Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

RAILWAY INVESTIGATION REPORT R13Q0001

COLLISION AND DERAILMENT QUEBEC NORTH SHORE AND LABRADOR RAILWAY FREIGHT TRAIN FCN-05 AND IRON ORE TRAIN BNL-005 AT MILE 124.2, WACOUNA SUBDIVISION, NEAR MAI, QUEBEC 11 JANUARY 2013

Canada

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

Railway Investigation Report R13Q0001

Collision and derailment

Quebec North Shore and Labrador Railway freight train FCN-05 and iron ore train BNL-005 at Mile 124.2, Wacouna Subdivision, near Mai, Quebec 11 January 2013

Summary

On 11 January 2013, at approximately 0018, Eastern Standard Time, freight train FCN-05 collided with the rear end of iron ore train BNL-005 at Mile 124.2 on the Quebec North Shore and Labrador Railway's Wacouna Subdivision, near Mai, Quebec. The first locomotive on train FCN-05 was completely destroyed and the second locomotive derailed. Eight cars on train BNL-005 derailed. The members of the FCN-05 train crew sustained minor injuries. Approximately 40 feet of track was damaged.

This report is also available in French.

Factual information

The accident

On 10 January 2013, at approximately 2000[1], Quebec North Shore and Labrador Railway (QNS&L) freight train FCN-05 (train FCN) departed the yard at Sept-Îles, Quebec, Mile 8.9 on the Wacouna Subdivision, travelling northward to Schefferville, Quebec (Figure 1). The train consisted of 3 locomotives and 55 loaded cars. It was about 2190 feet in length and weighed approximately 3950 tons.

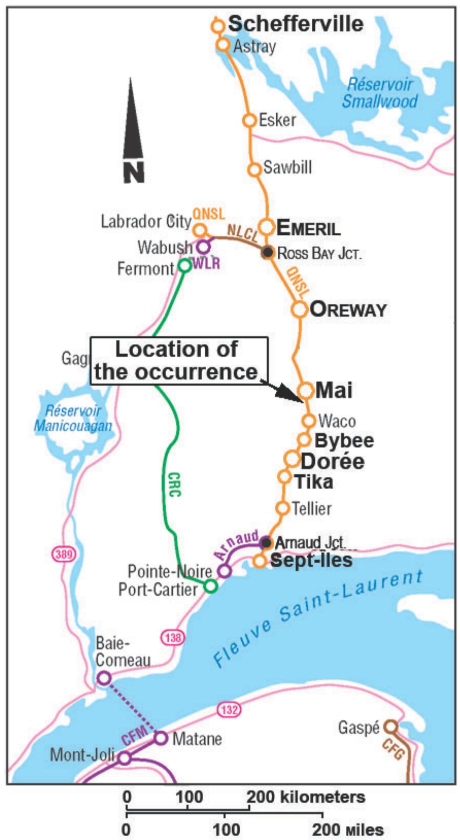

Figure 1. Accident site (Source: Railway Association of Canada, *Canadian Railway Atlas*)

Train FCN was operated by a locomotive engineer trainee, in the presence of an engineer with over 20 years of experience who was qualified for the position. Both were familiar with the territory and met fitness and rest standards. They had completed their previous assignment more than 72 hours before their shift and had slept well the night before the accident. The locomotive engineer trainee was undergoing practical training and had not yet received any formal training on the *Canadian Railway Operating Rules* (CROR).

[1] All times are Eastern Standard Time (Coordinated Universal Time minus 5 hours).

Throughout the evening, train FCN was following QNS&L iron ore train BNL-005 (train BNL), which had departed about 30 minutes earlier. Train BNL consisted of 3 locomotives and 238 empty cars; it was about 8600 feet in length and weighed approximately 6170 tons. On 11 January 2013, at approximately 0018, after passing the advance signal for south-east siding switch Mai, at Mile 123.9, train FCN collided with the tail end of train BNL at a speed of 26.5 mph. The latter was stopped on the main track at the home signal for south-east Mai while the train crew was in the process of clearing snow that prevented the remote operation of the switch providing access to the siding (Photo 1).

Photo 1. Train FCN-05 in collision with the tail end of train BNL-005 (source: QNS&L)

The crew members of train FCN-05 sustained minor injuries. Just prior to the collision, the engineer instructor got up from his seat and moved next to the engineer trainee. The engineer instructor braced himself behind the engineer trainee's seat, while the latter bent forward in his seat awaiting the impending collision. The cabin of the lead locomotive on train FCN (locomotive 320) was destroyed by the impact. The second locomotive on train FCN (locomotive 318) and 8 cars from train BNL derailed and sustained varying degrees of damage. Approximately 40 feet of track was damaged.

At the time of the accident, the skies were clear and the temperature was –11°C (–18°C with the wind chill).

Site examination

The first locomotive on train FCN came to rest at Mile 124.2, at the exit of a 3° left-hand curve. This curve, located right after signal 1239, is preceded by a 2°30′ right-hand curve. The cabin on this locomotive was destroyed. Two truck side frames from derailed cars on train BNL were projected into the cabin. The rear truck on the second locomotive of train FCN derailed.

The last 6 cars of train BNL lifted off the rails following impact and descended the embankment. The other 2 derailed cars remained on the track bed.

Track information

The Wacouna Subdivision consists of a single main track linking Sept-Îles (Mile 8.9) to Emeril Junction (Mile 225.30). Train movements are governed by the Centralized Traffic Control system (CTC) authorized by the CROR, and supervised by a Rail Traffic Controller (RTC) located in Sept-Îles.

It is a Class 3 track according to the Transport Canada-approved *Railway Track Safety Rules*. Maximum allowable speed is 40 mph. Traffic consists of 9 trains per day (ore, freight, and passenger), for an annual tonnage of close to 28 million gross tons.

The track was in good condition. It consisted of 136-pound continuous welded rail. The rails were laid on 18-inch double shoulder tie plates in curved track and on 14-inch double shoulder tie plates in tangent portions. The rails were fastened to the ties with 6-spikes. There were approximately 3250 wooden ties per mile of track. Ties were box-anchored every second tie. The ballast was about 12 inches thick, with shoulders between 12 and 16 inches. It was mainly made up of 1.5- to 3-inch diameter crushed rock.

Recorded information

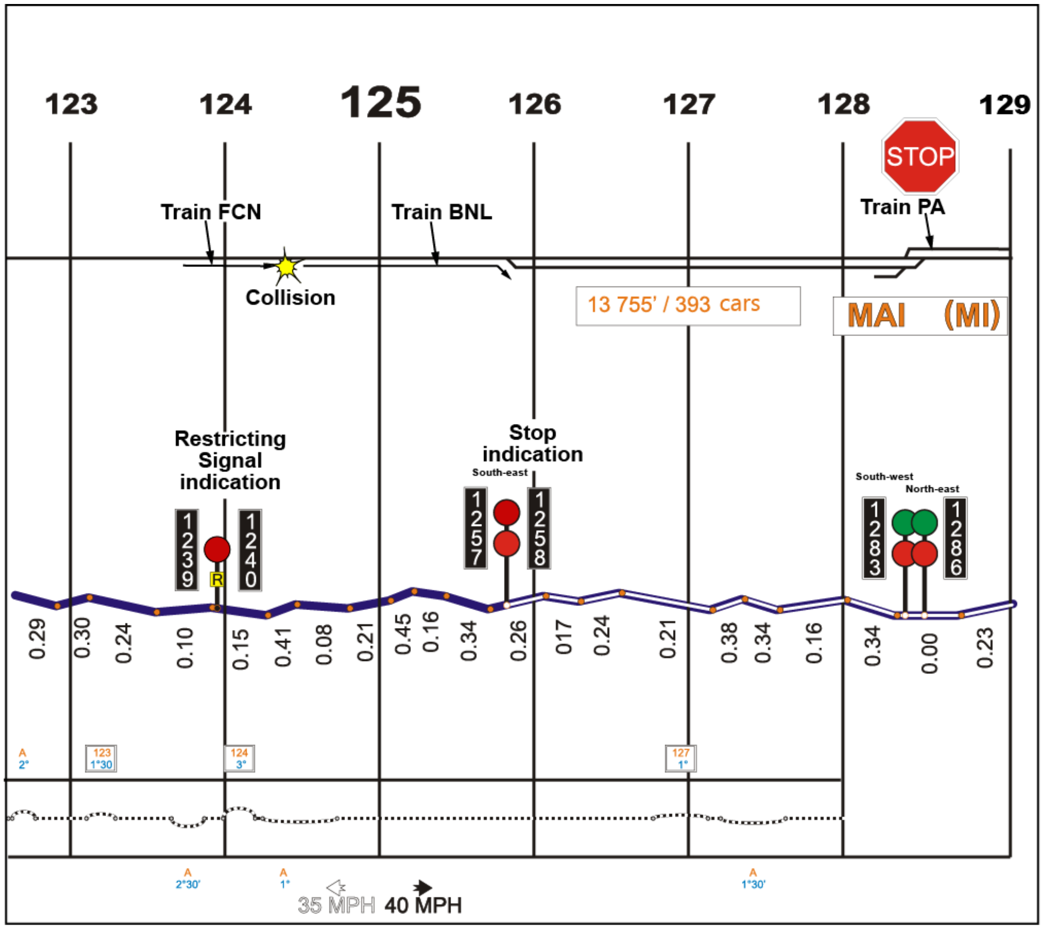

Figure 2. Track profile, signal layout and trains in the vicinity of Mai

In the course of the evening, train FCN met 2 other trains and received some 20 alarms from the proximity detection device (PDD).[2] Table 1 shows the sequence of events and the actions taken by the crew.

2 See the section on the proximity detection device in this report.

Table 1. Sequence of events that led to the collision

Time	Event
2322:47	Near the end of his shift, the RTC calls train BNL to advise that it would have to apply CROR Rule 564 (a pass stop authority) at signal 1257,[3] south-east Mai, since the switch was clogged with snow. The engineer would need to clear the snow off the switch and take the siding.
2323:18	RTC calls train FCN to advise that the block governed by signal 1257 south-east Mai should already be clear upon its arrival, but that he can't give him the block governed by signal 1283 north-east Mai, because the switch is clogged with snow. RTC also advises engineer to set off a locomotive for another train yarded at Mai (train PA). RTC and engineer instructor conclude that train FCN will reach Mai Station at the expected time to set off the locomotive for the other train.
2330	RTC shift change.
0001:24	At Mile 115.0, crew of train FCN acknowledges receipt of type 1 alarm from locomotive 424 on train BNL indicating latter's position less than 8 miles away.
0009:32	Crew of train BNL stops short of signal 1257 to clear snow from switch (signal 1257 indicates stop).
0010:29	At Mile 120.6, locomotive 320 on train FCN receives type 1 alarm warning that locomotive on train PA, yarded at Mai, is less than 8 miles away. Train FCN is to set off locomotive for this train. Crew acknowledges receipt of alarm.
0010:32	At Mile 120.7, locomotive 320 receives type 2 alarm warning that locomotive 424 on train BNL is less than 5 miles away. Crew acknowledges receipt of alarm. Position of locomotive 424 (train BNL): Mile 125.6 (stopped).
0011:58	At Mile 121.2, throttle is engaged; train travelling at 17.2 mph.
0013:57	Train FCN passes signal 1219 indicating Clear to Stop[4]. Train is travelling at a speed of 30.3 mph. Position of locomotive 424 (train BNL): Mile 125.62 (speed of 1.7 mph in order to enter the siding).
0015:33	At Mile 122.9, locomotive 320 receives type 3 alarm warning that locomotive 424 on train BNL is less than 3 miles away. Crew acknowledges receipt of alarm without reading displayed data. Train speed is 35.9 mph. Position of locomotive 424 (train BNL): Mile 125.63 (stopped).

[3] The names of the signals, such as signal 1257, identify their location (Mile 125.7).
[4] Proceed, preparing to stop at next signal.

Time	Event
0015:51	Crew of train FCN disengages throttle; speed is 38.0 mph and train is located at Mile 123.1.
0016:59	At Mile 123.8, approximately 750 feet from signal 1239 displaying a Restricting Signal indication[5], a minimum brake application was made with the train travelling at 40 mph.
0017:13	At signal 1239, train speed is 40 mph and dynamic braking is applied.
0017:22	At Mile 124.1, train speed is 37.9 mph and there is a full service brake application.
0017:27	At Mile 124.1, train FCN's emergency brakes are applied while train is travelling at 36.8 mph.
0017:40	At Mile 124.2, train FCN collides with rear end of train BNL at a speed of 26.5 mph.
0017:49	Train FCN comes to a stop at Mile 124.21.

An analysis was done of the data from the PDD on locomotive 320 compiled by the central server. 10 type 1 alarms and 1 type 2 alarm sounded between locomotive 320 and locomotive 424. However, the type 3 alarm was not recorded since the PDD on one of the locomotives only transmitted every 10 or 12 seconds. The event recorder on locomotive 318 recorded all the alarms and indicated they had been acknowledged.

According to the event recorder, it took approximately 8 seconds from the service and emergency brake application for deceleration to become pronounced and constant. Taking into account the train's deceleration curve and a reaction time of 1 second on the part of a locomotive engineer, the braking distance required to come to a complete stop for a train similar to the occurrence train would be 1500 feet , whereas the distance required to lower the speed to 15 mph would be 1300 feet.

QNS&L training program

The program established by QNS&L for training locomotive engineers includes theoretical courses and a practical phase. During the practical phase, the engineer trainee is accompanied by an engineer instructor and must meet specific objectives at designated stages (Table 2). After each stage, the trainee is evaluated by a manager. In addition, to meet the stipulations for one-person crew operations, QNS&L is required by Transport Canada to have each locomotive engineer re-evaluated by a manager during a trip at least every 8 months.

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[5] "Proceed at RESTRICTED speed." RESTRICTED speed: "A speed that will permit stopping within one-half the range of vision of equipment, also prepared to stop short of a switch not properly lined and in no case exceeding SLOW speed. When moving at restricted speed, be on the lookout for broken rails …" SLOW speed: "A speed not exceeding fifteen (15) miles per hour." Source: Transport Canada, *Canadian Rail Operating Rules*, Definitions, available at: https://www.tc.gc.ca/eng/railsafety/rules-tco167-160.htm (last accessed 18 March 2014)

Table 2. Learning objectives for engineer trainees, QNS&L railway

Stage	Learning objectives
36-hour theory course	• QNS&L induction
300 hours of practice	• Become familiar with the location and mileage of each station as well as with permanent speed restrictions • Be able to locate the advance signal for each station
160-hour theory course	• Understand basic locomotive concepts, General Operating Instructions (GOI), Timetable No. 21 and car switching (these hours do not count toward acquired experience)
300 hours of practice	• Operate a train from Carol Lake (Newfoundland-and-Labrador) to Mai (Quebec) without the benefit of notes or the track profile • Be able to recite procedures to the instructor (trainee and instructor switch places)
300 hours of practice	• Operate a train from Mai to Sept-Îles without the benefit of notes or the track profile
100 hours of practice	• Prepare for the qualification trip (instructor takes up position in the second locomotive for a minimum of 2 trips)

CROR training courses are not offered on a regular basis. Among the 31 employees hired by QNS&L between February and July 2012, 25 received CROR training within 3 months of joining the company. The other trainees, some of whom had been hired in May 2012 (including the trainee involved in this occurrence), still had not received that training at the time of the accident, i.e. more than 7 months later.

In addition, the learning objectives of the engineer trainees and the re-evaluations of the locomotive engineers are not completed on time. Sixteen trainees had exceeded 300 hours of practice; of this number, only 9 had been evaluated by a manager. Of the 54 qualified locomotive engineers, 27 had not been re-evaluated by a manager within an 8-month period, and some of them were serving as instructors for trainees.

The engineer trainee was hired in May 2012 and paired with his instructor in July 2012. This was the first time the engineer had served as an instructor. No training is given to engineers before they become instructors. Other railway companies have instructor training programs that focus on reinforcing the mentoring skills of engineer instructors. Other aspects are also covered, such as communication, listening, observation and feedback.

Proximity detection device

The PDD warns the operator about the presence of any other rail vehicle within a specified distance. It is equipped with a GPS that can determine the position, direction and speed of any rail vehicle fitted with the device.

A signal containing the movement parameters of rail vehicles, such as identification, position, relative distance and speed, is transmitted by radio every 10 or 12 seconds, with the information displayed on the screens of other vehicles in the area (see Figure 3).

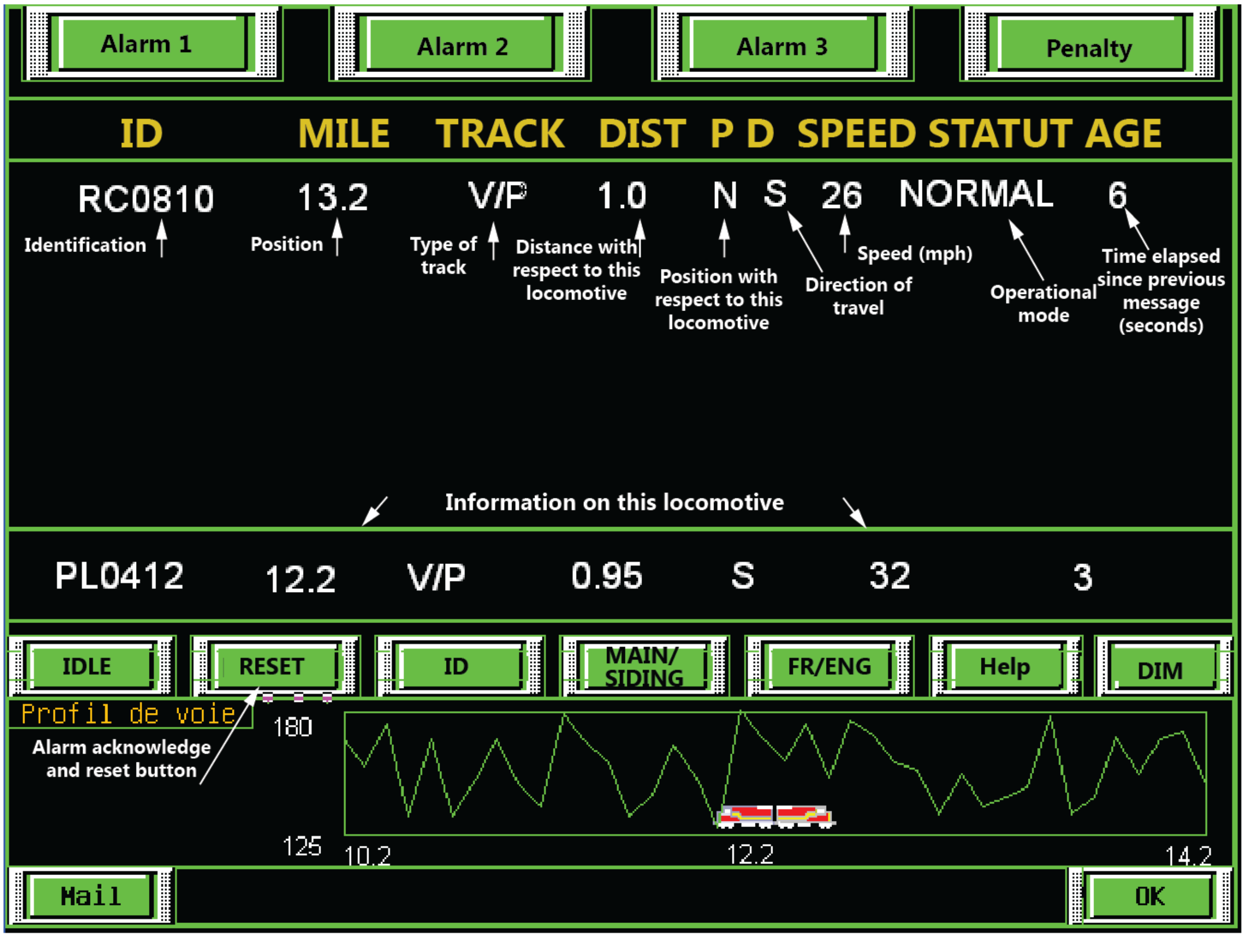

Figure 3. Standard screen for a proximity detection device (source: QNS&L)

The PDD displays the distance between rail vehicles along with the other positions received. This distance calculation does not take into account the length of a train and only provides the distance between vehicles that have an onboard PDD. The distance must be interpreted by the engineer. When the separation between locomotives is less than 8, 5 or 3 miles, a visual warning indicating the alarm level (1, 2 or 3) is displayed on the screen and an audible warning is sounded (identical for all 3 alarm levels). To acknowledge receipt of type 1 and 2 alarms, the engineer must press the button on the crew alertness device located near the PDD screen or click on the "**REARMER**" button on the PDD screen itself. For type 3 alarms, the engineer must first press the button on the crew alertness device within 10 seconds of the alarm, and then click on the "**REARMER**" button in the next 5 seconds. If an engineer fails to acknowledge receipt of a type 2 or 3 alarm within 10 seconds, the system triggers automatic braking of the rail vehicle.

Representatives from the TSB and QNS&L examined the PDD (TSB Laboratory report LP 013/2013) and determined that the device performed per specifications.

Following Signal Indications

Following the investigation into the collision between 2 Canadian Pacific Railway (CPR) trains in 1998, near Notch Hill, British Columbia (TSB Investigation Report R98V0148), the Board determined that the backup safety defences for signal indications were inadequate and recommended that:

> The Department of Transport and the railway industry implement additional backup safety defences to ensure that signal indications are consistently recognized and followed by crew members.
>
> R00-04, issued February 2011

Action to date on the deficiency has resulted in procedural improvements implemented by CPR with its crew resource management practices. While there has been some safety benefit, administrative or procedural defences are not always adequate to protect against an operating crew's misinterpreting or misperceiving wayside signal indications. TC and the railways are exploring the potential for current locomotive fleet computer systems to include signal recognition and air brake control capabilities. However, to date, there has been no formal strategy developed to adapt either emerging technology or existing on-board computer systems to provide fail-safe physical train control defences. Therefore the Board reassessed the response to Recommendation R00-04 to remain “Satisfactory In Part”.

Given that the risk of a serious collision or derailment remains if rail signals are not consistently recognized and followed, the TSB included this deficiency on its 2012 Watchlist. The TSB has indicated that, since 2002, there has been an average of 11 occurrences per year in which a signal indication was misidentified, misinterpreted or not immediately recognized, thereby contributing to the occurrence. If signal indications are not followed, the CTC system cannot ensure that trains on the same line are separated appropriately. CTC does not provide any warning that a train may be passing beyond a restricted location, nor does it provide automatic means to slow or stop a train before it passes a stop signal or other points of restriction. The level of safety afforded by wayside signal systems has not improved significantly beyond their original design, which dates back over 100 years.

To add CTC safety measures, railways have adopted various other defence mechanisms to help prevent accidents. However, these defences are inadequate in situations where the train crew misinterprets or misperceives a signal indication or does not apply, or misapplies, an operating rule.

Following another accident resulting from a signal being misperceived or misinterpreted, which occurred in Aldershot[6], Ontario in February 2012, the Board recommended that:

> The Department of Transport require major Canadian passenger and freight railways to implement physical fail-safe train controls, beginning with Canada’s high-speed rail corridors.
>
> R13-01, issued June 2013

[6] TSB Railway Investigation Report R12T0038

Locomotive crashworthiness

The assessment of the crashworthiness of locomotive 320 showed that the sheeting on the cab of locomotive 320 was much thinner (0.13 inch) than the thickness specified in the existing rules (0.25 inch). The locomotive was not fitted with either collision posts, which are designed to reduce cabin deformation in frontal collisions, or corner posts, which serve to reinforce the cab's structure in the event of a collision or rollover. Nor was it equipped with anti-climbers, which are designed to prevent colliding objects from travelling up over the frame and striking the cab.

When locomotive 320 was built in the '70s, the regulations then in effect in Canada did not contain any specific requirements relating to locomotive cab crashworthiness. The *Railway Locomotive Inspection and Safety Rules* approved by Transport Canada went into effect in 1997. These rules contain requirements pertaining to crashworthiness, but only for new locomotives. In view of the fact that over 90% of main line locomotives were built prior to the establishment of the current crashworthiness standards, the Board, in its investigation of the accident that occurred at Aldershot in 2012, recommended that:

> The Department of Transport require that crashworthiness standards for new locomotives also apply to rebuilt passenger and freight locomotives.
>
> R13-03, issued June 2013

TSB Laboratory reports

The following TSB Laboratory reports were completed:

- LP 012/2013 – Crashworthiness Analysis, Freight Train, FCN-05
- LP 013/2013 – Proximity Detection Device System Analysis, Freight Train, FCN-05

These reports are available from the TSB upon request.

Analysis

No track or equipment defects were considered contributory to the accident. The members of the crew were well rested. Therefore, the analysis will focus on the operation of the train, the training program and the limitations of the PDD.

Accident

The train crew, having received a 'Clear to Stop' indication at signal 1219, did not establish a speed enabling it to stop at signal 1239. What's more, with a Restricting indication, the crew did not reduce speed in compliance with this indication. Indeed, the train passed Signal 1219 at a speed of 30 mph and its speed continued to fluctuate. At Mile 123.1, train FCN's speed was 38 mph and continued to increase until it reached 40 mph approximately 750 feet from signal 1239, which displayed a Restricting Signal indication. When signal 1239 became visible, a minimum brake application was made, followed some 20 seconds later by a full automatic brake application to further slow the train and conform to the signal indication. However, owing to the inertia of the braking system, the speed decreased only slightly and the train passed signal 1239, displaying a Restricting Signal, at a speed of 40 mph. When the rear end of train BNL came into view, the emergency brakes were applied, but because the train's speed was still too high, train FCN could not stop in time and collided with the tail end of train BNL, which was stationary.

Non-compliance with restricting indication at signal 1239

Slightly less than 1 hour before the collision, a conversation with the RTC might have led the crew to understand that signal 1257, south-east Mai, would be clear when train FCN arrived there and that it would reach Mai Station at the expected time to transfer a locomotive to train PA. Previous TSB investigation reports (R10Q0011, R12T0038) have established that information provided in advance to train crews leads to mental models that can influence subsequent actions. It is difficult to alter a mental model once developed. Given the conversation with the RTC a little less than 1 hour before the collision, and despite the type 3 alarm, the crew continued to believe that train BNL would be in the siding at Mai Station and that signal 1239 would not display a restrictive indication.

Wayside signals provide a physical signal installation combined with an administrative requirement to follow the signal indication. This defence relies on the train crew to observe the signal, recognize the intent of the signal, and take appropriate action. Operating rules and company GOI require that all signals be identified and announced within the cab and that some signals be announced over the railway radio system. When an engineer is alone onboard a train, he must announce all signals over the radio system. Those defences, while of value, are inadequate in situations where the train crew misperceives, misinterprets or does not follow a signal indication. For more than a decade, the Board has had an outstanding recommendation calling for additional defences in signalled territory to ensure that signal indications are consistently recognized and followed. In the absence of additional physical fail-safe train controls in signalled territory, the existing defences proved inadequate to prevent the collision.

Sightline distance and braking distance with respect to signal 1239

Because signal 1219 displayed a 'Clear to Stop' indication, the crew needed to be sure it could stop the train at the next signal (signal 1239). To do so, a reduction in speed was required even before signal 1239 came into view as the sightline for this signal was only 750 feet. As a result of their conversation with the RTC, the train crew anticipated a more permissive indication and therefore maintained a speed of approximately 38 mph, which is below the authorized maximum speed in this area. However, at such a speed, the braking distance before coming to a complete stop would be 1500 feet and the distance required to reduce speed would be at least 1300 feet, even if the emergency brakes were applied. Considering the sightline distance to signal 1239, it would be impossible for a train traveling at the permitted speed to follow the signal indication once it became visible, which increases the risk of collision.

The engineer instructor did not intervene to have the trainee reduce speed even before signal 1239 came into view. Once the signal became visible, even though the engineer instructor intervened to apply the emergency brakes, it was too late. The engineer instructor's delayed intervention may be attributable to the fact that he was less vigilant because he trusted the trainee, having been paired with him for approximately 6 months, and because he himself did not expect signal 1239 to display a Restricting indication.

Training program for locomotive engineer trainees

Although signal 1239 was seen by the engineer trainee, the latter responded with a minimum brake application whereas he should have quickly and significantly reduced his speed to comply with the signal indication. The engineer trainee had not yet received CROR training, therefore he had limited signal experience. As a result, he did not have a complete grasp of the actions required with respect to a Restricting indication. QNS&L's training program for locomotive engineer trainees does make any reference to CROR qualification even though an engineer trainee could be operating a train under an instructor's supervision, as soon as his second trip.

The fact that a large number of new locomotive engineers were hired in 2012 caused delays in required signal training and certification, which had not been completed for some trainees after 7 months. Although this length of time exceeded usual training timeframes, the fact remains that engineer trainees were authorized to operate a locomotive without completing their basic training and certification requirements. To confirm that trainees fully understand the measures necessary to address various signal indications, they must have completed CROR training, which includes signal rules. Moreover, to ensure that the necessary measures are taken in a timely fashion before arriving at a signal and in reaction to a signal, the proper procedures must be overlearned; that is, they must become, through repetitive practice, an automatic response that will allow the process to be implemented more easily. In the absence of adequate CROR training and overlearned procedures, engineer trainees lack sufficient means to operate trains safely.

The engineer was serving as an instructor for the first time without ever having received training specifically intended for this type of role. Contrary to other railway companies, QNS&L does not have an established program for training engineers to become instructors. These training programs focus on reinforcing the mentoring skills of engineer instructors, but also cover aspects such as communication, listening, observation and feedback. Locomotive engineers, even experienced ones, are not necessarily able to effectively teach their skills to engineer trainees. Without an instructor training program, it is difficult to ensure that knowledge and best practices are properly transferred to engineer trainees so they can operate trains safely.

According to the company's policies and to ensure compliance with Transport Canada requirements, each locomotive engineer should be accompanied by a manager on 1 trip at least every 8 months. However, only half of the qualified locomotive engineers had been accompanied by a manager within the specified timeframe. The absence of any regular re-evaluation of engineers' skills means unsafe engineer practices that may increase the risk of accident cannot be identified.

Limitations of the proximity detection device

The audible warnings sounded by the PDD force the operator to refocus his visual concentration on the screen. The operator acknowledges each alarm by clicking on the "**REARMER**" button located at the bottom left of the screen. However, this does not prompt the operator to take note of such critical parameters such as separation distance, and the speed and location of the nearest rail vehicle. A visual warning signal associated to these parameters would draw the operator's attention to this critical information. Moreover, the distance given for a train preceding another train in the same direction indicates the distance between the 2 locomotives and not the actual separation distance between the 2 trains. The operator must extrapolate the distance from the identification code of the trains to determine the actual distance. Therefore, when the type 3 alarm sounded, the actual separation between the 2 trains was approximately 1 mile whereas the screen indicated 3 miles. Given that the PDD screen does not show the actual separation distance between 2 trains moving in the same direction, the operator did not fully realize that a collision was imminent.

To acknowledge the type 3 alarm, the engineer trainee had to press the push-button on the crew alertness device and then click on the "**REARMER**" button on the PDD screen; otherwise the system would have triggered automatic braking of the train. However, since the engineer trainee was already aware of the presence of train BNL even before the alarm was generated, there was an automatic response involved in acknowledging the alarm without reading the data displayed higher up. Among other details, the data on the PDD screen indicated a speed of 0 mph along with the location of the lead locomotive on train BNL. This information was sufficient for the trainee to take steps to reduce speed. Since the locomotive trainee acknowledged the type 3 alarm without reading the data concerning train BNL, he maintained a high speed and therefore was unable to stop the train in time.

Locomotive crashworthiness

More robust cab sheeting, along with the presence of collision posts, corner posts and anti-climbers, would have minimized damage to the cab and afforded more protection for the crew. The absence of regulations requiring improvements in crashworthiness for locomotives built before 1997 increases the risk of injury for crew members and the risk of damage being sustained by such locomotives during an accident.

Findings

Findings as to causes and contributing factors

1. Train FCN, having passed signal 1239, which displayed a Restricting indication, at a speed of 40 mph, was unable to stop in time despite an emergency brake application, and collided with the rear end of train BNL, which was stationary.

2. Given the conversation with the RTC a little less than 1 hour before the collision, and despite the type 3 alarm, the crew continued to believe that train BNL would be in the siding at Mai Station and that signal 1239 would not display a restrictive indication.

3. Because the engineer instructor did not expect Signal 1239 to display a Restricting indication and because he trusted the trainee, he did not intervene to control the speed on approaching signal 1239.

4. The engineer trainee had not yet received *Canadian Railway Operating Rules* (CROR) training; therefore he had limited signal experience. As a result, he did not have a complete grasp of the measures required with respect to a Restricting indication.

5. Given that the proximity detection device (PDD) screen does not show the actual separation distance between 2 trains moving in the same direction, the operator did not fully realize that a collision was imminent.

6. Since the locomotive trainee acknowledged the type 3 alarm without reading the data concerning train BNL, he maintained a high speed and was therefore unable to stop the train in time.

Findings as to Risk

1. In the absence of additional physical fail-safe train controls in signalled territory, the existing defences proved inadequate to prevent the collision.

2. Considering the sightline distance to signal 1239, it would be impossible for a train, traveling at the permitted speed, to follow the signal indication once it became visible, thereby increasing the risk of collision.

3. In the absence of adequate CROR training and overlearned procedures, engineer trainees lack sufficient means to operate trains safely, which increases the risk of accident.

4. Without an instructor training program, it is difficult to ensure that knowledge and good practices are properly transferred to engineer trainees so they can operate trains safely.

5. The absence of any regular re-evaluation of engineers' skills means that unsafe engineer practices that may increase the risk of accident cannot be identified.

6. The absence of regulations requiring improvements in crashworthiness for locomotives built before 1997 increases the risk of injury for crew members and the risk of damage being sustained by such locomotives during an accident.

Safety action

Safety action taken

Transportation Safety Board of Canada

On 16 January 2013, the TSB issued Rail Safety Advisory Letter 02/13 to Transport Canada regarding the importance of comprehensive training for safe train operations. The TSB suggested that Transport Canada review the training provided to locomotive engineer trainees at QNS&L given the determination that the engineer trainee who operated the accident train had not received formal CROR training and had not completed his practical training phase.

Transport Canada

On 22 February 2013, Transport Canada issued Notice of Danger 4581 to QNS&L under Part II of the *Canada Labour Code* citing the risk of operating a locomotive without CROR qualification. On the same date, Transport Canada issued Notice of Danger 4582 to QNS&L, citing the risk of having an engineer trainee operate a locomotive on his own.

In response to TSB Rail Safety Advisory Letter 02/13, Transport Canada indicated on 5 March 2013 that its Quebec Regional Office had begun an in-depth review of the training and supervision of QNS&L employees.

Within the scope of its risk-based business planning process for 2013-2014, Transport Canada has increased supervision of QNS&L operations. Also, in the summer of 2013, Transport Canada audited QNS&L's safety management system (SMS) with a focus on the training programs for locomotive engineers and engineer instructors, supervision of engineers who operate trains, supervision of engineer trainees, and the corrective actions implemented in the wake of this accident.

This report concludes the Transportation Safety Board's investigation into this occurrence. The Board authorized the release of this report on 12 March 2014. It was officially released on 31 March 2014.

Visit the Transportation Safety Board's website (www.bst-tsb.gc.ca) for information about the Transportation Safety Board and its products and services. You will also find the Watchlist, which identifies the transportation safety issues that pose the greatest risk to Canadians. 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.