to ensure employees are applying the rules correctly in the field.[22]

1.14 Other TSB investigations involving deficiencies in track worker protection and/or protection for contractors working on the track

Since 2011, the TSB has conducted 5 other investigations (Appendix E) involving deficiencies in track worker protection and/or protection for contractors working on the track. These investigations examined a number of track worker protection issues, including

- adequacy of job-briefing practices for contractors;
- adoption of engineered safety defences to protect on-track workers; and
- gaps in regulatory protection for third-party contractors working for federally regulated railways.

[22] Transport Canada, response to Rail Safety Advisory Letter 16/15: Inadequate Rule 42 Blocking and Routing Arrangements (30 May 2016).

2.0 ANALYSIS

The condition of the track and the manner in which train 868-078 was operated did not contribute to the occurrence. The analysis will focus on the protection of on-track workers, including third-party contractors, job safety briefings, adaptations to sub-foreman procedures, situational awareness, and company overview of track worker protection.

2.1 The accident

The accident occurred when train 868-078, authorized to operate eastward through *Canadian Rail Operating Rules* (CROR) Rule 42 (Planned Protection) limits on the Connaught track, struck the occupied backhoe, resulting in serious injuries to the operator and damage to the backhoe and the lead locomotive.

At 0232, the Rule 42 foreman had established with the rail traffic controller (RTC) that trains requiring passage though the work limits should be operated on the Macdonald track. The supervisor made the request for this arrangement to the foreman earlier, and communicated it to others during job briefings. Subsequently, 2 westbound trains had successfully passed through the work limits on the Macdonald track. Later, the foreman realized that the RTC had routed an eastbound train toward the work limits on the Connaught track. The RTC deviated from the routing arrangement that had been established with the foreman.

The foreman told all sub-foremen and contract workers under his protection and the supervisor that an eastbound train would require the Connaught track for passage in about an hour. Contrary to the Canadian Pacific Railway (CP) *Engineering On-Track Safety/Task Assessment Booklet*, no formal job briefing was conducted to inform all employees and contractors of the change in track routing for trains. At that time, the eastbound train had not yet arrived, nor had its crew requested permission to pass through the work limits.

When the train approached the work limits, the crew contacted the foreman and requested permission to pass through the work limits. Before authorizing the train to pass through the work limits, the Rule 42 foreman confirmed that all workers and track equipment under his direct supervision were clear of the track, and the sub-foreman and the supervisor told him that the track was clear.

The supervisor had overall responsibility to ensure that the track work was completed safely and on time. He did not control the work limits. However, he was directing the activities of multiple contractors within the work limits. When the foreman made the follow-up call to confirm that the Connaught track was clear for the eastbound train, the supervisor was focused on a separate task with other off-track activities. Unknown to the foreman, and without his permission, the supervisor instructed the backhoe operator to resume work on the Connaught track after confirming to the foreman that the Connaught track was clear.

At CP, rules and operating procedures require that all employees, including contractors working on the main track within Rule 42 limits, be under the direction of the foreman or a designated sub-foreman. When ad hoc control over a number of work activities occurs, it creates ambiguity in the chain of command relating to track worker protection. In this occurrence, the supervisor assumed the responsibility of a sub-foreman to protect some of the contracted track workers without having acquired formal sub-foreman designation from the foreman. The misapplication of procedures for Rule 42 protection resulted in misunderstandings among team members and important information being missed.

2.2 Canadian Pacific Railway Rule 42 protection of third-party contractors

At CP, contractors who are hired to perform on-track work do not receive the same level of training as do regular employees on the applicable rules, regulations, and company instructions. Contractors undergo eRailSafe familiarization training. At the work site, these contractors are normally protected by a qualified railway employee while working on or near the track. Provided that the qualified railway employee is vigilant in ensuring protection for the contractors, safety will be maintained.

2.2.1 Safety briefings

On the morning of the occurrence, a number of on-track safety (OTS) job briefings were conducted in different locations and at different times with different employees and contractors. However, only 1 OTS briefing form had been completed by the supervisor. The track workers and contractors did not have copies of the job briefing form, nor were they required to have them.

During the initial job briefing, it was stated that all trains were to operate on the Macdonald track only. However, after the routing for the eastbound train was changed to the Connaught track and the supervisor was informed, the backhoe operator was not updated, nor was a follow-up job briefing conducted. A secondary job briefing indicating that the train's route was changing would have provided sufficient information to all workers, including the backhoe operator, that they needed to clear the Connaught track.

If follow-up job briefings are not conducted with track workers when safety-critical decisions, such as changes to routing of trains through Rule 42 work limits, are made, the risk of accidents is increased.

2.2.2 Reliance on working memory

Reliance on working memory increases the likelihood of errors. Procedures and memory aids available for use by the Rule 42 foreman were all designed to assist in keeping track of sub-foremen. In addition, there are no formal pre-printed documents available to sub-foremen to keep track of workers whom they are overseeing.

The investigation determined that the Rule 42 foreman and sub-foreman used various ad hoc methods to keep track of employees, including a separate notepad or adhesive notes on

the vehicle dashboard. As a result, individual foremen were using their own methods to account for people on the track. If appropriate memory aids are not available to help all foremen responsible for managing activities within the work limits, foremen might rely primarily on working memory, increasing the risk of errors.

2.3 Situational awareness

Safe operations require team members to develop and maintain a shared situational awareness, or mental model, of the operating environment. This is facilitated by procedures that limit reliance on working memory, promote the sharing of relevant information between team members, and allow team members to monitor each other effectively.

In this occurrence, reliance on working memory, rather than the use of the formal sub-foreman protection process, contributed to the Rule 42 foreman and the supervisor having a different understanding of the track on which train 868-078 would operate, the location of the backhoe, and the protection required for the backhoe operator.

2.4 Adaptations to rules or standard operating procedures

When a deliberate decision to act against a rule or standard operating procedure has been made, and that adaptation takes place before an accident happens, the adaptation can be categorized as an unsafe act. In this occurrence, the supervisor chose to informally assume sub-foreman duties under Rule 42. The supervisor had informally assumed the role of sub-foreman on previous occasions without adverse consequences. The supervisor believed that by informally taking responsibility for the activities of a number of contractors, the workload of the Rule 42 foreman would be reduced.

Like many adaptations to rules or standard operating procedures, the supervisor's adaptation was well intended. However, this adaptation created a level of ambiguity between those being protected (the contract workers) and those providing protection (the supervisor and the foreman). The ambiguity in the chain of command within the Rule 42 work limits created an unsafe condition that contributed to the backhoe operator being instructed to resume work activities on the active track.

3.0 FINDINGS

3.1 Findings as to causes and contributing factors

1. The accident occurred when train 868-078, authorized to operate eastward through *Canadian Rail Operating Rules* Rule 42 (Planned Protection) limits on the Connaught track, struck the occupied backhoe, resulting in serious injuries to the operator and damage to the backhoe and the lead locomotive.

2. The rail traffic controller deviated from the routing arrangement that had been established with the foreman.

3. No formal job briefing was conducted to inform all employees and contractors of the change in track routing for trains.

4. Unknown to the foreman, and without his permission, the supervisor instructed the backhoe operator to resume work on the Connaught track after confirming to the foreman that the Connaught track was clear.

5. The misapplication of procedures for Rule 42 protection resulted in misunderstandings among team members and important information being missed.

6. The ambiguity in the chain of command within the Rule 42 work limits created an unsafe condition that contributed to the backhoe operator being instructed to resume work activities on the active track.

3.2 Findings as to risk

1. If follow-up job briefings are not conducted with track workers when safety-critical decisions, such as changes to routing of trains through Rule 42 work limits, are made, the risk of accidents is increased.

2. If appropriate memory aids are not available to help all foremen responsible for managing activities within the work limits, foremen might rely primarily on working memory, increasing the risk of errors.

3.3 Other findings

1. Reliance on working memory, rather than the use of the formal sub-foreman protection process, contributed to the Rule 42 foreman and the supervisor having a different understanding of the track on which train 868-078 would operate, the location of the backhoe, and the protection required for the backhoe operator.

4.0 SAFETY ACTION

4.1 Safety action taken

4.1.1 Transportation Safety Board of Canada

On 04 December 2017, the TSB issued Rail Safety Advisory 14/17 to Transport Canada (TC) indicating that, given the inherent risks to track workers when trains are operated through track work locations, TC may wish to review the manner in which track workers, particularly third-party contractors, are protected.

4.1.2 Transport Canada

On 10 November 2017, TC issued a letter of concern to Canadian Pacific Railway (CP) regarding this occurrence, stating that it was concerned that "providing clearance for a train to enter into a foreman's limits when equipment is being operated foul of the track could compromise the safety of railway operations and lead to a serious collision and injury."[23]

4.1.3 Canadian Pacific Railway

On 02 November 2017, CP issued a Safety Flash [emphasis in original]:

> All employees must ensure there is clear communication when clearing a movement through protected limits.
>
> This includes validating that all parties understand the direction and are aware of the limits being provided.[24]

This report concludes the Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 27 February 2019. It was officially released on 29 March 2019.

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

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23 Transport Canada, letter of concern to Canadian Pacific Railway (10 November 2017).

24 Canadian Pacific Railway, Safety Flash – Employee Injured when Machine Struck by Train (02 November 2017).

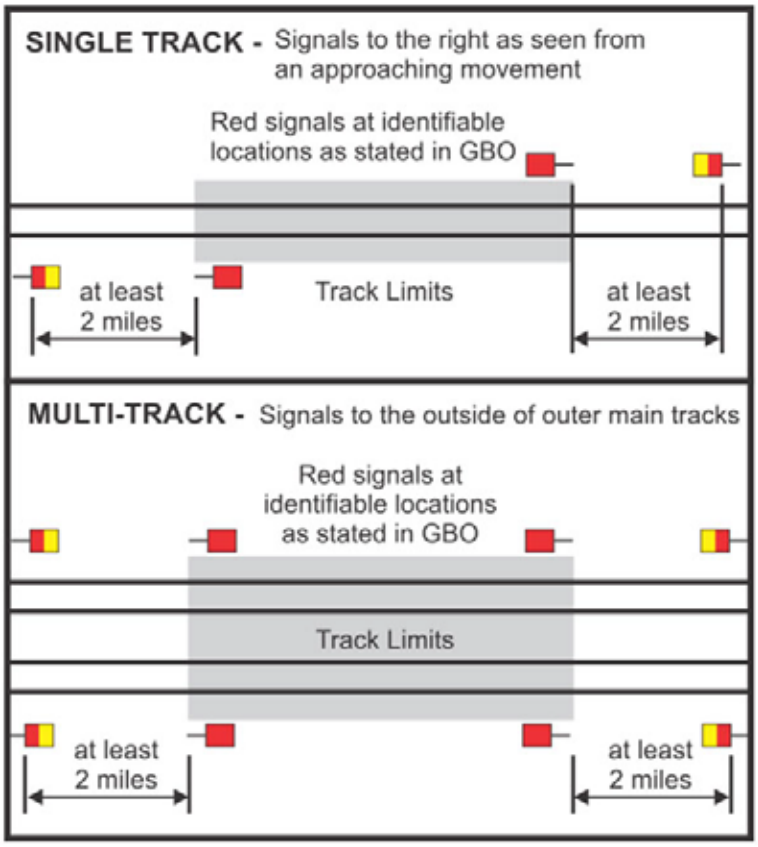
APPENDICES

Appendix A – *Canadian Rail Operating Rules* Rule 42 (Planned Protection) and Rule 842

Canadian Rail Operating Rules Rule 42 states in part:

> (a) Rule 42 signals must not be in place more than 30 minutes prior to or after the times stated in the GBO [General Bulletin Order] unless provided for in the GBO.

Figure A1. Placement of Rule 42 signals (Source: Transport Canada, Canadian Rail Operating Rules)



Note: Foreman must refer to Rule 842

In Figure A1, above, for single track, red signals are depicted at the locations stated in the GBO, and yellow-over-red flags are placed at least 2 miles in advance of the red flags. The flags are placed to the right of the track as seen by approaching movements. For multi-track, red signals are depicted at the location stated in the GBO, and yellow-over-red flags are placed at least 2 miles in advance of the red flags. The flags are placed outside of outer main tracks.

Canadian Rail Operating Rules Rule 42 also states:

> (b) A movement in possession of the Form Y must not proceed beyond the red signal located at the identifiable location stated in the GBO, enter the track limits

stated in the GBO, or make a reverse movement within such track limits until instructions have been received from the foreman named in the GBO.

When a specific track is to be used, instructions from the foreman must specify the track upon which the instructions apply.

(c) The instructions must be repeated to, and acknowledged by, the foreman named in the GBO before being acted upon.

(d) When a signalled turnout is within two miles of Rule 42 protection which does not apply on all tracks, every movement must approach such location prepared to comply with the requirements of Rule 42 until it is known which route is to be used.

Appendix B – Canadian National Railway Company training requirements for contractors

Annex D, Safety Guidelines for Contractors, of the Canadian National Railway Company (CN) eRailSafe training program, specifies, in part:

> **4.2.7 Vehicles**
>
> […]
>
> .4 All employees operating Hi-Rail equipment where track occupation is involved shall be required to obtain CROR training and certification from a CN approved source. The Contractor shall be required to send employees to the CROR rules course before commencing the work.[25]

CN's General Engineering Instructions (GEI) require in part:

> **12.0 Contractor Employee Qualifications**
>
> […]
>
> **Contractor Requirements**
>
> […]
>
> 12.2 Provide CN with a list of the employees working on or expecting to work on CN property and their qualifications. This includes the employee's full name, date of birth as well as:
>
> - Training completion dates
> - Refresher and recertification due dates
> - Proof of training provider (i.e. CN, other railroads, outside college, etc.)
>   - CN will only accept CROR qualifications that are provided by a CN Operating Practices approved training supplier.
>
> 12.3 Employees must carry documented proof of training in their possession while on CN property. Employees who are not in the list per rule 12.2 and who's [*sic*] proof of qualifications are not provided will not be allowed on CN property.
>
> 12.4 Contractors must ensure that their employees are briefed and are provided current copies of CN's standards and policies including most recent updates.
>
> […]
>
> **CN Requirements**
>
> 12.7 CN will provide the track protection for contractors, except in specific cases as authorized by the Vice President of Engineering.
>
> 12.8 CN will specify the level of training required in the following tables.[26]

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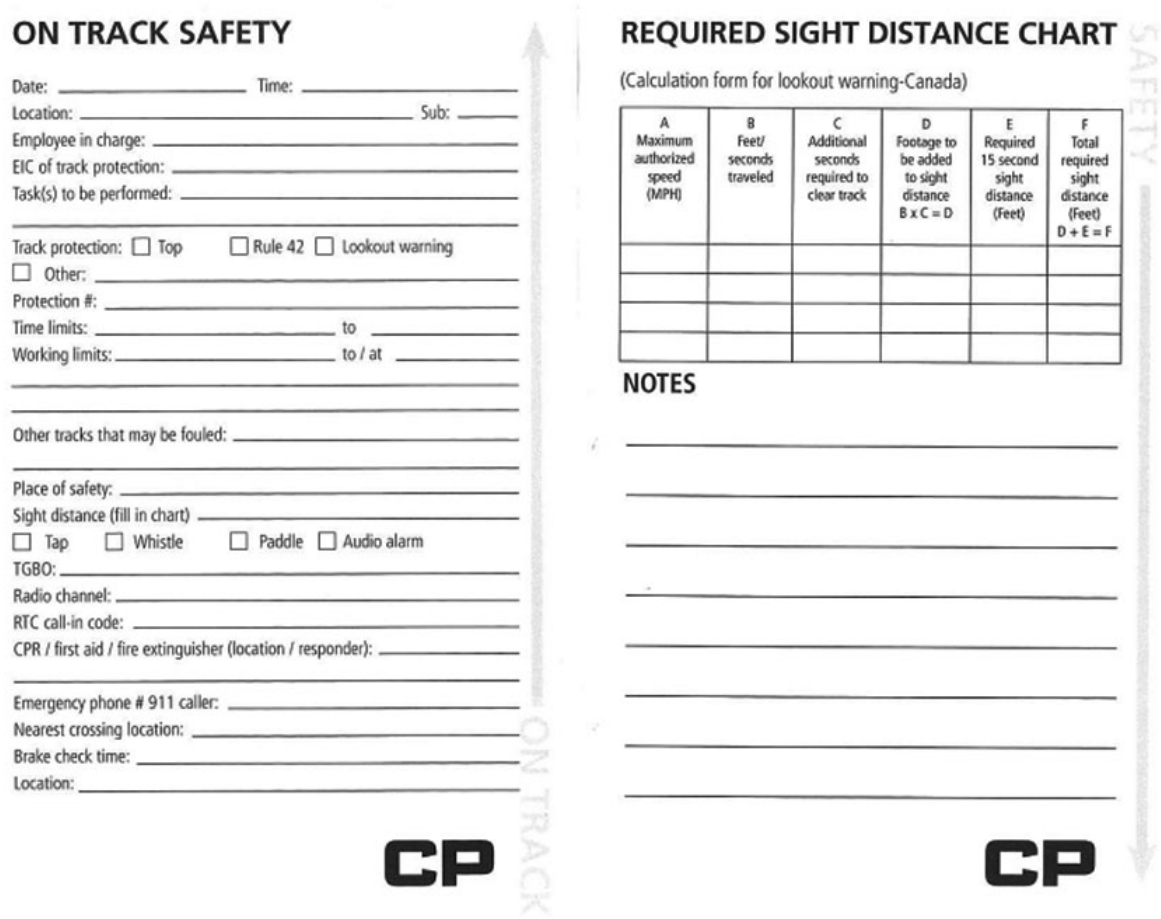
25 Canadian National Railway Company, eRailSafe training program, Annex D: Safety Guidelines for Contractors, section 4: Site Rules, subsection 4.2.7.4 (July 2012), p. 8.

26 Canadian National Railway Company, *General Engineering Instructions* (November 2013), pp. 25–26.

Appendix C – On-track safety job briefing form provided to the employees



ON TRACK SAFETY

Date: _____ Time: _____
Location: _____ Sub: _____
Employee in charge: _____
EIC of track protection: _____
Task(s) to be performed: _____

Track protection: ☐ Top ☐ Rule 42 ☐ Lookout warning
☐ Other: _____
Protection #: _____
Time limits: _____ to _____
Working limits: _____ to / at _____

Other tracks that may be fouled: _____

Place of safety: _____
Sight distance (fill in chart) _____
☐ Tap ☐ Whistle ☐ Paddle ☐ Audio alarm
TGBO: _____
Radio channel: _____
RTC call-in code: _____
CPR / first aid / fire extinguisher (location / responder): _____

Emergency phone # 911 caller: _____
Nearest crossing location: _____
Brake check time: _____
Location: _____

CP

ON TRACK SAFETY

REQUIRED SIGHT DISTANCE CHART

(Calculation form for lookout warning-Canada)

A Maximum authorized speed (MPH)	B Feet/ seconds traveled	C Additional seconds required to clear track	D Footage to be added to sight distance B x C = D	E Required 15 second sight distance (Feet)	F Total required sight distance (Feet) D + E = F

NOTES

_____
_____
_____
_____
_____
_____
_____
_____

CP

Appendix D – Job briefing form as completed by the supervisor

STOP

Switch install Oct 31 2107

OUR GOAL:	To Be The Safest Railway In North America
CHALLENGE:	To Be Injury and Incident Free for 2017
INJURY FREE DAYS: 100	

Expected Production: prep for install	**Previous Production:**

Employee In Charge:	[redacted]
EIC Track Protection:	[redacted]
Track Protection Used:	Protect against
Work Description:	Prep for switch install
Working Limits:	Mile 66-69 all main
Work Location:	68.3
Surfacing:	
Clear Location:	Rogers

Safety Item of the Day:	31-Oct	E-0 , 1 What must be done once existing or potential hazards have been identified at the work site?
Safety Flashes / Alerts:	Boom truck tie drop on track collision	

HAZARDS					
TURNOUTS	**CROSSINGS**	**ROADWAYS**	**BRIDGES**	**CULVERTS**	**OTHER**
Shuswap	Davies rd			Multiple	Multi Track

COMMUNICATIONS					
EMERGENCY CHANNEL	**WORKING CHANNEL**	**RTC CHANNEL**	**MAINTENANCE CHANNEL**	**ROAD CHANNEL**	**CP POLICE**
CP 15 – 911	CP 11	CP 6 *4161#, then CP 19	CP 11	CP 5	[redacted]

LOCATION OF FIRST AID KITS:	All Machines	LOCATION OF AED/OXYGEN :	BTMF

Lunch Break between 5th and 6th hour, NO GARBAGE is to be left on track or worksite.

It's mandatory to be wearing all required PPE while on duty and in machinery.

H&S REPRESENTATIVES	DESIGNATED SUB FOREMAN	CREW CONTACT #'s
	Front and Rear machines must have protection and be scanning proper channels.	RM - [redacted] RM – [redacted] TKPR – [redacted] EGF – [redacted]

Emergency First Aid Communication Plan:	*Report all injuries to Roadmaster and/or EIC immediately* *Stop work and keep channel clear until severity is known* *Arrange First-Aid and transportation if required*
911 CALLER:	[redacted]
HOSPITAL INFO:	Golden Golden & District General Hospital 835 9th Street North RR 2 Golden, BC V0A1H2 250-344-5271

+ Everyone is required to inspect passing trains and notify Roadmaster/Foreman of any defects +

+ Assist reverse movements when applicable and safe to do so +

+ If your tasks change, please ensure that you fill out the required Hazard Assessment Booklet +

Machine Operators are to test the functionality/effectiveness of their brakes and record it on their Job Briefing. The purpose of recording the time and location of the test is to serve as a reminder that Machine Operators are responsible to assess their brake effectiveness confirming to themselves that they are in control of their machine. Supervisors will check Job Briefings to ensure operators are complying.

BRAKE TEST TIME:	LOCATION

I commit to work safely

CREW SPECIFIC

- Remember to let bus driver know of any temp rates of pay
- make sure to lock doors and remove all garbage daily
- Setting up or removing flags must be clearly communicated to foreman

[Together Everyone Achieves More]

Appendix E – Other TSB investigations involving deficiencies in track worker protection and/or protection for contractors working on the track

R16V0195 (Roberts Bank) – On 18 December 2016, a Toronto Terminals Railway switching crew was shoving 66 empty intermodal platforms onto the east leg track at Roberts Bank Yard in Delta, British Columbia. At the same time, 2 contracted PNR RailWorks track workers were clearing snow from a switch on the same track. One of the track workers was struck by the leading platform of the movement and was transported to hospital with serious injuries. The investigation determined that if not all track workers are part of a comprehensive job briefing, they may not protect themselves from the hazards inherent in the job tasks, increasing the risk of accidents.

R16H0024 (Nemegos) – On 06 March 2016, Canadian Pacific Railway (CP) freight train 100-03 was proceeding eastward at about 35 mph when it collided with a stationary hi-rail vehicle at Mile 118.36 near Chapleau, Ontario. The foreman and machine operator had exited the hi-rail vehicle just before the collision. There were no injuries and there was no derailment. The hi-rail vehicle was destroyed. The collision occurred when the track unit was mistakenly operated past the outer main-track signal west of Kinogama Siding without having obtained a track occupancy permit to protect the movement. The investigation determined that if physical safety defences to warn or to intervene when a track unit has exceeded its track occupancy permit limits are not implemented, unsafe situations resulting from human error can remain undetected, increasing the risk of collisions between trains and track units.

R15T0245 (Whitby) – On 25 October 2015, VIA Rail Canada Inc. (VIA) passenger train number 65 was proceeding westward from Montréal, Quebec, to Toronto, Ontario, on the south track of the Kingston Subdivision near Whitby, Ontario. While travelling at about 38 mph, the train passed a red flag and entered into the work limits of track workers. The train stopped approximately 500 feet from the track workers and equipment on the track. The rail traffic controller had incorrectly lined the movement into the work zone. The investigation determined that implementation of existing technology, such as proximity detection devices and advance warning devices, can be an effective means to warn train crews and track workers that they are approaching one another.

R12V0008 (Messiter) – On 14 January 2012, Canadian National Railway Company (CN) freight train A41651 13, proceeding eastward from Kamloops, British Columbia, to Edmonton, Alberta, struck a track unit at Mile 14.5 of CN's Clearwater Subdivision. There were no injuries and there was no derailment. The track unit was destroyed. The lead locomotive of the train was undamaged. The investigation determined that advance warning systems exist and can provide backup safety defences for foremen who mistakenly travel outside their limits of authority. At the time of this accident, these systems were not typically used in Canada.

R11T0161 (Durham Junction) – On 14 July 2011, VIA passenger train number 051 was proceeding westward from Montréal, Quebec, to Toronto, Ontario, when it struck and fatally

injured a CN Engineering Services employee at Mile 314.4 of the Kingston Subdivision. CN maintained the track in the area. The workers were focused on their work and unaware of the imminent approach of the train.