Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

RAILWAY INVESTIGATION REPORT
R07T0270

COLLISION AND TRAIN DERAILMENT

CANADIAN NATIONAL YARD ASSIGNMENT YWCS60-17
AND
CANADIAN NATIONAL FREIGHT TRAIN M33931-17
MILE 0.00, HALTON SUBDIVISION
MACMILLAN YARD, TORONTO, ONTARIO
17 SEPTEMBER 2007

Canada

Railway Investigation Report

Collision and Train Derailment

Canadian National Yard Assignment YWCS60-17 and Canadian National Freight Train M33931-17 Mile 0.00, Halton Subdivision MacMillan Yard, Toronto, Ontario 17 September 2007

Report Number R07T0270

Summary

While pulling south on the pullback track with a consist of 67 loads and 30 empties, weighing about 9054 tons, the 2200 West yard assignment side-collided with the tail end of train M33931-17. The train was departing MacMillan Yard at 15 miles per hour on the Halton outbound track. Two locomotives and two cars of the yard assignment derailed. Six cars on train 339 derailed and/or sustained damage, including two special dangerous goods tank cars containing chlorine (UN1017). Approximately 3785 litres of diesel fuel (UN1202) leaked from the derailed locomotives. There were no injuries.

Other Factual Information

On 17 September 2007, Canadian National (CN) west control hump yard assignment YWCS60-17 (2200 West) was performing routine switching operations at MacMillan Yard in Toronto, Ontario (see Figure 1). The assignment was powered by CN7241 and booster unit CN241, and controlled by two Beltpack [1] operators, a yard conductor (the foreman), and an assistant yard conductor (the helper). The assignment weighed about 9054 tons and was 5914 feet long.

Figure 1. Map of accident location (Source: Railway Association of Canada, *Canadian Railway Atlas*)

At approximately 0249 eastern daylight time (EDT), [2] the foreman completed assembling a block of 97 cars in track C24. The head end was 5840 feet to the south on the pullback track (Green Route). The Halton outbound track runs parallel to the Green Route, and then joins the Green Route south of the Highway 7 overpass (see Figure 2).

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1 "Beltpack" is the trade name of the remote control locomotive operations technology that was developed and marketed by Canac, a former subsidiary of CN.

2 All times are eastern daylight time (Coordinated Universal Time minus four hours).

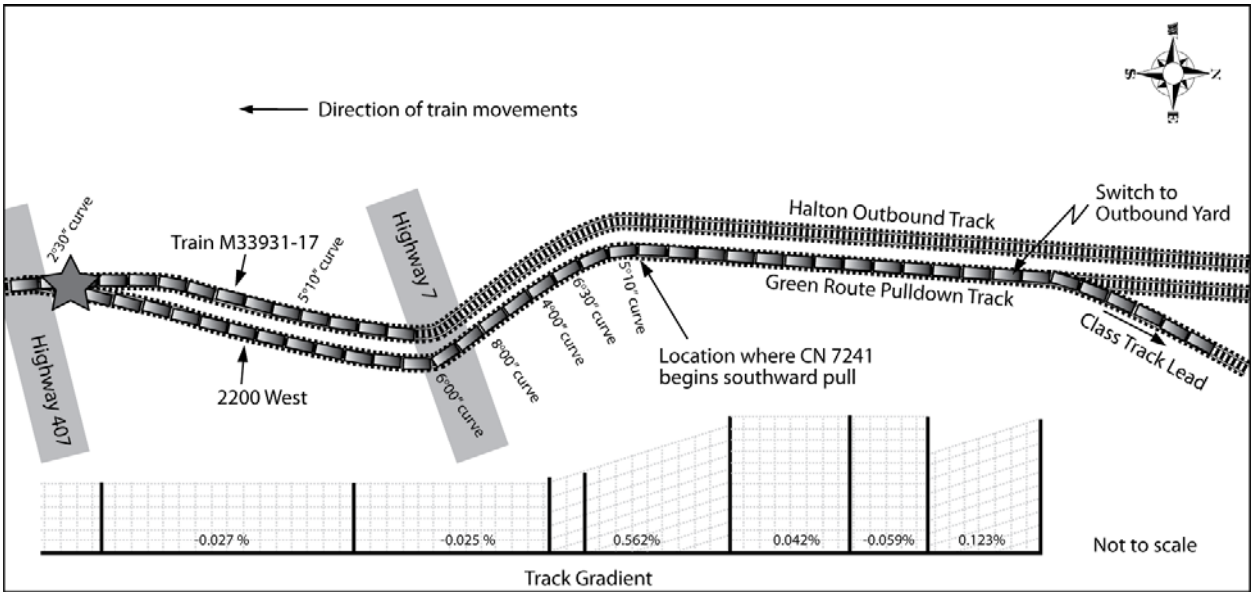

Figure 2. Diagram of location at time of collision

Because this was a long yard movement that might exceed the length of the Green Route, the train was to be handled by the helper in order to provide point protection for the movement. The foreman pitched [3] control of the movement to the helper, located on the locomotive at the south end of the movement at 0249:40 The helper began pulling down the Green Route with instructions to be on the lookout for train M33931-17 (train 339) departing the yard on the Halton outbound track. Movement 2200 West proceeded south and accelerated to approximately 10 miles per hour (mph) as train 339 was departing at 15 mph.

The foreman gave the helper a car count when the tail end of the movement was approximately 25 car lengths and again at 15 car lengths from a switch they needed to clear in order to shove the train back into the West outbound yard (See "Switch to Outbound Yard" in Figure 2). At this time, the foreman reminded the helper that the train only had brakes on the locomotives.

The helper had begun to reduce speed, but was still travelling at more than 8 mph. The helper began to apply brakes and turned the headlight onto full power only to see train 339 ahead. Approximately three car lengths from the Halton outbound junction switch, the helper placed movement 2200 West into emergency. As the brakes took hold, train slack ran-in. The movement surged twice and then struck train 339. At 0254:43, the helper radioed that the assignment had collided with train 339 and was derailed. The sky was clear, there was no wind, and the temperature was 9°C.

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3 A "pitch-and-catch" procedure is a system for transferring control of a remote control train movement from one Beltpack controller (operator control unit or OCU) to the other. When changing direction of the movement, one operator pitches control of the movement to the other OCU so movement control is at the point (front position in the direction of the movement), providing much greater safety.

Site Examination

The locomotive and booster unit (CN7241 and CN241) as well as the following two head-end cars derailed and remained upright. The derailed cars included a tank car loaded with bunker "C" oil (GATX71793, non-placarded) and a bulkhead flat car loaded with steel plate (TTPX805536). All the derailed cars showed substantial surface, truck, and appliance damage on the side where they contacted train 339. CN7241 came to rest with the lead truck on a wood plank crossing south of the switch, approximately 50 metres (165 feet) past the fouling point of the Halton outbound route (see Photo 1). The east rail was rolled and the fuel tank on locomotive CN7241 was punctured. The switch and approximately 200 feet of track were damaged or destroyed.

Photo 1. The 2200 West post-derailment. Inset: Damage to CN7241 at point of collision.

On train 339, the 67th to the 72nd cars were damaged or derailed (see Figure 3). The first car contacted was the 67th car, a covered hopper car (CEFX15509) that sustained minor scrapes. It was followed by a second hopper car (CSXT260289) that remained upright on the rails. The car body had become unseated from its trucks and was leaning to the west. There was a train separation between the 68th and 69th car, a loaded box car (IC533027) on its side. A second loaded box car (ATW111012) was also derailed and leaning to the west.

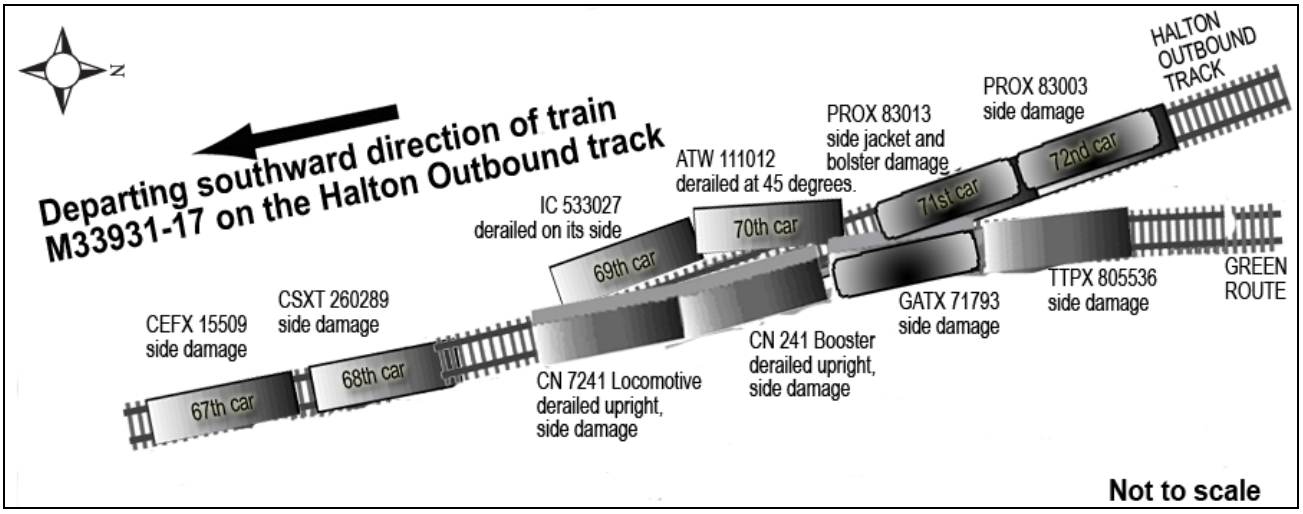

Figure 3. Accident site diagram

The 71st and 72nd cars (PROX83013 and PROX83003) were loaded special dangerous commodity cars containing chlorine gas (Class 2.3, UN1017). These cars, both 105J tank cars, sustained significant damage to their jackets, handrails, and structure. The cars derailed, but remained upright and tank integrity was not breached. The damage on the chlorine tank cars occurred from contact with the bulkhead flat car TTPX805536.

Dangerous Goods Response

At 0835, CN Environmental was called to respond to the diesel fuel leak. An assessment was conducted and visible pooling of diesel fuel was observed. An environmental emergency response team was called at 1000. The oil had seeped into the ground, so wells were drilled and an environmental recovery plan implemented. An estimated 3785 litres (1000 gallons) of diesel was spilled. Approximately 3000 litres (800 gallons) of diesel was recovered and 4 tons of contaminated soil was removed.

CN undertook temporary repairs to the wheel, truck brake, and end sill to make PROX83013 and PROX83003 safe to travel for offloading. On 19 September 2007, Transport Canada (TC) issued an estoppel [4] for CN's plan to move the two loaded chlorine tank cars as a dedicated movement to a trans-loader for offloading on September 21. The movement was accompanied by trained mechanical personnel and restricted to 15 mph. Once unloaded, the cars were loaded on a flat car for shipment to the owner.

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4 An estoppel is issued when a TC inspector provides an undertaking not to prosecute for non-compliance should the railway move the car according to agreed upon conditions proposed by the railway.

Particulars of the Track

The Halton outbound track and the Green Route Pulldown track (Green Route) run parallel to each other on the west side of MacMillan Yard. Cars drawn from the south end of the classification tracks travel up a 0.1 per cent grade in the vicinity of the West Control Tower and onto the Green Route. The Green Route is 5400 feet long. Continuing south, the track descends a 0.56 per cent gradient through a 6.5-degree left-hand curve, followed by an 8-degree right-hand curve before passing under the Highway 7 overpass. The overpass and track curvature restricted sightlines for 2200 West to as little as 300 feet. South of Highway 7, the gradient flattens and the track is relatively tangential for the next 175 metres. There is one last right-hand degree curve, and then approximately 375 metres (1230 feet) of tangent track to the junction between the Green Route and the Halton outbound track.

Recorded Information

2200 West Assignment

The yard engine was not equipped with a locomotive event recorder (LER); however, the Beltpack operator control unit (OCU) records all actions taken by the operators and OCU units. Information from the OCU indicates the foreman pitched control of the yard locomotives to the helper at 0249:21.

At 0249:40, the operator requested 1 mph on his OCU and the assignment began to move seven seconds later. The head end of the train was on a 0.56 per cent downgrade.

The train began to accelerate. After approximately 100 feet, locomotive CN7241 was moving at about 4 mph. The operator requested 10 mph.

At 0253:20, with the assignment travelling at 10.07 mph, the operator requested 15 mph for 7 seconds. CN 7241 was passing under the Highway 7 overpass.

At 0253:27, a maximum speed of 10.47 mph was reached with the head end located 2511 feet from the start of the pull down movement. At this time, the head end was approximately 624 feet from the end of the Green Route. Over the next 30 seconds, the operator began to slow the movement using the speed selector, by requesting 10 mph, then 7 mph, then 4 mph, and lastly 1 mph. At 0253:56, with the assignment travelling at 9 mph, the operator selected COAST B (brake), and then two seconds later he selected STOP.

At 0254:00, the train experienced a 0.14 mph/s acceleration over 7 feet (consistent with a run-in of train slack). At 0254:02, the operator selected EMERGENCY. Between 0254:02 and 0254:03, a second surge event was recorded as emergency braking was applied.

Over the next ten seconds, with an emergency service brake application, speed was reduced to approximately 4.13 mph. There was a slight acceleration followed by a sharp deceleration (consistent with a collision and derailment event). The movement stopped 20 seconds later at 0254:43. In total, locomotive CN7241 had travelled 3829 feet from where the last coupling had been made.

Train 339

Train 339's LER information indicated that:

- The train began pulling to depart at 0232 [5] EDT.
- At 0254, the train experienced an undesired emergency brake application while travelling at 15 mph.
- Emergency braking was initiated at a point where the head end of the train was approximately 2.27 miles from the point of departure.
- It took 24 seconds or approximately 0.05 miles for the train to come to a stop.

At 15 mph, the speed at which train 339 was travelling prior to the accident, it would have taken 51 seconds from the time that the collision had occurred for the tail end of the departing train to safely clear the junction switch.

2200 West Yard Operations

The 2200 West assignment operates nightly from 2200 to 0800 and typically builds trains by lifting cuts of cars from the Hump Classification tracks and then assembling the cars into outbound trains.

The foreman of each assignment is provided with a "cut-list" that describes the blocks of cars that are to be built into a train, in the correct order. There is only one copy of the cut-list provided to each assignment.

Crews are taught that building a long train as a single movement and then placing it in the outbound yard is more efficient than building trains in smaller segments. There is no maximum or minimum number of cars specified, but the distance between the end of the Green Route and the switch back into the outbound track limits the length of movements to approximately 5400 feet or the equivalent of 80 to 90 car lengths.

CN's MacMillan Yard operations are required to be compliant with *Canadian Rail Operating Rules* (CROR) as well as CN's own guidelines, policies, practices, and procedures. Under CROR Rule 105, yard movements can not operate at more than 15 mph and must be able to stop within one-half their range of vision of equipment. Yard assignments work without cutting in the air brake systems on the cars they are handling. Brake function is restricted only to the locomotives and boosters in the consists. There are no restrictions on the number of cars and/or the tonnage to power ratio for a single Beltpack assignment. Yard operating employees are encouraged to perform switching operations at the safest maximum allowable speed to optimize yard productivity. Based on operational considerations, the work was often performed as close to the maximum speed of 15 mph as possible.

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5 LER time is internally accurate, but not normalized to other LER event recorders.

Job Briefings for MacMillan Yard Operations

The MacMillan Yard Manual specifies the requirement for a Job Briefing in 1.10 of the Safety section: [6]

> *1.10 Job Briefing*
>
> Job briefings ensure crew members communicate critical information pertaining to safe operations prior to and throughout the tour of duty. Performing job briefings ensures an understanding of the work to be done and is of paramount importance in the prevention of accidents and protection of personal safety.
>
> a) Content
> Job Briefings must include information pertinent to the planned work as well as personal preparation….
> …Crew members must ensure that they are aware of the job experience of those they work with and take special care where inexperience may be involved.
>
> b) Responsibility
> All crew members are responsible for ensuring that a Job Briefing is performed. Supervisor/foreman are responsible for ensuring that a proper Initial Job Briefing is performed before the assignment begins work….
> …It is imperative that prior to the commencement of any movement all parties have a clear understanding of who is controlling the movement, where crew members will be located, what protection is required, and how it will be provided.
>
> c) Continual Job Briefing
> Continual Job Briefings must be performed as work, roles, or conditions change. Frequent communication between crew members is essential in the prevention of accidents and injuries.

Experience and Productivity

MacMillan Yard is a complex rail yard with more than 200 tracks. Experienced conductors and trainers indicated that it usually takes between a year and 18 months to become fully familiar with this yard.

The 2200 West crew consisted of two qualified conductors. The foreman was an experienced conductor and was familiar with the MacMillan Yard. The helper was a newly qualified conductor with one month of railway experience. Prior to this shift, the helper had never handled a movement of more than 50 cars.

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6 Ryhorchuk, D.V., *MacMillan Yard Operating Manual*, revised 01 April 2007, Concord, Ontario

In MacMillan Yard, newly qualified conductors are required to wear an identifying fluorescent green vest for the first year of service. The 2200 West foreman and other supervisory staff were aware that the helper was inexperienced. Also, through informal communications between staff, the foreman was aware that other yard operating personnel did not believe that the helper was sufficiently skilled to perform the full duties of a conductor.

The usual practice when working a pull down assignment is to have one operator control the locomotives while switching and coupling the train. Then, when the first build is complete, the crew switches roles and has the other operator build the second train.

On the night of the occurrence, 2200 West had six trains to build. Nearly halfway through their shift, they had only completed one train. Instead of handing over control at the end of the first build, the more experienced foreman continued to control the train during the second build.

When the helper took control of the train movement, he was not familiar with how the locomotives were handling, nor how the make-up of cars was affecting the train behavior. The helper did not have a copy of the cut list. An extra assignment had been ordered for 0005 to assist, but they were still not keeping up with the workload.

Beltpack Remote Control Operations

The Beltpack is a remote control system for locomotive operations that is designed to apply as much throttle or brake as is necessary to reach and maintain a desired speed (see Photo 2). The locomotive will accelerate at approximately the same rate regardless of speed setting.

Once the locomotive is moving, moving the speed selector will change the locomotive's speed. If the locomotive is moving slower than the desired speed, the Beltpack will automatically throttle up. Conversely, if the locomotive is moving faster than the desired speed, it will automatically remove power and apply locomotive independent brakes until the desired speed is reached (+/- ½ mph). Speed changes requested through the Beltpack should be made gradually to avoid unnecessary stress on couplers.

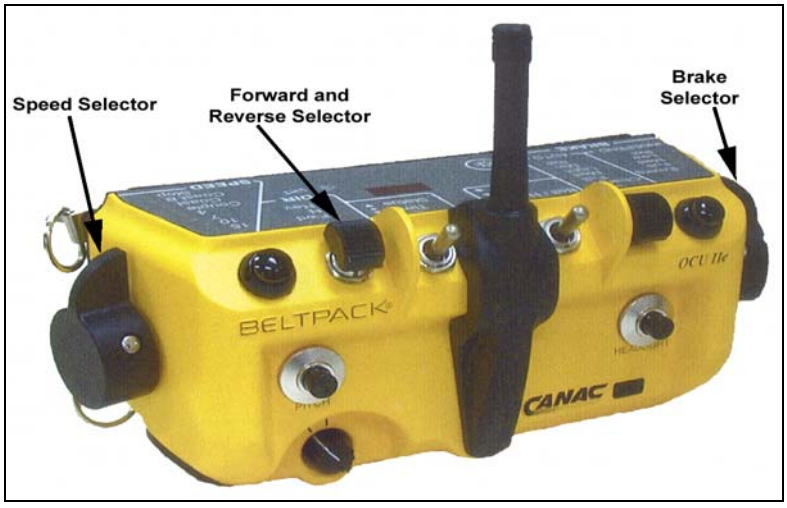

Photo 2. Beltpack operator control unit (OCU)

The normal method for stopping is to gradually reduce the speed selector to the desired speed. When the speed selector is set to Coast, Coast B, or Stop, the Beltpack applies full independent brakes when the speed drops below ½ mph. Operators are cautioned not to use Coast or Coast B speed positions when approaching obstructions (cars, buildings, etc.) because, when doing so, the operator must estimate the actual movement speed and, therefore, stopping distances. This can significantly increase the risk for over-speed coupling, equipment damage, and injury.

In emergency situations, either operator can apply emergency brakes by moving the OCU's brake selector to the emergency position. The Beltpack then activates the emergency brakes of the locomotive consist and the train, if the latter's air line is connected. It also deactivates the throttle, sounds the bell, and cycles the horn until the movement comes to a stop.

The CN General Operating Instructions (GOI), Section 6, governing Beltpack operations define a Beltpack operator as an operating employee who, through training, experience, and knowledge is qualified to perform switching operations and to provide engine movement signals using the Beltpack technology. For a two-person "pitch-and-catch" operation, the controlling member has full control of the locomotive speed, direction, and braking function, and can see the selected command in a small view screen. There is no actual speed indication. The Beltpack only indicates "desired" speed. There is also no indication of acceleration, braking force, or required braking distance.

When one Beltpack operator has control, the other operator can not use the OCU to monitor the actions of the person in control. Either operator can place the train in emergency at any time. There is also a tilt safety function that will sound an alarm on the OCU if it is tilted more than 45 degrees in the event of an employee trip or fall. In this situation, after four seconds, if the 45-degree angle is not corrected, the OCU will automatically send an emergency brake command to the locomotive.

Conductor Training Program Design

Until 1999, all CN conductors were first qualified as assistant yard conductors on a three-person switching crew. After completing a minimum number of shifts as set out in their contract, they would be qualified as conductors.

With the introduction of the Beltpack technology, the three-person crew was replaced with the current two-person foreman/helper structure. A new "Fast Track" conductor course was implemented. Over the years, the course has evolved to meet the changing role of railway conductors. A timeline for the course, based on the 2007 program, is summarized in Table 1. A detailed description of the course content is included in Appendix A.

Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14	Week 15	Week 16
Classroom Instruction – CN basic operating rules		Observation Trips – Exposure to conductor duties. Ride with conductors but do not operate equipment		Classroom Training in rules and QSOC subjects - Trainees are tested on knowledge and must pass test in order to continue in course. There is no test on yard knowledge.			Beltpack Training - Learn to set-up and operate remote control locomotives.		Trial Trips – Minimum of 45 trial trips in yard and road operations under supervision of an experienced conductor. The student is expected to operate yard assignments and apply theoretical learning to build trains, or to perform the duties of conductor on road assignments. Conductor trainers provide written assessment of progress.					Note: With limited assignments, many trainees can not complete the minimum trips in the allotted five weeks.	Qualification Test – Administered by conductor trainer.

Table 1. Timeline for completion of Fast Track Conductor Training Course.

The Fast Track training process was designed to take five to six months to complete. In 2007, the training programs at MacMillan Yard were being completed in three to four months, which resulted in the reduction of the number of trial trips.

In 2005, three classes were scheduled with a minimum of three months between start times. This allowed observation trips and supervised practical training to be scheduled without overlap. Also, with more time, classes could be broken into smaller groups so each student received more hands-on time in the Beltpack instruction portion of the course. A total of 40 students were trained in 2005. In 2006, there were 44 students trained in three classes following a similar format.

In 2007, due to a shortage of operating employees, the number of classes doubled and the number of trainees increased to 107. To accommodate these numbers, a new class started each month. Without an increase in the training staff, the compressed schedule created increased demand on practical training resources. In some cases, observing trainees were placed on the same assignment as operating trainees. The number of students in each Beltpack session was increased and, contrary to the course design, it became practice to include "observation trips" when calculating the minimum number of trips required before qualifying as a conductor. The trainees typically had between 30 and 35 operational trips. There were no provisions in place to extend the practical portion of the course for trainees who had demonstrated a need for extra training.

Prior to 2007, conductors were only qualified for one year after completing the course and were required to retake their CROR exam. There was a high failure rate on the one-year retest, so the course was restructured so that the retest occurred at the end of the training program. Since 2007, new conductors have been considered fully qualified and their certification is valid for three years. There are no special operational restrictions placed on newly trained conductors.

Supervised Trial Trips

The practical application portion of the training program begins after trainees have been trained on the Beltpack and have passed their classroom coursework. Trainees are placed in control of remote control yard movements under the supervision of a trained conductor who completes and submits daily trainee evaluation forms.

The helper involved in this occurrence was a member of the class that began on 30 April 2007. The conductor trainee assessments for the helper (Figures 4a & 4b) show clear and continuing areas of deficiency including yard knowledge, train handling, and radio operation. In the case of yard knowledge, 12 of the 15 assessors (80 per cent) identified this as an area where the helper needed improvement.

Count	Date	Yard Knowledge (OK/NI/NA)	Preshift	Beltpack	Riding Equipment	Train Handling	Using Air	Hump Operations	Radio Operation	Coupling & Uncoupling	Handbrakes	Switches	Point Protection	Hand Signals	Safety	Assignment
22	6-Aug-07	X	-	-	-	X			X	X	-	-	X	X	-	0700 East
21	28-Jul-07	X	-	-	-	X	X		X	-	-	-	X	-	-	1500 East
20	27-Jul-07	X	-	-	-	X	X		X	-	-	-	X	-	-	1500 East
19	21-Jul-07	-	-		-	-		-	-	-	-	-	-		-	2200 Dual
18	20-Jul-07	X	-		-	X		-	-	-		-	-		-	2300 Dual
17	20-Jul-07	X	-	X	-	-	-		-	-	-	-	-	-	-	0030 West Inc
16	19-Jul-07	X	-	X	-	-	-		-	-	-	-	-	-	-	0030 West Inc
15	13-Jul-07	X	X	X	-	X			X	X	X	-	X		X	700 East
14	12-Jul-07	X	-	X	X	X			X	X		X	X		X	700 East
13	11-Jul-07	X	-	X	-	X			-	-	-	-	-	-	-	700 East
12	10-Jul-07		-	-	-		-		-	-		-			-	700 BIT
11	9-Jul-07		-	-	-		-		-	-		-			-	700 BIT
10	7-Jul-07	-	-	X	-	-			-	-	-	-	-	-	-	600 West
9	4-Jul-07	X	-	-	-	X			X	X	-	-	X	X	-	1400 West
8	3-Jul-07	X	-	X	-	X			X	-	-	-		X	-	1515 South
7	2-Jul-07	X	-	X	-	X	X		X	-	-	-	X	-	-	1515 South
6	24-May-07		-		-	-	-			-	-	-	-	-	-	Frontier Yard
5	18-May-07		-		-		-		X	-	-	-	-	X	-	MacYard
4	17-May-07		-		-		-		X	-	-	-	-	X	-	MacYard
3	16-May-07		-		-		-		X	-	-	-	-	X	-	MacYard
2	15-May-07		-		-		-		-	-	-	-	-	-	-	MacYard
1		-	-		-		-		-	-	-	-	-		-	Nortown

Figure 4a. Tabulation of Helper's trainee evaluation (Note: "Needs Improvement" assessments are represented by darker shaded blocks.)

Total

Needs Improvement	12	1	8	1	10	3	0	11	4	1	1	7	6	2
Okay	3	21	6	21	5	10	2	10	18	17	21	12	9	20
No Entry	7	0	8	0	7	9	20	1	0	4	0	3	7	0
% Needs Improvement	55%	5%	36%	5%	45%	14%	0%	50%	18%	5%	5%	32%	27%	9%
% Okay	14%	95%	27%	95%	23%	45%	9%	45%	82%	77%	95%	55%	41%	91%
% No Entry	32%	0%	36%	0%	32%	41%	91%	5%	0%	18%	0%	14%	32%	0%

Figure 4b. Summary of Helper's Trainee Evaluation

In addition, the helper identified Yard Knowledge as an area where he needed improvement and he sought additional training. The training officer agreed to extend the duration of his training. However, there was no formal process in place to review any of the supervising conductor trainer evaluations during the course, nor to incorporate this information in the enhancement of training plans for conductor trainees. Even with the additional training rides, the helper still did not receive the minimum 45 training trips.

MacMillan Yard Orientation

MacMillan Yard knowledge was not tested during training and qualification. There were no maps included in the training material. There were no maps of the yard in the yard manual. Conductors were given little direction and were left to learn the layout of the yard as they worked on the job. Some conductors adapted by making their own hand-drawn sketches (see Figure 5a) or by making copies of other employees' sketches. This is in contrast to mainline operations, where crews are provided with timetables, illustrated train-handling guides and track diagrams (see Figure 5b).

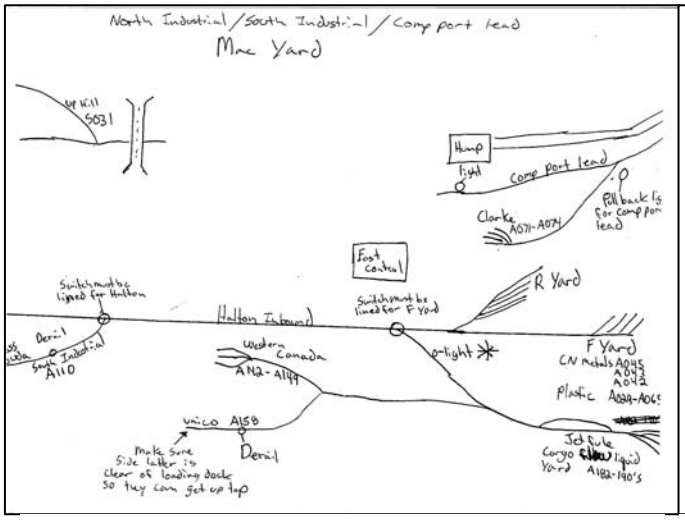

Figure 5a. Helper's sketch of MacMillan Yard

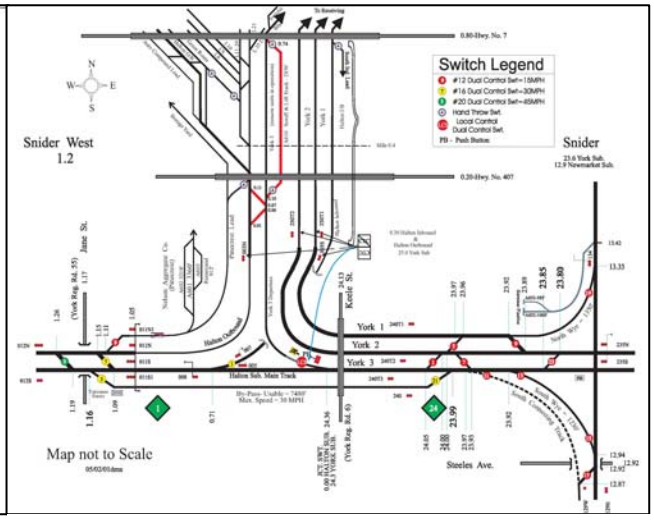

Figure 5b. CN diagram entrance to MacMillan Yard

Qualifying Test for Conductor

The helper on the 2200 West assignment qualified as a conductor on 14 August 2007 after completing 34 training trips and a qualifying test. The two-hour test, conducted on day shift at West Control, was as follows:

- Required to explain how to pull cars out of bowl and assemble train, given a switch list with 9 blocks.
- Required to couple in a track using proper methods to couple equipment, using radio and throwing switches.
- Required to move locomotives (no cars) from one lead track to another while other yard movements were working in the area.
- Required to describe the concept of knowing where other crews were in relation to himself and what they were doing.
- Required to describe, in detail, methods of pulling cars from the dual-control hump and the permissions required.
- Required to fully describe the meaning of point protection zone (PPZ) and the meaning of the various signals displayed by PPZ lights.
- Required to use appropriate speeds while pulling equipment and making joints.

A train master provided point protection and monitored radio transmissions at all times through the testing process.

Train Handling in Beltpack Training Course

Chapter 7 of the Beltpack training course manual is devoted to train handling. It describes the four main forces that act on a cut of cars: vertical, lateral, buff, and draft forces. The section describes conditions that amplify track/train forces:

- working with long cuts of cars;
- working with combinations of heavy and light cars: combinations can cause problems if they are not dispersed evenly throughout the cut; and
- anchor effect: an anchor effect is produced when a car or locomotive acts as an anchor to the movement.

The section discusses how to handle in-train forces with long or heavy car cuts in order to avoid stringlining (the tendency of a long cut of cars to shortcut a curve when being pulled) or jackknifing (a run-in of rail cars that can push couplers out of alignment, particularly on curves,

and cause the cars to accordion). It also provides advice on how to use gradual speed changes to manage in-train forces. There is no discussion on how train length, tonnage, or topography can affect train-braking distances.

Simulator Training in Remote Control Yard Operations

Remote control operation training software that incorporates virtual technologies has been developed to help teach new railway employees how to safely conduct yard switching operations. Rail operations simulation (ROS) programs recreate existing rail yards, including flat switching and hump yard operations. While not currently used in Canadian Class 1 railway operations, a United States (U.S.) Class 1 railroad has developed and incorporated ROS into its training since 2007.

At this U.S. railroad, the ROS program is used by employees to learn remote control switching operations and gain railroad knowledge. The program monitors student performance on the simulators and provides a printed scorecard of their performance. Sessions are recorded and can be reviewed with the student. Trainees can not progress to on-the-job training until they have demonstrated competency in more than 80 areas of proficiency, including "control of 25 to 50 cars", "control of 50 to 75 cars", and "control of 75 to 100 cars". All tasks require a minimum of three successful repetitions and must be signed-off by the trainee and the instructor/trainer/mentor. The same applies for on-the-job training. When trainees are ready to qualify, they are provided with a four-hour qualifying exam that involves supervised completion of actual work duties.

CN has used simulator training in their locomotive engineer training programs for more than 20 years. However, CN does not provide simulator training for remote control operations to employees. Based on their experience, the U.S. railroad stated that it would take between four and six months to develop a ROS version to model hump yard operations at MacMillan Yard.

TSB Laboratory Analysis

The TSB Engineering Laboratory conducted a train dynamics analysis of the movement of the 2200 West prior to and leading to the derailment (LP 003-08 [7]). Effective stopping distances for the movement—based on brake function, track geometry, and train tonnage distribution—were also analyzed.

The laboratory analysis determined:

- Between the initiation of emergency and the collision, the 2200 West was travelling on an equivalent average descending grade of 0.062 percent and curvature of 1.45 degrees. The grade induced a forward force that increased the stopping distance of the movement.

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[7] This report is available from the Transportation Safety Board upon request.

- When the head end of 2200 West had an unobstructed view of the junction with the Halton outbound track, it was travelling too fast to stop within half the range of vision.

- At the speed at which the assignment was travelling, the train would have had to be placed in emergency more than 448 feet from the fouling point of the switch in order to prevent the collision.

- When "Stop" was requested at 0253:58, the speed on the 2200 West was 8.57 mph and decreasing.

- It took four seconds from the "stop" request to initiate emergency braking (at 8.19 mph at 0254:02). The collision would still have occurred even if emergency braking had been initiated at the moment of the "stop" request.

- Based on average deceleration data, the 2200 West assignment was under a braking force of about 60 per cent of the full locomotive emergency braking force immediately before the emergency initiation.

- Simulations were conducted with the assumption that 2200 West went into emergency at a brake cylinder pressure (BCP) level of 60 per cent of full emergency BCP and took another five seconds to fully build up BCP. An emergency brake ratio of about 36 per cent was the best fit calibrated by the records at 0254:12.

- By using locomotive-only emergency braking, 2200 West would have taken 74 seconds and traveled 448 feet to stop from the moment when emergency braking was applied at 8.19 mph.

- On the night of the occurrence, track curvature, the adjacent train 339, and bridge piers restricted the sightlines for the 2200 West to between 300 feet and 1200 feet.

- To have been able to stop within half the range of vision of equipment (as required by CROR 105), the pull down movement should not have exceeded five mph for a vision distance of 300 feet.

- With car brakes cut in, the stopping distance would have been shortened. However, even with all car brakes cut in, it is likely that the collision would have occurred.

- Considering the speed, track grade, train weight, and brake ability on the day of the occurrence, emergency braking was initiated too late to stop the 2200 West assignment from colliding with train 339.

Other Related Yard Accidents

Since 2007, there have been two employee injury occurrences at MacMillan Yard that resulted in severe injuries to persons in control of a remote control movement:

- On 19 March 2007, during Beltpack switching operations in track CO71, the operating employee (a supervisor) controlling the movement from the tail-end tank car attempted to couple, but was travelling in excess of 12 mph and, instead, punched a cut of cars back toward the hump. The employee detrained, ran, and entrained onto the leading end of the trailing runaway cars in an attempt to stop the movement by setting a hand brake. While attempting to set the hand brake, the employee lost his footing and fell to the ground in the path of the L1 wheel.

- On 18 November 2008, a CN employee was operating the 2200 West assignment using Beltpack in track C-0005. The employee was attempting to open a knuckle while the movement was still in motion and was caught between the couplers.

These two accidents speak to the severity of recent occurrences in MacMillan Yard involving remote control movements under the control of the person at the point of the movement where the injury occurred.

Since 2006, there have been a number of similar collisions involving yard movements during flat switching where conductor training and experience were contributing factors to the accident. In each of these occurrences, by the time the crews applied emergency braking, they were unable to comply with Rule 105. In addition, familiarity with the territory, the length and tonnage of the switching movement, and the geometry and gradient of the yard were also identified as contributing factors:

- At approximately 1910 Pacific daylight time on 21 May 2006, Canadian National Kamloops 1230 yard assignment (switching movement YKSS30) pulling southward toward the Okanagan connecting track collided with unoccupied Rocky Mountaineer Vacations Inc. passenger train RMV P61051-21, pushing northward from the Okanagan connecting track into track KF21 in Kamloops Yard. Four passenger cars derailed and Canadian National locomotive 1420 was heavily damaged. There were no injuries (TSB report No. R06V0111).

- On 13 February 2007, a Canadian National hump yard assignment was performing switching operations at Symington Yard (Mile 145.2 of the Sprague Subdivision) in Winnipeg, Manitoba. While travelling westward at approximately 6 mph on track ER-08, the hump yard assignment sideswiped Canadian National train L53241-13, which was outbound on track ER-04. Four cars from the hump assignment derailed. A total of nine cars were damaged. No dangerous goods were involved and there were no injuries (TSB report No. R07W0042).

- On 04 August 2007, a Prince George South Yard Beltpack assignment was pulling 53 loaded cars from track PA02 at the north end of the yard. While attempting to clear the "bull switch" in order to access the classification tracks, the movement ran away northbound, striking CN train M35761-30, which was entering the north end of the yard. The Beltpack movement struck a car load of gasoline, derailing it and the next car ahead, also a loaded car of gasoline. Two locomotives, a booster unit and a loaded centre beam flatcar in the yard consist derailed. The subsequent fire destroyed the two tank cars, the centre beam flatcar, as well as the two locomotives and booster of the yard consist. There were no injuries. Approximately 172 600 litres of fuel (1600 litres of diesel and 171 000 litres of gasoline) was lost (TSB report No. R07V0213).

TC Review of CN Operating Practices

On 05 January 2006, TC published Phase 1 of the *Final Report: Targeted Inspection of CN Operations*. TC's Rail Safety Directorate developed a two-phased action plan to assess overall compliance and safety of CN. Targeted inspections were conducted between August 22 and September 16 2005. The findings confirmed previous concerns. In the area of train operations, one of the five key areas was identified as the "necessity for rules for Transfer Movements and Remote Control Locomotive Operations."

On 12 June 2006, TC published Phase 2 of the *Final Report: Audit of Safety Management Practices at CN*. The audit conducted between 14 November and 10 December 2005 focused on selected areas of risk identified in Phase 1. Findings included the following:

- There is a disconnect between senior management and front-line supervisors/employees in understanding management's commitment to safety. Many employees and some front-line supervisors feel pressured to get the job done in a manner that could compromise railway safety.

- There is a need for a comprehensive review of safety performance by senior management that focuses on more than U.S. Federal Railroad Administration (FRA) reportable accident criteria.

- Data from day-to-day operational monitoring systems could be used more frequently to trigger formal risk assessments. The audit team did not find evidence that data from Performance Monitoring and Rules Compliance (PMRC) System, safety audits/blitzes, and Functional Safety Inspections/Defect Logs and Reports is being used to trigger documented risk assessments.

- More thorough recording and tracking of details is necessary to improve the management of risk mitigation strategies (i.e., corrective actions). The audit team could not find documented details describing the risk mitigation controls (such as responsibilities, key implementation activities and dates, and status) contrary to the intent of CN's Corrective Action/Safety Measure Management Standard.

- The effectiveness of CN's safety culture improvement initiatives need to be reviewed. The focus on training, involvement, communications, coaching, and recognition were not being effectively implemented.

- Current field-level practices were identified as contributing to the high rate of defects/deficiencies.

- CN's safety management documentation can be improved. Documentation did not include clear descriptions of overview roles and responsibilities for management levels above the front-line supervisor.

On 11 October 2005, CN provided responses to Phase 1 of TC's targeted inspection activities. CN cooperated with all aspects of the audit and, in general, acted promptly in addressing identified safety concerns and providing corrective action.

With regard to remote control locomotive operations, in anticipation of a Section 19 order from TC, CN committed to bringing forward the order to the Railway Association of Canada (RAC) Rule Revision Team and filing its submission by the due date stipulated in Section 19.

In June 2006, TC's report on Phase 2 of their CN operations audit was published. In 8 of 11 areas of the Phase 1 audit selected for verification, corrective actions had been implemented. Others required longer-term development, such as CROR revisions to include transfer movements and remove control locomotive operation. TC assessed that CN management demonstrated a commitment to review and improve its safety management practices; however, action in this direction still needs to be established and implemented.

While the audit showed evidence of risk assessments undertaking consistent with CN's safety management system (SMS) risk assessment protocol, data from on-going data collection processes is not regularly used to trigger a formal risk assessment. "The process for tracking, analysis, and follow-up of Corrective Actions stemming from completed Risk Assessment was not implemented as outlined in CN's "Corrective Action/Safety Measure Management Standard." [8]

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[8] Transport Canada, *Final Report: Audit of Safety Management Practices at CN* (Phase 2 of Transport Canada Action Plan to Address CN Safety Issues, June 2006)

Qualification Standards and Training for Operating Crews

In the 2007 report titled, *Stronger Ties: A Shared Commitment to Railway Safety,* [9] the Railway Safety Act Review Panel (RSRS) made the following observations:

> The Railway Employee Qualification Standards for Operating Crew Regulation (QSOC) has been in effect since March 16, 1987. Although the regulation has not been updated since it was implemented, it contains provisions to ensure that the training and certification of locomotive crews are being maintained at a significantly high level. QSOC also outlines the requirements for an instructor responsible for training and certifying candidates for a position specified in the regulations. It specifies that a training program must be filed with Transport Canada, Rail Safety Directorate, along with any changes or alterations to the program.

Analysis

Track maintenance, track inspection, and the condition of the equipment were not considered contributory to this accident. Train 339 on the Halton outbound track departed in a manner consistent with yard operating rules. The analysis will focus on the operation of the 2200 West assignment. It will consider employee yard knowledge, experience, and job briefings. It will also consider the adequacy of and compliance with the railway's conductor training program.

The Accident

The CN yard assignment was pulling 38 empties and 69 loads as it began to travel down the Green Route. The helper was on the lead locomotive in control of the Beltpack movement. Without train line air brakes, the helper was entirely reliant on the braking force of the locomotive and booster units to control the speed of the movement. Laboratory analysis determined that when the movement was placed in emergency, it would have required at least 448 feet to stop. Emergency brake application began approximately 200 feet from the fouling point. Therefore, the movement was too long, heavy, fast, and close to the junction with the occupied Halton outbound route to stop before colliding with train 339.

The helper had only recently qualified as a conductor. During the training, he had identified a need for assistance in yard orientation. These needs were echoed in written reports from supervising foremen on his training assignments. The course providers did not monitor supervising foreman feedback and records indicate that these deficiencies were neither recognized nor adequately acted upon during the training process. The helper did not receive the minimum number of training trips prescribed within the course design. Other conductors reported that, once certified, the helper still did not possess the necessary skills and yard familiarity to safely complete yard switching duties involving handling long, heavy cuts of cars on various grades. Although the new conductor had been certified by CN as qualified to

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[9] Railway Safety Act Review Secretariat, *Stronger Ties: A Shared Commitment to Railway Safety,* Review of the *Railway Safety Act*, November 2007

operate Beltpack switching assignments, on the day of the occurrence neither his training nor his experience was adequate for switching long, heavy cuts of cars on tracks with descending grades.

The helper's line of sight varied from 300 to 1200 feet. For Rule 105 compliance, stopping distances must be half that distance. In addition to considering length, tonnage, and brake set-up, the conductor must consider the braking ability of the cars and locomotives. Braking conditions can vary widely [10]. With such a wide variability in braking force, train length, and tonnage, the only way to estimate braking distances in a long, heavy cut of cars is to be familiar with the locomotive, consist, and track gradient. Furthermore, the helper was not in possession of the list of cars he was handling and, therefore, was not familiar with his movement.

Without a complete understanding of the train's behaviour under braking and an accurate consist, the helper could not accurately estimate the stopping distance of this long, heavy train on the descending grade.

Because the operator could not estimate stopping distances, prior to the collision the operation of the movement did not meet the requirement of Rule 105 to be able to stop within one-half the range of vision of equipment.

The 2200 West crew was not completing assigned work in the time available. For operational considerations, cars are often moved at a speed as close as possible to the maximum of 15 mph. These were factors that likely contributed to the 2200 West assignment operating at an excessive speed.

The circumstances of this accident demonstrate inadequate planning and job briefing. The foreman was the only employee in possession of a cut list. The foreman had assembled this train alone, and was aware of its approximate length and tonnage. The foreman knew that 2200 West was too long to fit within the point protection zone (PPZ) and knew the helper was inexperienced. None of this information was shared when the control of the movement was pitched to the helper.

Instead of waiting for train 339 to clear or setting the train out into the departure yard as two cuts, the inexperienced helper was placed in control of a difficult move without knowing all the risks. Had they waited for the tail end to clear, it would have added less than a minute to the move. The decision to place a difficult-to-handle train in the hands of an inexperienced operating employee without an adequate job briefing contributed to the collision and derailment.

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[10] Association of American Railroads (AAR) Recommended Practice (RP) 509-88 (rev. 1994) permits braking ratios as low as 20 per cent; however, the *Railroad Engineering Handbook* notes that braking ratios for locomotives can be as high as 90 per cent.

MacMillan Yard is a large, complex rail yard but, at the time of this occurrence, there were no yard maps or track diagrams included in course instructional material, or the yard manual. When operating trains in a large, complex rail yard (for example, MacMillan Yard), a site map, including track layouts, would be a useful job aid to be given to conductor trainees and newly qualified conductors.

The Handling of Length and Tonnage in Yard Switching

The TSB has investigated a number of recent collisions and derailments involving CN flat switching operations (such as Kamloops Yard - R06V0111, Symington Yard - R07W0042, and Prince George Yard - R07V0213). In all these instances, by the time the crews applied emergency braking, they were unable to comply with Rule 105.

The longer and heavier the movement, the more difficult it is to match train speed to required stopping distances. During the course of a movement, sightlines can vary. Rather than risk operating a movement at a speed that exceeds reduced sightlines, a safer course would be to adjust train speed so the movement remains in compliance with the half the range of vision of equipment provision of Rule 105 throughout the entire movement. While it may be expeditious to switch long cuts of cars, this practice makes stopping distances unpredictable and meeting the requirements of Rule 105 unreliable. Without mitigating this risk, yard collisions involving long, heavy consists will likely continue to occur.

Beltpack Training and Experience

The 2200 West collision and derailment is one of several similar events investigated by the Board where familiarity with the territory, the length and tonnage of the switching movement, and the geometry and gradient of the yard have been identified as contributing factors. An analysis of Fast Track Conductor training at MacMillan Yard found that content dealing with yard orientation and the effects of train length, tonnage, and track geometry on stopping distances was absent from the program.

Locomotive engineers operating on main-line track are required to comply with minimum training standards in regards to train handling. There are no such requirements for yard crews involved in remote control operations. This has been recognized by the regulator, Transport Canada (TC), as a gap. To date, however, no action has been taken to ensure that there are regulations mandating minimum training standards for operating employees working in non-main-track operations.

While conductor trainees receive basic instruction and testing in handling yard movements as part of their Beltpack course, they do not receive specific instruction or practical experience on the effects of tonnage, length, marshalling, or topography on braking distances. In the absence of such training and with no special operational restrictions placed on these newly trained personnel, conductors are inadequately qualified to safely operate yard movements at all times.

Adequacy of Conductor Qualification Testing

To qualify increasing numbers of students without increasing training resources, compromises were made. It was left to the conductor trainees to learn the yard on their own, and opportunities for practical, hands-on training were reduced without consideration to the course design. There were no resources dedicated to monitoring the quality of program graduates. This matches the noted deficiencies identified in TC's review of CN operating practices.

Conductor qualification testing did not meet the test of ecological validity, because the methods, materials, and setting of the examination did not approximate the real-life work conditions. The training program, as structured, was qualifying conductors without the requisite skills or hands-on practical training to do the job. They did not have adequate experience handling long, heavy train movements, nor did they know the intricacies of the territory in which they were required to operate. The theoretical exam tested knowledge, but not its practical application. The testing was done in the daylight with no requirement to physically set up equipment or to plan and build a train.

The qualifying test to certify conductors in Beltpack yard operations is not sufficiently rigorous to evaluate conductor trainee skills under work conditions. Consequently, trainees without the requisite skill or experience are being placed in active service without any restrictions on their duties.

Skill Deficiency Identification During Conductor Training

A broader and more detailed audit of CN operations was conducted by TC in 2005 and 2006. An analysis of the Fast Track conductor training matches TC's broader findings. Recording and tracking of details was inadequate and often inaccurate. There were little, if any, formal quality assurance practices in place, or evidence of safety management strategies being implemented prior to this occurrence. The number of other serious occurrences in 2006 and 2007 suggests, as stated in TC's audit report, that the effectiveness of CN's safety culture improvement initiatives needs to be reviewed. The focus on training, involvement, communications, coaching, and recognition were not being effectively implemented. [11]

In the absence of a process to review and incorporate student and conductor feedback into the training program, skill deficiencies will not be identified and addressed during the training program.

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[11] Transport Canada, Phase 2, *Final Report: Audit of Safety Management Practices at CN*, 12 June 2006.

Findings as to Causes and Contributing Factors

1. When the Canadian National (CN) west control hump yard assignment YWCS60-17 (2200 West) was placed in emergency, the only operable brakes were those of the locomotive and the booster unit. The movement, with limited braking capacity, was too long, heavy, fast, and close to the junction with the occupied Halton outbound route to have been able to stop before colliding with train 339.

2. Although CN had certified the new conductor as being qualified to operate Beltpack switching assignments, neither his training nor his experience was adequate for switching long, heavy cuts of cars on tracks with descending grades.

3. Without a complete understanding of the train's behaviour under braking, and without a list of the cars and tonnage, the operator could not accurately estimate the stopping distance of this long, heavy train on the descending grade.

4. Without knowing the stopping distance, the operation of the movement did not meet the requirement of Rule 105 to be able to stop within one-half the range of vision of equipment.

5. The 2200 West crew was not completing assigned work in the time available. The railway expects that cars be moved at a speed as close as possible to the maximum of 15 miles per hour. These factors likely contributed to the 2200 West being operated at an excessive speed.

6. The decision to place a difficult-to-handle train in the hands of an inexperienced operating employee without an adequate job briefing contributed to the collision and derailment.

Findings as to Risk

1. While it may be expeditious to switch long cuts of cars relying only on locomotive brakes, this practice makes stopping distances unpredictable and meeting the requirements of Rule 105 unreliable. Without mitigation of this risk, yard collisions involving long, heavy consists will continue to occur.

2. While conductor trainees receive basic instruction and testing in handling yard movements as part of their Beltpack course, they do not receive specific instruction or practical experience on the effects of tonnage, length, marshalling, or topography on braking distances. In the absence of such training and with no special operational restrictions placed on these newly trained personnel, conductors are inadequately qualified to safely operate yard movements at all times.

3. The qualifying test to certify conductors in Beltpack yard operations is not sufficiently rigorous to evaluate conductor trainee skills under work conditions. Consequently, trainees without the requisite skill or experience are being placed in active service without restrictions on their duties.

4. In the absence of a process to review and incorporate student and conductor feedback into the training program, skill deficiencies will not be identified and addressed during the training program.

Other Finding

1. When operating trains in a large, complex rail yard (for example, MacMillan Yard), a site map, including track layouts, would be a useful job aid to be given to conductor trainees and newly qualified conductors.

Safety Action Taken

Transport Canada Section 19 Order Regarding Employee Qualification

On 21 December 2007, the Minister of Transport, pursuant to Paragraph 19(1)(a) of the *Railway Safety Act,* ordered all federally regulated railway companies to develop and file a rule to update and replace CTC 1987-3 RAIL, *Railway Employee Qualification Standards Regulations* (see Appendix C). The revised rule will "apply only to any occupation category and any railway position directly engaged in the movement or control of equipment in yard service or on main track and railway employees authorized to operate cranes or other machines moving equipment (e.g., Locomotive Engineer, Conductor, Remote Control Operator, Yard Foreman, Hostler, Rail Traffic Controller)."

The revised rule will include a description of the railway's training program for each occupational category, certification standards for employee categories, classrooms, contracts, and on-the-job training instructors. It will include testing criteria that will accurately measure the person's knowledge in key subject areas, establish minimum passing grades, performance monitoring, and refresher training. This safety action will establish government-mandated minimum standards for the training and qualification of yard employees engaged in remote control train operation.

In June 2009, revised rules were approved. These rules will come into effect once all federally regulated railway companies become signatories to the new rules and the current regulations are repealed.

Revisions to Canadian National FastTrack Conductor Training

Following this occurrence, Canadian National (CN) reintroduced a MacMillan Yard familiarity test to ensure that trainees demonstrate knowledge of local yard layout and operations, and added a person to the training staff responsible for tracking and monitoring feedback from supervising conductors during on-the-job training.

More recently, the global economic downturn beginning in 2008 has resulted in little conductor hiring and training. With this lull in training, CN has committed to taking steps to improve documentation and quality control processes in relation to their new hire conductor training. CN is undertaking a system-wide review of training-related processes in place at each terminal. These processes will be defined and documented. CN will take the best practices currently in effect at various terminals and apply them system-wide through a published system standard.

The standard will reflect the:

- content of the conductor trainee evaluation form;
- quality standards on completion of this form by the supervising conductor;
- record retention and availability (in particular, there must be one properly completed form for every tour of duty recorded);
- written record of field observations of, and discussions with, the trainee by the supervising conductor trainer and by transportation officers; and
- written record of observations made during the final qualification tour by the supervising conductor trainer.

At the point of qualification, CN's ongoing audit program takes over, in that it requires particular focus on field observations of rules compliance to be placed on new employees.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 04 September 2009.

*Visit the Transportation Safety Board's Web site (**www.tsb.gc.ca**) for information about the Transportation Safety Board and its products and services. There you will also find links to other safety organizations and related sites.*

Appendix A – MacMillan Yard Fast Track Conductor Training Course Content

At MacMillan Yard, the course is now structured as follows:

- 2 weeks classroom rules instruction:
  Trainees receive the basic instruction in CN operating rules and must pass a written exam. At this time, a basic orientation course includes field trips to the car repair facility, diesel shop, and a day on live equipment. Ninety per cent of content is classroom instruction.
- 2 weeks on trial trips for observations:
  Conductor trainees are exposed to road switchers, yard assignments, Beltpack assignments, and main-line trains. They ride with qualified conductors as observers, but do not handle the operation of the equipment.
- 3 weeks classroom training in rules and QSOC [Qualification Standards for Operating Crews] subjects:
  Trainees are tested on their knowledge and must pass in order to continue with their training. At one time, the course included a yard orientation component that included a test on yard knowledge. By 2007, a test on yard knowledge had been dropped from the course curriculum. Also, during the late 1990's, the yard manual and course material included maps of MacMillan Yard; this material was not included in the 2007 course or the update to the yard manual.
- 2 weeks Beltpack training:
  The Beltpack training course is designed to teach the trainee how to set up and safely control locomotives using a remote operator control unit (OCU). The OCU is designed for use as a one-person or two-person operation. The course includes a theoretical and a hands-on component, and trainees are tested. A trainee must successfully complete Beltpack training before continuing on to the operating portion of the course.
- 45 trial trips with qualified conductors:
  The trainee then is required to complete 45 trial trips under the supervision of a qualified conductor. The trainee is expected to be placed in control of the Beltpack and radio equipment in order to get hands-on experience working the various yard and main line assignments. Qualification categories include:
  - Equipment – proper personal protective equipment.
  - Train handling – start smooth (couple speed), stop smooth, uses appropriate speeds when coupling, pulling, and shoving; spotting cars, kicking cars
  - Riding equipment – entrains/detrains safely, faces direction of travel, rides point of leading car, and maintains three-point contact.
  - Coupling and uncoupling – understands switch lists/blocks, uses proper speeds, checks and aligns drawbars properly, leaves sufficient space between cars, stretches joints, leaves knuckles open, and leaves equipment in the clear.
  - Securing equipment – uses platform to reach handbrake, uses proper body mechanics, and employs the push/pull test.

  - Switches – uses both hands, uses proper body mechanics, checks points, checks targets, and route to be used.
  - Point protection – understands and can describe a point protection zone (PPZ), understands route indicators, and in position to observe PPZ lights.
  - Dual hump – understands route lights in the receiving (R) yard, communicates clearly with yardmaster, understands permissions must be given, pulls back at sufficient speeds, inspects cuts, shoves cars to the crest, and understands hump speeds.
  - Radio procedures – clear and proper identification, repeats instructions, gives proper car counts and intervals, uses "over and out", and aware of other crews.
  - Safety – awareness of surroundings, looks before crossing tracks, does not walk between tracks, and does not walk on rails.

- Just before completion of their trial trips, the conductor trainees are brought back into class and re-examined on all subjects. At this point, if they pass the CROR training, they are considered fully qualified conductors for the purpose of rules compliance, and are not required to re-qualify for three years. This re-examination is a modification from a previous course structure where conductor trainees were only given a temporary rules qualification valid for one year. At the end of the first year of service, they would be re-examined and required to pass in order to continue. However, under the previous structure, there was a high failure rate on the re-tests.

- At the end of this training, the conductor trainee receives a practical test administered by the conductor trainer. If deemed satisfactory, they are qualified to commence duties. The whole process is expected to take between five and six months.

Appendix B - Sample Conductor Trainee Evaluation Form 06 August 2007

CN CONDUCTOR TRAINEE EVALUATION : YARD

TRAINEE: [redacted] PIN: [redacted] DATE: AUG. 6/07

TRAINER: [redacted] PIN: [redacted] ASSIGNMENT: GOOD EAST

	OK	N/I	N/A
PRESHIFT			
DRESSED AND READY 10 MINS PRIOR	/		
PROPER PPE	/		
JOB BRIEFING (ONGOING)	/		
READ & SIGN DOB	/		
BELTPACK			
SET UP: CONTROL STAND			
SET UP: PROGRAMMING			
PROPER TESTING	/		
PITCH AND CATCH	/		
OVERALL USE AND KNOWLEDGE	/		
	/		
RIDING EQUIPMENT			
ENTRAINING & DETRAINING >4 MPH			
USES TRAILING FOOT FIRST	/		
FACES DIRECTION OF MOVEMENT	/		
3 POINT CONTACT	/		
	/		
TRAIN HANDLING			
STARTS SMOOTHLY (COUPLE SPEED)		/	
STOPS SMOOTHLY		/	
USES APPROPRIATE SPEED		/	
SPOTTING CARS		/	
KICKING CARS	/		
USES BELL & WHISTLE PROPERLY	/		
USING AIR			
COMMUNICATES INTENT FIRST		/	
COUPLES HOSES SAFELY	W	W	W
OPENS ANGLE COCK SLOWLY	W	W	W
LEAVES COCK OPEN WHEN LEAVING	/		
RADIO OPERATION			
PROPER IDENTIFICATION USED		/	
CLEAR TRANSMISSIONS		/	
PROPER REPEATS USED		/	
PROPER CAR COUNTS GIVEN		/	
PROPER INTERVALS USED		/	
OBTAINED PROPER PERMISSIONS		/	
ENDS TRANSMISSIONS WITH "OVER"		/	
ENDS FINAL TRANSMISSIONS WITH "OUT"		/	

	OK	N/I	N/A
COUPLING AND UNCOUPLING			
COUPLES AT >4 MPH		/	
ALIGNS DRAWBAR USING PROPER BODY MECHANICS		/	
LEAVES SUFFICIENT SPACE(50') BETWEEN CARS	/		
STRETCHES JOINTS	/		
SECURES EQUIPMENT	/		
LEAVES EQUIPMENT IN CLEAR	/		
OPENS KNUCKLES	/		
		/	
HANDBRAKES			
USES PROPER PLATFORM			
SUFFICIENT # APPLIED			
PROPER BODY MECHANICS	/		
PUSH / PULL TEST	/		
	/		
SWITCHES			
PROPER BODY MECHANICS			
USES 2 HANDS			
CHECKS SWITCH POINTS	/		
CHECKS TARGETS & ROUTE TO BE USED	/		
	/		
POINT PROTECTION			
OBSERVES TRACK TO USED			
UNDERSTANDS PPZ			
IN POSITION TO OBSERVE PPZ LIGHT			
	/		
HAND SIGNALS		/	
PROPER SIGNAL USED	/		
IN VIEW OF OPERATOR		/	
SIGNAL GIVEN DISTINCTLY			
SAFETY			
LOOKS BEFORE CROSSING TRACKS	/		
DOES NOT WALK BETWEEN TRACKS	/		
DOES NOT STEP ON RAILS	/		
AWARENESS OF SURROUNDINGS	/		
GENERAL			
ASKS PERTINENT QUESTIONS			
EAGERNESS TO LEARN	/		
RESPONSIVE TO DIRECTIONS & CRITICISM	/		
YARD KNOWLEDGE	/		
		/	

COMMENTS NEEDS MORE TRAINING. COMMUNICATION NEEDS TO BE WORKED ON AS WELL AS READING LISTS.

OK = SATISFACTORY PERFORMANCE N/I = NEEDS IMPROVEMENT, MORE TRAINING REQUIRED N/A = NOT APPLICABLE

TRAINERS: YOU MUST FILL OUT AND SUBMIT EVALUATION FORM DAILY TO QUALIFY FOR THE TRAINING RATE

Appendix C - TC Order Regarding Revisions to Railway Employee Minimum Qualification Standards

On 21 December 2007, the Minister of Transport, pursuant to Section 19(1)(a) of the *Railway Safety Act* (RSA), ordered all federally regulated railway companies to develop and file a rule to update and replace CTC 1987-3 RAIL, *Railway Employee Qualification Standards Regulations* (see Appendix C). The revised rule should include, at a minimum, the following:

1. Definitions similar to that of the *Railway Employee Qualification Standards Regulations.*

2. This rule will apply only to any occupation category and any railway position directly engaged in the movement or control of equipment in yard service or on main track and railway employees authorized to operate cranes or other machines moving equipment (e.g. Locomotive Engineer, Conductor, Remote Control Operator, Yard Foreman, Hostler, Rail Traffic Controller).

3. A description of the training programs for each occupational category established by the railway company.

4. Identification and establishment of certification standards for:

- Each category identified in (No. 2.) above;
- Classroom training instructors;
- On-job training instructors; and
- Contract training inspectors/consultants.

5. Criteria for testing knowledge shall include but not be limited to:

- Training and examination in the railway's rules, federal regulatory requirements, and practices for the safe operation of trains (including crossing safety);
- Covering the following subjects: personal safety practices, operating practices, equipment inspection practices, train handling practices, and compliance with federal safety rules and regulations; and
- Accurately measuring the person's knowledge of the covered subjects.

6. The development and identification of the certification process will include the following:

- Testing knowledge
- Minimum passing marks
- Issuance of certificate
- Monitoring performance
- Refresher training, etc.

7. Criteria of training programs and consultation to include:

- A railway company shall establish and modify its employee training programs in consultation with relevant associations and organizations representing employees in the occupational category identified in no. 2 above.

- Within a specified time period, to be determined after the coming into force of these rules, a railway company shall file with the Department a description of all employee training programs related to each occupational category.

- Within a specified time period to be determined after any change is made to an employee training program a railway company shall file with the Department a description of the change.

8. Criteria for monitoring operational performance of occupational categories i.e., criteria regarding yearly reporting to the Department on its training program, to include:

- Number of employees in each occupational category who took part in training;
- Successes/failures;
- Follow-up action taken.

Regulatory Process

As required under subsection 19(2) of the RSA, each relevant association or organization (as defined in subsection 4(1) of the RSA) likely to be affected by the implementation of the new rules must be given a period of sixty days to consult with the federally regulated railway companies on their proposed rules before these companies file them with the Minister.

Department Review and Position

Given the above, the attached Order be issued to all federally regulated railway companies and that they be given 10 months to submit their proposal. Following any subsequent approval, the new rule would not come into effect until all federally regulated railway companies are signatory to it, adequate training is scheduled for these employees, and the *Railway Employee Qualification Standards Regulation,* SOR/87-150, is revoked by the Governor in Council.