Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

RAILWAY INVESTIGATION REPORT
R12E0004

MAIN-TRACK COLLISION
CANADIAN NATIONAL
RUNAWAY ROLLING STOCK AND TRAIN A45951-16
MILE 44.5, GRANDE CACHE SUBDIVISION
HANLON, ALBERTA
18 JANUARY 2012

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

Main-Track Collision

Canadian National
Runaway Rolling Stock and Train A45951-16
Mile 44.5, Grande Cache Subdivision
Hanlon, Alberta
18 January 2012

Report Number R12E0004

Summary

On 18 January 2012, at 1212 Mountain Standard Time, 13 loaded coal cars, which were running uncontrolled northward from the Hanlon siding, Mile 41.7 on the Grande Cache Subdivision, collided with stationary train A45951-16 at Mile 44.5. Nine of the 13 cars and the 3 leading locomotives from the train derailed. Two crew members sustained minor injuries and were treated on site. The 3rd crew member was seriously injured and was air lifted to hospital in Hinton, Alberta. Approximately 2800 litres of fuel and 740 tons of coal were spilled. About 250 feet of track was damaged.

Ce rapport est également disponible en français.

Factual Information

At 2110 [1] on 16 January 2012, train A45851-16 (train 458) departed Swan Landing, Alberta, Mile 0.0 on the Grande Cache Subdivision, northward toward Winniandy, Alberta, Mile 108.5 (see Figure 1). Train 458 consisted of 5 head-end locomotives, 1 tail-end locomotive, 91 loaded coal cars and 1 empty car. It weighed about 13 620 tons and was approximately 5830 feet in length. Each loaded car weighed approximately 136 tons. The crew consisted of a locomotive engineer and a conductor. They were qualified for their respective positions and met established fitness and rest requirements.

At 2325, train 458 experienced a train-initiated emergency brake application and stopped at Mile 25.7. Upon inspection by the conductor, it was determined that the drawbar on car CN 199114 (5th car from the head end) had shattered, leading to a train separation. The tail-end portion of the train was then secured with hand brakes. The head-end portion, consisting of 5 locomotives and the first 5 cars, continued onto the Hanlon siding, Mile 41.0. The 5 cars were placed in the north end of the siding. The locomotives then proceeded back to the secured tail-end portion at Mile 25.7.

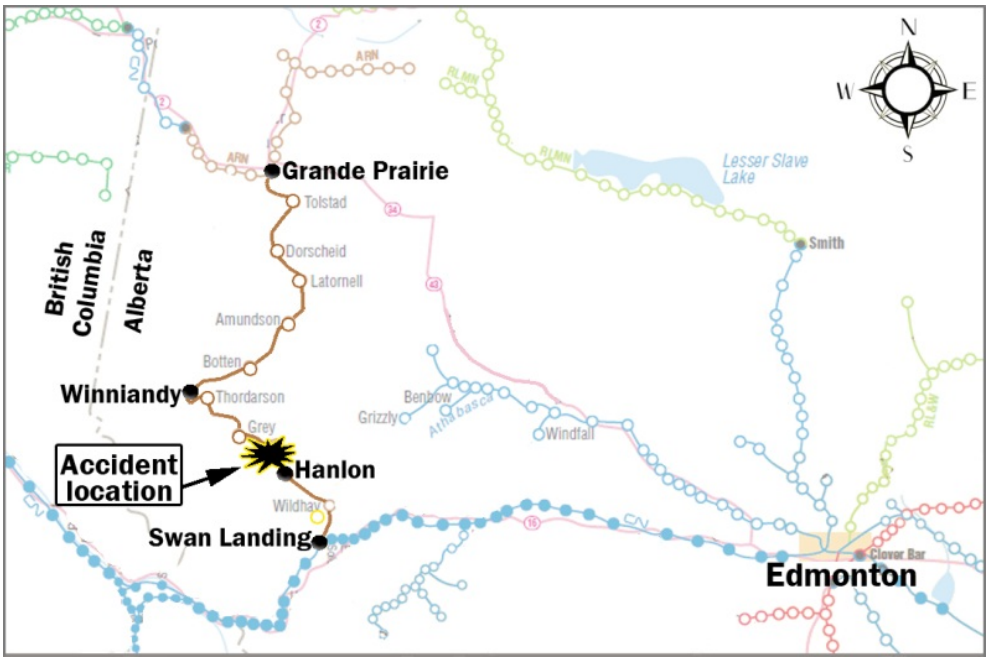

Figure 1. Location map (source: Railway Association of Canada, *Canadian Railway Atlas*)

After coupling back onto the tail-end cars, train 458 began to depart. The train then experienced a second emergency brake application. An inspection revealed that the drawbar on the 13th car (CN 199183) had broken, [2] separating the train. The tail-end portion was secured, and the head-

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1 All times are Mountain Standard Time (Coordinated Universal Time minus 7 hours).

2 In extremely cold weather, drawbars are more susceptible to brittle failure.

end portion (that is, 5 locomotives and 13 loaded coal cars) returned to the Hanlon siding. In the vicinity of the siding, the 13 cars were initially left secured on the main track while 4 of the 5 cars from the siding were added to this group of cars. The 17 cars were then shoved into the north end of the siding with car CN 199183 leading. Once in the siding (approximately 0510 on 17 January 2012), a hand brake was set on the lead car and a brake effectiveness test was performed. It was conducted by attempting to push the cars in the southward (that is, upgrade) direction. While the conductor was familiar with the territory, he was under the impression that the north end of the Hanlon siding was on level grade.

After completing the brake test, the tail-end 13 cars of the movement were left in the siding along with the original defective car, CN 199114 (see Figure 2). The 4 north-end cars were taken back to the train at Mile 25.7. To protect the point of the movement, the conductor was required to ride on the leading end of the 4th car. Due to the cold temperatures and long distance back to the train, frequent stops were made to allow the conductor to warm up in the locomotive cab. Once back at Mile 25.7, the train was recoupled and the brake system recharged. The crew had used their allowable hours of service and were relieved of duty at approximately 1000.

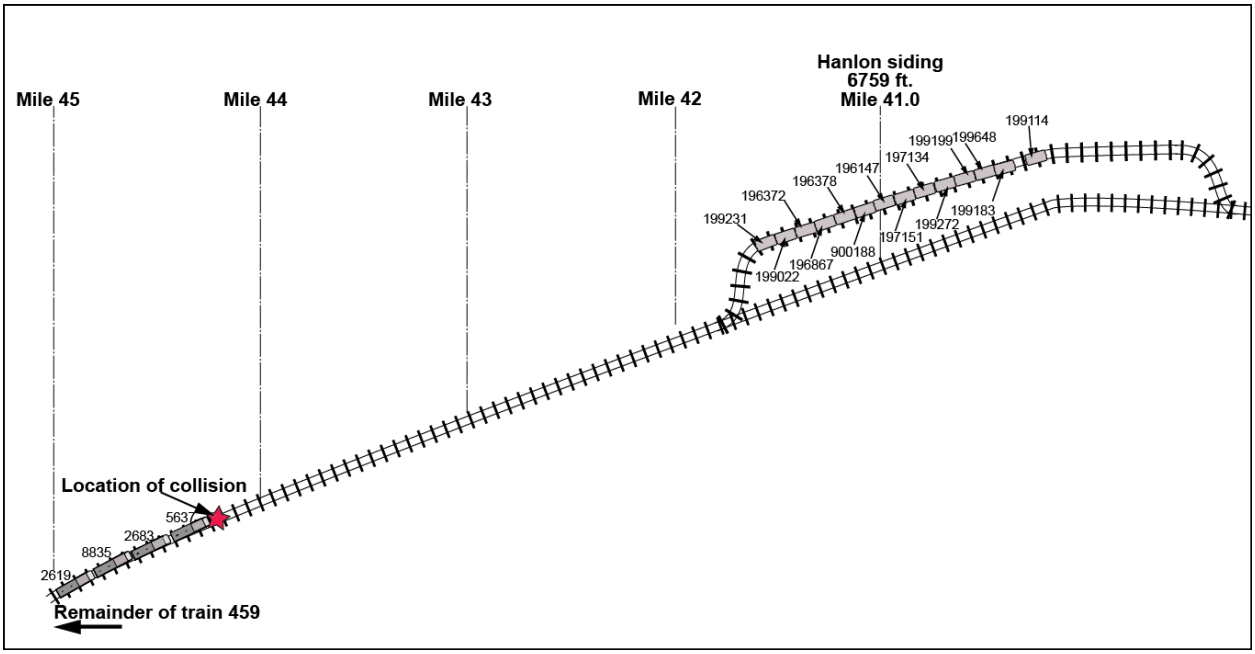

Figure 2. Site diagram (not to scale)

At 0830 on 18 January 2012, train A45951-16 (train 459) departed southward from Winniandy, destined for Swan Landing. Train 459 consisted of 4 head-end locomotives, 65 loaded cars and 9 empties. It weighed about 9273 tons and was approximately 4670 feet in length. The crew of train 459 consisted of a locomotive engineer, a conductor and a locomotive engineer trainee. They were qualified for their respective positions and met fitness and rest requirements.

At about 1200, train 459 stopped at approximately Mile 44.5 on the main track at the bottom of a hill. The crew members were planning to secure their train on the main track and then proceed southward with their locomotives to the south end of the Hanlon siding in preparation to add a

locomotive from Hanlon to their train. At 1212, while the crew was preparing for the move, a cut of 13 uncontrolled loaded coal cars [3] collided with the head end of train 459. At the time of the collision, the locomotive engineer and conductor were positioned on the rear platform of the third locomotive preparing to separate it from the 4th locomotive. The locomotive engineer trainee was at the controls of the lead locomotive (CN 5637).

The 13 loaded coal cars had rolled northward uncontrolled down the 1% descending grade from the north end of the Hanlon siding, a distance of about 3 miles. As a result of the collision, the first 9 cars of the 13 loaded coal cars derailed, 7 of which were destroyed. The first 3 locomotives derailed and were extensively damaged. The lead locomotive came to rest on top of the 3rd locomotive (see Photo 1). Both the 2nd and 3rd locomotives derailed on their side. The 4th locomotive remained upright on the tracks and sustained minor damage. Approximately 2800 litres of fuel and 740 tons of coal were spilled. About 250 feet of track was damaged.

Photo 1. Lead locomotive (CN 5637) positioned on top of the 3rd locomotive

The cab of the lead locomotive was damaged but not crushed during the impact (see Photo 2). The locomotive engineer trainee was able to exit the overturned locomotive after the collision. He sustained serious, but non-life threatening, injuries and was air lifted to hospital in Hinton, Alberta. The other 2 crew members sustained minor injuries and were treated on site.

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[3] A group of cars coupled together without a locomotive engine.

Photo 2. Lead locomotive from train 459

Weather Information

On 17 January 2012, the weather was clear with a high temperature of -32°C and a low temperature of -41°C. At 0500 on 17 January 2012 (that is, when the coal cars were placed in the Hanlon siding), the temperature was -40°C.

On 18 January 2012, the weather was clear with a high temperature of -22°C and a low temperature of -40°C. At about 1200 (that is, when the uncontrolled coal cars left the Hanlon siding), the temperature was -22°C.

Site Inspection

An inspection of the 13 loaded coal cars involved in the accident determined that none of the wheels on any of the cars had "bluing" or any other heat-related damage. It was also determined that only one hand brake had been applied (that is, on the south end of car CN 199183).

CN 199272, CN 199199 and CN 199183 (that is, 3 of the 4 cars that did not derail) were taken to Canadian National's (CN) facilities in Edmonton, Alberta, for brake shoe force testing and stationary rolling resistance testing.

Locomotive Event Recorder for Train 458

An examination of the locomotive event recorder from the 4th locomotive of train 458 revealed that:

- At 0506:04, the locomotive throttle was placed in position 2 to begin reversing into the north entrance to the siding with the 17 loaded coal cars.
- Once in the siding, the locomotive was stopped for 3 minutes and 51 seconds while the hand brake was applied.
- At 0512:54, the brake effectiveness test began. The throttle was placed in position 1 and increased to position 2 to begin reversing, but the speed remained at 0 mph.
- At 0513:15, the throttle was reduced to position 1. Three seconds later, the locomotive brake cylinder air pressure began to increase.
- The throttle was placed in idle at 0513:20, completing the test.

The locomotive remained in idle for 5 minutes and 18 seconds while the 4th and 5th cars were uncoupled and then the head end was pulled forward to exit the siding.

Train 458's Crew

The locomotive engineer had worked on the Grande Cache Subdivision for 8 years, the last 4 years as a locomotive engineer. The conductor was qualified in May 2011 and had worked on the Grande Cache Subdivision for approximately 8 months before the accident. The work-rest schedule for the conductor is presented in Table 1.

Table 1. Work-rest schedule for the conductor before the accident

Date	Woke Up	Worked	Napped	Went to Sleep
10 January 2012	0900	1100-1600 (5 hours)	1700-1900 (2 hours)	0230 – 11 January
11 January 2012	1245 (had 10.25 hrs sleep)	Off	1530-2030 (5 hours)	0330 – 12 January
12 January 2012	0930 (had 6 hours of sleep)	Off		0100 – 13 January
13 January 2012	0800 (had 7 hours of sleep)	Off		2300 – 13 January
14 January 2012	1400 (had 15 hours of sleep)	Off		2359 – 14 January
15 January 2012	0500 (had 5 hours of sleep)	0700-2330 (2 trains) – 16.5 hours		0300 – 16 January
16 January 2012	1400 (had 11 hours of sleep)	1600-0830 (dead head 4 hours + train 458) – 16.5 hours		

Subdivision Information

The Grande Cache Subdivision consists of single main track extending from Swan Landing to Grande Prairie, Alberta (Mile 232.9). This subdivision is part of CN's north/south freight traffic corridor. Train movements are controlled by the Occupancy Control System as authorized by the *Canadian Rail Operating Rules* (CROR) and supervised by a rail traffic controller located in Edmonton. In the vicinity of the derailment, the maximum permissible speed for freight trains was 25 mph.

The track near the accident location consisted of 115-pound rail laid on 14-inch double-shouldered tie plates, fastened to either hardwood or softwood ties with spikes and anchored every second tie. The ties were in good condition. The cribs were full with crushed rock ballast. The shoulders were approximately 18 inches wide. The drainage was good.

Hanlon is the first designated siding north of Swan Landing. The siding is 6759 feet long and extends from Mile 40.09 at the south siding switch to Mile 41.46 at the north siding switch. From the south switch to Mile 40.56, the grade is relatively level. Northward from Mile 40.56, the grade descends at approximately 1% to about Mile 45.0.

In the 12 months before the accident, Hanlon siding had been used 11 times to set out cars (see Table 2). In each of these cases, it is not known how long the cars remained in the siding.

Table 2. Cars set out in the Hanlon siding

Date	No. of Cars
06 February 2011	16
11 March 2011	29
13 April 2011	38
14 April 2011	50
30 May 2011	21
11 June 2011	20
29 September 2011	90
12 October 2011	6
17 November 2011	30
19 November 2011	2
16 January 2012	108

Securing Equipment Using Hand Brakes

CROR Rule 112(a), Securing Equipment, states in part

> (a) When equipment is left at any point a sufficient number of hand brakes must be applied to prevent it from moving. Special instructions will indicate the minimum hand brake requirements for all locations where equipment is left. If equipment is left on a siding, it must be coupled to other equipment if any on such track…

For the Hanlon siding, there were no special instructions regarding the applicable number of hand brakes required on cars left in the siding.

Section 7.12, Application of Handbrakes, of CN's General Operating Instructions (GOIs), effective 01 October 2008, provides instruction on the minimum number of hand brakes required and states in part

> In the application of Rule 112, unless otherwise specified by special instruction, sufficient number of handbrakes shall be a minimum of one, with one additional handbrake for every 10 cars to a maximum of 5* in total.
>
> e.g., 1 car - 1 handbrake,
> 2 cars - 1 handbrake,
> 10 cars - 2 handbrakes.
>
> […]
>
> * Note: If the results of the testing of the effectiveness of the handbrakes applied indicate additional handbrakes are required, additional handbrakes are to be applied as needed.

CN also supplies instructions on securing trains or transfers [4] on grades in excess of 0.75%. Regional Special Instructions for Timetable 16, effective 01 August 2009, indicate in part

> **Instructions for Securing Trains or Transfers on Steep Grades** [5]
>
> (a) When stopping to secure a train or transfer on steep grades, the lightest air brake application possible must be used to hold the equipment at rest.
>
> (b) Locomotives must be left attached with brake pipe continuity throughout the train or transfer and air brakes left applied.
>
> (c) GOI 7.12 (i) is not applicable in heavy grade territory.
>
> (d) When applying handbrakes, do not bleed off cars.
>
> (e) Apply sufficient handbrakes starting from the head-end regardless of whether the equipment is being secured on steep descending or ascending grade.

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4 Trains and transfers include a locomotive and, therefore, do not refer to a cut of cars.

5 Refers to a grade in excess of 0.75%.

The following chart is to be utilized as a guide re: "sufficient":

% Grade Minimum	% Train Handbrakes Required
0.75 to 0.9	25%
1.0 to 1.4	40%
1.5 to 1.9	55%
2.0 to 2.4	65%
2.5 to 2.75	75%
2.76 plus	Upon advice from RTC

Note: This chart is applicable to trains or transfers greater than 2000 tons.

Less than 2000 tons require two additional handbrakes to above chart.

Hand Brake Effectiveness

To ensure that there is sufficient retarding force to prevent a cut of cars from moving unintentionally should the train brake application bleed off, CROR Rule 112(b), Securing Equipment, requires that the hand brake application be tested. The rule states

> Before relying on the retarding force of the hand brake(s), whether leaving equipment or riding equipment to rest, the effectiveness of the hand brakes(s) must be tested by fully applying the hand brake(s) and moving the cut of cars slightly to ensure sufficient retarding force is present to prevent the equipment from moving. When leaving a cut of cars secured, and after completion of this test, the cut should be observed while pulling away to ensure slack action has settled and that the cars remain in place.

No additional instructions are provided in CN's GOIs regarding the procedures when testing the effectiveness of the hand brake application. In comparison, Canadian Pacific Railway's GOIs, Section 14, item 1.2, effective 06 July 2009, provides the following instructions:

> To ensure an adequate number of hand brakes are applied, release all air brakes and allow or cause the slack to adjust. It must be apparent when slack runs in or out, that the hand brakes are sufficient to prevent that cut of cars from moving. This must be done before uncoupling or before leaving equipment unattended.

Training of Operating Crews on Track Characteristics and Securing Equipment

Locomotive engineers are given track profiles for the subdivisions they operate on to assist them with identifying track gradient, curvature and other points of reference (for example, crossings and sidings). However, conductors are not generally provided with these subdivision profiles. Instead, they are expected to learn the particulars of the track (for example, gradient) initially through training trips and then on the job. Although there are no specific instructions related to conductors obtaining track profiles, conductors can acquire them from their supervisor.

Operating crews receive classroom instruction on company and regulatory requirements during their initial training and through periodic re-certification. This training includes determining the sufficient number of hand brakes for securing a cut of cars in a siding and verifying the effectiveness of the braking force.

Brake Shoe Force

Post-accident brake shoe force testing was conducted at CN's Walker Yard (Edmonton) on cars CN 199183 and CN 199199. The gross rail load (GRL) of each car was 286 000 pounds. This test measured the force applied at the brake shoe/wheel tread interface during a hand brake application of between 85 and 90 foot-pounds of torque. The measured results are summarized in Table 3.

Table 3. Brake shoe force testing (pounds)

Wheel	Car CN 199183	Car CN 199199
L1	1664	1669
L2	1239	1127
R1	1288	1450
R2	1664	1555
L3	1728	1900
L4	1434	1538
R3	1383	1710
R4	1716	1574
Total	12 116	12 523
	4.2% GRL	4.4% GRL

Engineering Analysis of the Uncontrolled Movement

The TSB Laboratory conducted an engineering analysis (LP 021/2012) of the uncontrolled movement (that is, the 13 cars left in the Hanlon siding). The calculations, based on brake shoe force testing and rolling resistance testing, evaluated the adequacy of the hand brakes in preventing an uncontrolled movement and estimated the speed at which the cars collided with train 459. It was determined that

- If 1 hand brake was applied before the cut of cars was set up in emergency brake, the cut of 13 loaded cars would have run away when the brake cylinder air bled off. The estimated collision speed would be approximately 56 mph.

- If 2 hand brakes were applied before the cut of cars was set up in emergency brake, the cut of 13 loaded cars would still have run away when the brake cylinder air bled off. The estimated collision speed would be approximately 51 mph.

- Based on the measured brake shoe force from the 2 tested cars, using a rolling resistance of 2.15 pounds/ton, the minimum number of hand brakes required to secure the cut of 13 loaded cars on the 1% grade would be 5.1. [6]

Derails

Derails are installed to protect against the unintended movements of equipment and must be secured in the derailing position whenever the track on which they are installed is not in use. Because derails are to be left in the derailing position, they are not normally used on sidings or main track where train operations will be affected. More commonly, derails are installed in yard or storage tracks where cars are often set out.

Section 3.2, Derails, of CN's Engineering Track Standards states that derails must be installed

> where there is any possibility of equipment, which has been left standing on tracks other than main tracks or sidings, being moved by gravity so as to obstruct a main track or siding.

Section 3.2, Derails, goes on to explain that the installation or removal of derails, including special derails, is left to the discretion of the Regional Chief Engineer when informed by Operations of the intention to use the track to hold cars. Although not common, special derails can be used on sidings.

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[6] Because the braking force supplied by an applied hand brake varies between applications and between cars, the actual number of hand brakes needed to secure the cars also varies and may be more or less than 5.1.

CROR Rule 104.5, Derails, provides for the use of "special derails." Special derails are derails that can be left in the non-derailing position when the track is clear of equipment, facilitating the passage of trains.

There were no special derails installed in the siding at Hanlon.

Crashworthiness of CN Locomotives

In the early 1970s, after experiencing some head-on collisions, CN voluntarily undertook to redesign locomotive cab structures and ergonomic conditions to promote safety and crew comfort. The cab strength features included two full height internal collision posts in the front nose rated at 500 000 pounds each at 30 inches above the deck, a full width nose constructed of high strength thick plate, bullet-proof heated glass windows, 3 exit doors, and a substantial front plate mounted anti-climber to inhibit other vehicles (highway and rail) from climbing above the deck.

All new CN locomotives from 1973 were equipped with the CN design protected cab. In the late 1980s, the Federal Railroad Administration (FRA) expressed an interest in the CN cab design and the Association of American Railroads (AAR) undertook the preparation of *Manual of Standards and Recommended Practices* (MSRP) Standard S-580, Locomotive Crashworthiness Requirements, in a cooperative process with member railways, the EMD (Electro-Motive Division of General Motors), General Electric and the FRA. The fundamental design was based on the CN design. From the early 1990s, new road locomotives in North America have been built to this AAR standard.

The following TSB Laboratory report was completed:

- LP 021/2012 – Brake Force Analysis

This report is available from the Transportation Safety Board of Canada upon request.

Analysis

The analysis will focus on the actions of the crew of train 458, the hand brake requirements when securing cars and the procedures when cars are left in a siding.

The Accident

The collision occurred when a cut of 13 loaded coal cars, which had been set out in the Hanlon siding the previous day, ran uncontrolled northward and collided with the head end of stationary train 459. The coal cars had been left by the crew of train 458 when the train experienced 2 emergency brake applications due to broken drawbars. Before securing the cut of 13 cars in the north end of the Hanlon siding, the crew of train 458 had spent about 5 ¾ hours handling and setting out the cars. During this period, the conductor spent the majority of his time working outdoors in -40°C.

The conductor was generally familiar with the territory. However, he was not aware that there was a 1% descending grade at the north end of the Hanlon siding. He was under the impression that the grade was level throughout the siding. When the 13 cars were secured, he was aware of the requirement to apply at least 2 hand brakes, but only 1 hand brake was applied.

The time of day when the cars were being handled and secured (that is, between 0300 and 0500) coincides with a known circadian low point during which alertness can be reduced and attention to detail can suffer. The conductor had worked approximately 16.5 hours on 15 January 2012, and then had approximately 11 hours of sleep. Approximately 13 hours into his next shift, he was securing the second damaged car. There had been 2 equipment breakdowns requiring multiple hand brake applications in extremely cold conditions late in the shift during early morning hours. The conductor was likely experiencing some performance impairment due to the time of day (that is, circadian low point) and to his prolonged exposure to extreme cold. His belief that the Hanlon siding was situated on level ground may also have led him to conclude that 1 hand brake was sufficient to secure the cut of cars.

In addition to the 1 hand brake, the 13 cars were being secured by an emergency application of the train brake. However, over the next 31 hours, the air in the cars' brake cylinders bled off, reducing the effective braking force of those cars. When the braking force from the train brakes was sufficiently reduced, the retarding force of the 1 applied hand brake could not resist the gravitational force of the 13 loaded coal cars. The cut of cars then began to roll uncontrolled northward down the 1% grade.

Adequacy of the Brake Effectiveness Test

It is not unusual for air to escape from the brake cylinders over time, especially during periods of cold temperatures. Consequently, CROR and CN's GOIs require that the hand brake application alone is sufficient to hold a cut of cars intended to be left standing on a track. The instructions indicate the minimum number of hand brakes to be applied.

Given that hand brake retarding force will vary between applications and between cars, a brake effectiveness test must be performed to ensure that the retarding force provided by the hand brake is sufficient to hold the cut of cars. CN's GOIs do not provide instructions on how to test for hand brake effectiveness when setting off cars as required by CROR Rule 112(b).

In this occurrence, the brake effectiveness test was conducted by attempting to push the cars in the southward (that is, upgrade) direction only. Consequently, the weight of the cars to be left never came to bear on the hand brake application. The brake effectiveness test did not adequately verify if the braking force of the hand brake application was sufficient to hold the cars.

Other railways require that the air brakes be released and the slack be allowed to adjust so that the hand brake application alone can be verified to be sufficient to prevent the cars from moving. In contrast, CN's GOIs do not provide instructions on how to test for hand brake effectiveness when setting off cars, as required by CROR Rule 112(b). When clear instructions are not provided detailing the manner in which the hand brake effectiveness test must be conducted, there is a risk that insufficient hand brake force will be applied and uncontrolled movements will occur.

Derails

Derails are installed to prevent an unintended movement of cars from entering the main track. The Hanlon siding is not considered to be a storage track and has no derails installed. However, when train reductions are required or when there are bad order cars, the Hanlon siding is regularly used to set out cars en route. Although it is not a common practice for railways to install derails in sidings, railways must guard against the risk of unintended movements should cars be left in a siding. This is especially important for sidings with steep descending grades down to the main track. When sidings are frequently used to set out cars and special derails are not installed, there is an increased risk of uncontrolled movements entering the main track, especially where sidings are located on steep grades.

Hand Brake Requirements

Unlike CN's instructions on securing trains or transfers on steep grades, its instructions for securing a cut of cars does not adequately consider the effect of grade. For example, had the crew been required to secure a train or transfer consisting of 13 cars and a locomotive at the same location, hand brakes on 8 cars would have been required instead of 2. Moreover, based on the measurement of brake shoe force, the minimum number of hand brakes required to secure the cut of 13 cars on the 1% grade could have been as high as 5.1, and possibly more. Applying only the minimum number of hand brakes, as set out in CN's GOI Section 7.12, to cars held on tracks with significant grades may not provide adequate securement.

Crashworthiness of Locomotive Cab (CN 5637)

The estimated speed of impact of the 13 loaded coal cars with the stationary lead locomotive was 56 mph. Due to the collision, the lead locomotive (CN 5637) came to rest on top of the 3rd locomotive. Despite the high impact forces during the collision, the locomotive cab did not collapse, but rather provided a safe area for the locomotive engineer trainee who sustained serious (but non-life threatening) injuries.

Findings

Findings as to Causes and Contributing Factors

1. The collision occurred when a cut of 13 loaded coal cars, which had been set out in the Hanlon siding the previous day by the crew of train 458, ran uncontrolled northward and collided with the head end of stationary train 459.

2. When the 13 loaded coal cars were secured, only 1 hand brake was applied.

3. Considering the 2 equipment breakdowns requiring multiple hand brake applications in extremely cold conditions late in the shift during early morning hours, the conductor was likely experiencing some performance impairment.

4. The conductor's belief that the Hanlon siding was situated on level ground may also have led him to conclude that 1 hand brake was sufficient to secure the cut of cars.

5. When the braking force from the train brakes was sufficiently reduced due to bleeding off of the air in the cars' brake cylinders, the retarding force of the 1 applied hand brake could not resist the gravitational force of the 13 loaded coal cars.

6. As the brake effectiveness test was conducted by attempting to push the cars in the southward (that is, upgrade) direction, it did not adequately verify if the braking force of the hand brake application was sufficient to hold the cars.

Findings as to Risk

1. When clear instructions are not provided detailing the manner in which the hand brake effectiveness test must be conducted, there is a risk that insufficient hand brake force will be applied and uncontrolled movements will occur.

2. When sidings are frequently used to set out cars and special derails are not installed, there is an increased risk of uncontrolled movements entering the main track, especially where sidings are located on steep grades.

3. Applying only the minimum number of hand brakes, as set out in Section 7.12 of Canadian National's General Operating Instructions, to cars held on tracks with significant grades may not provide adequate securement.

Other Findings

1. Despite the high impact forces during the collision, the locomotive cab on CN 5637 did not collapse, but rather provided a safe area for the locomotive engineer trainee who sustained serious (but non-life threatening) injuries.

Safety Action

In regard to Section 7.12 of Canadian National's (CN) General Operating Instructions (GOIs), CN issued Bulletin GP 2012-02 on 22 January 2012 which stated in part

> Until further advised, items "b" (double the handbrake applications) and "c" (brake piston released before handbrakes applied) of GOI 7.2 are applicable on all tracks on the […] Grande Cache Subdivision, with the exception of Grande Prairie yard, and Swan Landing.
>
> 7.12 APPLICATION OF HANDBRAKES
>
> (b) At locations that require double the handbrake applications, there shall be a minimum of two (when available) with two additional handbrakes for every 10 cars to a maxium of 10* in total.
>
> e.g. 2 cars – 2 handbrakes
> 5 cars – 2 handbrakes
> 10 cars - 4 handbrakes
> 20 cars – 6 handbrakes

* Note: If the results of the testing of the effectiveness of the handbrakes applied indicate additional handbrakes are required, additional handbrakes are to be applied as needed.

(c) Unless otherwise provided (e.g. leaving unattended trains in Mountain grade territory, spotting auto carriers) the brake piston on cars on which handbrakes are to be applied must be released before handbrakes are applied.

CN installed special derails at the Hanlon siding to be used when unattended cars are left in the siding.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 17 April 2013. It was officially released on 24 April 2013.

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.