Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

RAILWAY INVESTIGATION REPORT

R09W0118

MAIN-TRACK TRAIN COLLISION

CANADIAN NATIONAL TRAIN NO. M30131-27 AND CANADIAN NATIONAL TRAIN NO. Q10131-27

MILE 104.32, REDDITT SUBDIVISION

JONES, ONTARIO

28 JUNE 2009

Canada

Railway Investigation Report

Main-Track Train Collision

Canadian National Train No. M30131-27 and Canadian National Train No. Q10131-27 Mile 104.32, Redditt Subdivision Jones, Ontario 28 June 2009

Report Number R09W0118

Summary

On 28 June 2009 at 0631 Central Daylight Time, while proceeding westward on the Redditt Subdivision, Canadian National train Q10131-27 (Train 101) collided with the tail end of Canadian National train M30131-27 (Train 301), which was stopped on the main track at Mile 105.70. As a result of the collision, the four tail-end intermodal cars (six platforms in total) from Train 301 and the three head-end locomotives from Train 101 derailed. The locomotive engineer from Train 101 was transported to hospital with minor injuries.

Ce rapport est également disponible en français.

Other Factual Information

On 27 June 2009, the Redditt Subdivision sustained heavy rain and winds ranging from 27 km/h to 37 km/h. As a result of the severe weather, power outages occurred throughout the subdivision for extended periods of time. Throughout the early morning of 28 June 2009, power off indications were displayed on the rail traffic controller (RTC) screens. After these conditions were reported to Canadian National's (CN) signal department and the hydro company, it was determined that the area including Favel (Mile 99.30) and Jones (Mile 106.00), Ontario, would be without main power for up to 24 hours (see Figure 1). Signal maintainers were sent to those locations to deal with the signal problems. They worked through the night to address the power outages. Because of the power outage, the Redditt Subdivision RTC was unable to line signals in the field and had to issue several *Canadian Rail Operating Rules (*CROR*)* Rule 564 (d), "Authority to Pass Stop Signal at Restricted Speed" [1] to trains at various locations.

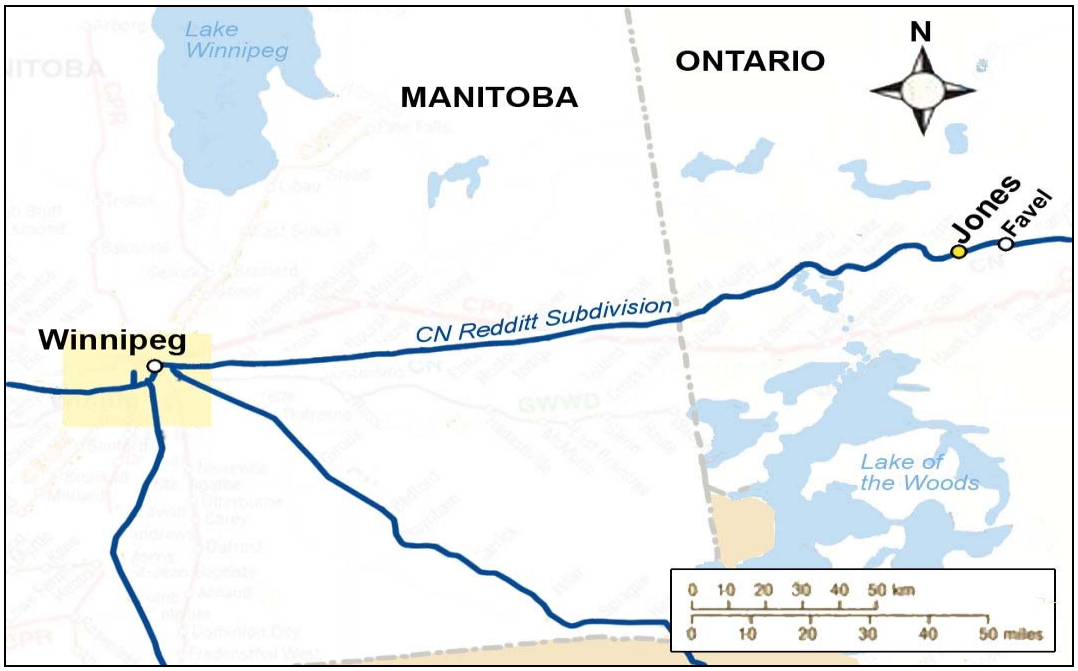

Figure 1. Accident location on the Redditt Subdivision (source: Railway Association of Canada, *Canadian Railway Atlas*)

At 0316 [2] on 28 June 2009, Train 301 departed Sioux Lookout, Ontario, destined for Winnipeg, Manitoba, and proceeded westward on the Redditt Subdivision. The train was powered by three head-end locomotives hauling 94 cars (49 loads and 45 empties). It was approximately

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1 RESTRICTED speed is "a speed that will permit stopping within one-half the range of vision of equipment, also be prepared to stop short of a switch not properly lined and in no case exceeding SLOW speed. When moving at Restricted Speed, be on the lookout for broken rails. When a broken rail is detected, the movement must be stopped immediately and must not resume until permission is received from the RTC or Signalman." SLOW Speed "is speed not exceeding fifteen (15) miles per hour."

2 All times are Central Daylight Time (Coordinated Universal Time minus five hours).

7540 feet long and weighed about 6851 tons. The crew consisted of a locomotive engineer and a conductor. They were both familiar with the subdivision, met fitness and rest standards, and were qualified for their respective positions.

At 0350 on 28 June 2009, Train 101 departed Sioux Lookout destined for Winnipeg and proceeded westward on the Redditt Subdivision following Train 301. The train was powered by three head-end locomotives hauling 70 cars (59 loads and 11 empties). It was approximately 11132 feet long and weighed about 10603 tons. The crew consisted of a locomotive engineer and a conductor. They were both familiar with the subdivision, met fitness and rest standards, and were qualified for their respective positions.

At 0600 on 28 June 2009, the day shift RTC came on duty at CN's Rail Traffic Control Centre in Toronto, Ontario. A transfer was conducted between the night and day shift RTCs during which train movements, weather conditions, and power off conditions on the Redditt Subdivision were discussed. The day-shift RTC ("the RTC") was qualified for the position and met company and regulatory fitness and rest standards.

The Accident

As Train 301 approached Favel (Mile 99.30), it encountered a stop signal and was brought to a stop. The RTC issued a CROR Rule 564 (d), "Authority to Pass Stop Signal at Restricted Speed." The crew copied the authority, after which the train departed and proceeded to Jones at restricted speed. The RTC indicated that Train 301 would likely encounter a stop signal at Jones and that a signal maintainer would likely be working to restore signal 1057 at Jones East (Mile 105.79). On arrival at Jones East at 0610:00, Train 301 encountered extinguished signals and came to a stop with its tail end just west of signal 1043 (that is, advance signal to Jones East) located at Mile 104.25.

Upon arrival at Jones East, Train 301 crew observed a signal maintainer who had started the generator at the signal bungalow. At 0616:41, the RTC's screen indicated that the power was back on at Jones East. At 0617:32, the RTC requested a permissive signal for Train 301 at Jones East, and at 0617:49, the signal cleared on the RTC's screen. Signal records indicated that the signal cleared in the field at 06:17:53.

With power restored, the signal maintainer and the RTC expected that the signal aspect would be restored and that Train 301 would proceed westward. However, in the field, the signal aspects remained extinguished, and the train remained stopped waiting for the signals to display. When Train 301's crew contacted the signal maintainer to inquire about the signals, the maintainer returned to the signal bungalow and adjusted the charge rate for the signal batteries, after which the aspects were visible to Train 301's crew. There was a delay of approximately 10 minutes from the time the signal appeared permissive on the RTC's display to the time that the signal was bright enough for the crew to positively identify it. The RTC could see on the display that Train 301 had not yet departed Jones East, but was unaware that the extinguished signal had further delayed Train 301.

Train 101 was stopped at Favel when the RTC advised the crew by radio that Train 301 was ahead in the block between Favel and Jones East on a CROR Rule 564 (d), "Authority to Pass Stop Signal at Restricted Speed." At 0618:00, the RTC issued Train 101 a CROR Rule 564 (e), "Authority to Pass Stop Signal at Reduced Speed" [3] and proceed to Jones. The Authority also indicated that there was "no equipment ahead in the block." [4] The RTC understood that the term "equipment" did not apply to trains. Train 101's crew acknowledged receipt of both messages and understood that "no equipment in the block" meant that there were no trains or movements ahead of them. Train 101 was the first train that morning at this location to receive and proceed under a CROR Rule 564 (e), "Authority to Pass Stop Signal at Reduced Speed."

At 0623:00, Train 101 departed westward from Favel on the main track. At 0630:13, Train 101 was travelling at 40 mph in throttle 8 as it exited a four-degree right-hand curve (in the direction of travel) and observed signal 1043 (advance signal to Jones East), about 1200 feet ahead. Train 101's crew observed a restricting signal indication and the tail end of Train 301 stopped on the main track clear, and just west of, the signal. At 0630:37, Train 101's locomotive engineer initiated an emergency brake application. Anticipating the impending collision, the crew exited the rear cab door of lead locomotive CN 2695 and moved toward the tail end of the locomotive. The locomotive engineer climbed onto the footboard between the lead and second unit while the conductor remained on the rear platform deck. At 0631:00, while travelling at 29 mph, Train 101 struck the tail end of Train 301. At 0631:23, Train 101 came to rest at Mile 104.31 (see Photo 1). The conductor had jumped clear of the wreckage; the locomotive engineer had held on to the locomotive. The locomotive engineer sustained minor injuries.

Photo 1. Derailed lead locomotive number CN 2695

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[3] CROR defines "Reduced Speed" as a speed that will permit stopping within one-half of the range of vision of equipment. When an authority indicates that there is "no equipment in the block," a train may travel at track speed.

[4] CROR defines a block as a length of track of defined limits, the use of which by a train or engine is governed by block signals, cab signals, or both.

As a result of the collision, Train 301 experienced an undesired emergency brake application. Train 301's crew contacted the RTC and indicated that the train was stopped in emergency at Jones and they were going to inspect the train. The RTC immediately contacted Train 101's crew to advise them that Train 301 was stopped ahead of them. Using a portable radio, Train 101's crew responded that they had collided with the tail end of Train 301.

Approximately two hours later, CN police arrived at the site, and the crew from Train 101 was transported to hospital. The weather at the time of the accident was rainy with fog, but signal visibility was not impeded. Winds were from the east at 19 km/h. The temperature was approximately 14°C.

Site Examination

Site examination revealed that the four tail-end inter-modal cars (6 platforms in total) from Train 301 had derailed and come to rest approximately 75 feet north of the main track. The three locomotives from Train 101 had derailed with the lead locomotive CN 2695, coming to rest down an embankment on its side (seeFigure 2).

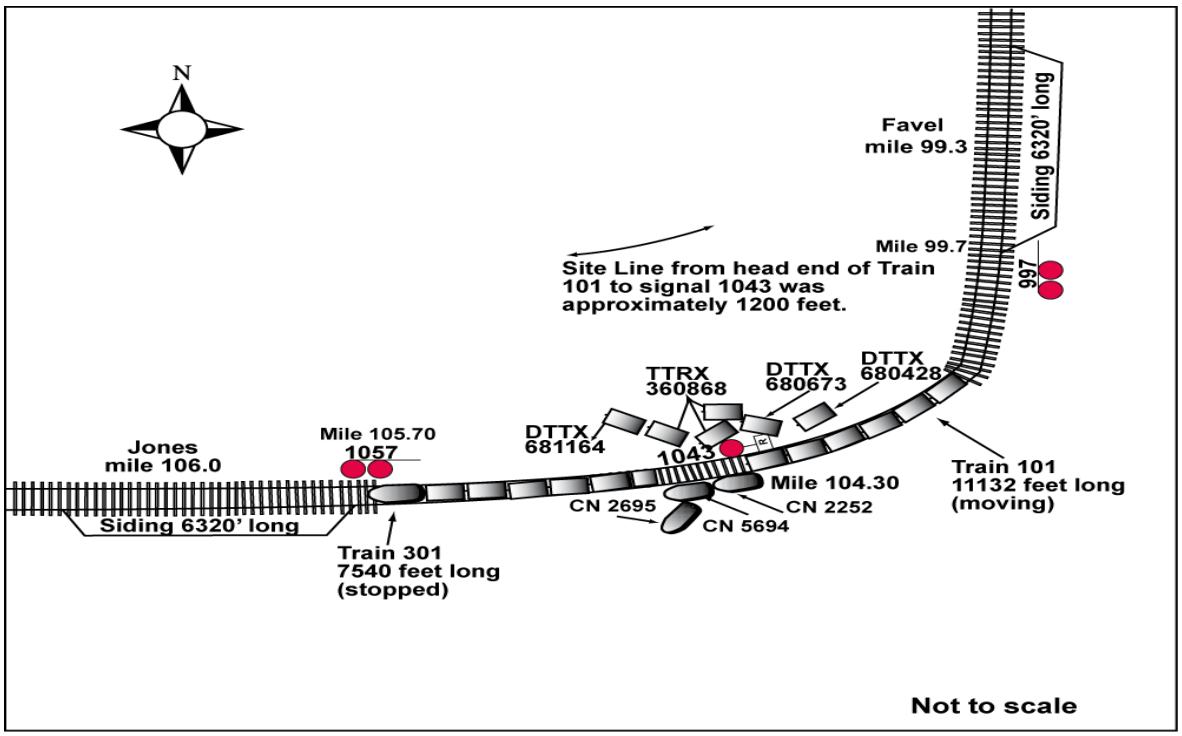

Figure 2. Track layout and derailed rolling stock location

All derailed equipment was heavily damaged and approximately 200 feet of track was destroyed.

Stopping Distance for Train 101

Recorded data recovered from the locomotive event recorder indicated that from the time Train 101 was placed into emergency until it came to a stop, the train travelled a distance of 1690 feet. TSB calculations determined that, under ideal conditions, at a speed of 40 mph, Train 101 required at least 1833 feet to safely come to a stop as a result of an emergency brake application.

Subdivision and Track Information

The Redditt Subdivision begins at Mile 0.0 in Sioux Lookout, Ontario, with increasing mileage westward toward Winnipeg, Manitoba. It consists mainly of single main track. The authorized timetable speed in the vicinity of the accident was 45 mph for freight trains and 50 mph for passenger trains. All movements are governed by centralized traffic control (CTC), as authorized by CROR. The subdivision is supervised by a CN RTC located in Toronto, Ontario.

In the vicinity of the derailment, the Redditt Subdivision is a single main track oriented in an east–west direction that ascends slightly toward the west. From Mile 103.85 to Mile 104.10, there is a four-degree right-hand curve, in the direction of travel. When exiting the curve, signal 1043 (advance signal to Jones East) is visible from approximately 1200 feet. From near the exit of the curve to control signal 1057 at Jones East, the track is tangent with no elevation by design.

The rail was 132-pound Sydney Carbon steel continuous welded rail manufactured in 1975 and laid on 8-foot 6-inch concrete ties. The rail was fastened with Pandrol clips, four per tie, with composite plastic and steel insulators. The ballast was crushed rock (two and one-half inches) with full shoulders and cribs. The track was located on raised fill, approximately 20 feet in height, with good drainage. The track was inspected according to regulatory and company requirements. No defects were reported in the derailment area during the most recent inspection.

CROR Definitions and Rules

Within CROR, the following definitions apply:

> EQUIPMENT is defined as one or more engines and/or cars that can be handled on their own wheels in a movement.
> MOVEMENT(S) is the term used in these rules to indicate that the rule is applicable to trains, transfers, or engines in yard service.
> TRACK UNIT (TU) is a vehicle or machine capable of on-track operation utilized for track inspection, track work, and other railway activities when on a track.
> TRAIN is defined, in part, as an engine that is intended to operate at speeds greater than 15 mph: without cars or with cars and equipped with a train information and braking system or remote control locomotive at the rear; or with cars including a caboose occupied by a crew member, with cars in passenger service or a track unit when so designated.

A pass-stop authority allows a train to pass a specified stop signal. The RTC blocks a train from one controlled block signal to the next controlled block signal. In this occurrence, Train 101 was blocked from signal 997 at Favel to signal 1057 at Jones. The authority specifies the stop signal number that the train is authorized to pass, but does not specify to which signal number the train is authorized. The rule does not differentiate between the next signal being an advance signal, an intermediate signal, or a control block signal. The next signal for Train 101 was signal 1043.

CROR Rule 564, "Authority to Pass Stop Signal," states in part that

> (a) A train or transfer must have authority to pass a block signal indicating Stop.
>
> (b) The RTC may authorize the train or transfer to pass the signal but before doing so must:
>
> (i) Ensure that there are no conflicting trains or transfers within, or authorized to enter, the control block affected (other than one authorized by rule 567 or 577); and
>
> (ii) Provide protection against all opposing trains or transfers.
>
> (d) The train or transfer so authorized need not stop at the signal but must positively identify the signal by number; operate at RESTRICTED speed to the next signal or Block End sign, and must be governed by Rule 104.1 at spring switches, Rule 104.2 at dual control switches, Rule 104.3 at power-operated switches and Rule 611 at automatic interlockings.
>
> (e) When a known condition prevents clearing of controlled signals into an affected block, the RTC may authorize operation at REDUCED speed to the next signal or Block End sign. The train or transfer will be advised whether or not equipment is present in the block. REDUCED speed remains applicable unless the block is known to be clear of equipment. REDUCED speed commences when the leading piece of equipment has passed entirely through the controlled location. The train or transfer must approach the next signal prepared to stop and there be governed by the indication displayed.

Issuing and copying a CROR Rule 564 (e), "Authority to Pass Stop Signal at Reduced Speed," is less common than CROR Rule 564 (d), "Authority to Pass Stop Signal at Restricted Speed"; pass-stop authorities at reduced speed with equipment in the block are rarely issued.

Another Canadian Class 1 railway has the CROR Rule 564 (e), "Authority to Pass Stop Signal at Reduced Speed," provisions. However, that railway permits its use only to allow locomotives to return to their own train during mainline switching. For other operational situations and in the interest of safety, that railway issues CROR 564 (d) authorities.

CN RTC Manual

Item 760 of CN's RTC Manual, which deals with issuing a CROR Rule 564 (e), "Authority to Pass Stop Signal at Reduced Speed," states in part:

1. Reduced speed application can only be applied for "KNOWN CONDITIONS" and RTC must obtain permission from Chief Dispatcher/MCO who will ensure criteria for utilization have been met. The following are examples of known conditions: electrical storm, forest fire, signal bungalow damage, planned outage, switch problems at a control location, imperfectly displayed signal and other conditions causing similar outages.
2. After meeting the requirements of Item (1), one of three options must be fulfilled prior to issuing a CROR Rule 564 (e) -Authority to Pass Stop Signal at Reduced Speed. These options are:
    - The block must first be patrolled by a Track Foreman.
    - A preceding movement must have operated through the block at RESTRICTED SPEED and reported that there are no misaligned switches or broken rails in the block.
    - A station re-check must be performed.
3. When issuing a Reduced Speed Rule 564 Authority the RTC must specify the route and indicate whether equipment is present in the block or not.

RTC and Operating Crew Rules Training at CN

Before 2004, CN operating crews received a one-day first aid course and a three-day CROR refresher course, including a re-qualification exam to maintain qualifications, every three years. CN RTCs received a four-day CROR training course and a re-qualification exam to maintain qualifications. In both cases, the programs were conducted by experienced rules instructors and included discussion of numerous operating scenarios.

In 2004, CN changed the way operating employees and RTCs were instructed on CROR. Instead of a three- or four-day rules review every three years, RTCs and operating employees would now be instructed by the employee's immediate supervisor (mentor), one day annually. A re-qualification exam would still be administered once every three years. The mentoring process follows a predetermined curriculum with a focus on rules associated with productivity.

Supervisors receive rule instruction at a course for supervisors, once every three years. Some supervisors may not have worked in the craft and may have limited experience with applying the CROR.

During CROR training and the yearly mentoring sessions, training material is provided with practice questions for review. All material provided in the year one and year two review sessions closely mirrors the exam that the employees receive in year three. The training material deals with a train operating on CROR Rule 564 (d), "Authority to Pass Stop Signal at Restricted Speed" to the next signal or block end sign. Although the training material deals with CROR Rule 564 (e), "Authority to Pass Stop Signal at Reduced Speed," it does not deal with the definition of "EQUIPMENT" or indicate that the next signal could be an intermediate or an advance signal in the direction of movement. For RTCs, there is no specific instruction on interpretation of CROR definitions.

Traffic Control Systems

Train control systems provide for safety in the operation of trains, in track work, and in maintenance on one or more main tracks. CTC is the preferred method of rail traffic control used by railways for main track in Canada. CTC track circuitry and associated software permits the system to display signal aspects (lights) in the field and corresponding track occupancies on RTC screens. In the field, the system displays a combination of red, yellow, and green signal aspects to train crews. The combination of lights governs the speed at which trains may operate and the limits within which trains operate; they also indicate whether the block ahead is occupied by another movement. A track occupancy on the RTC screen normally indicates the presence of a train. However, it can also indicate other operational situations (for example, the presence of a broken rail, an open switch, or an object shunting the track circuit between the two rails).

When an RTC requests signals for trains, the CTC system determines how permissive the signals will be. CTC allows RTCs to monitor a train's progress along blocks in a subdivision. However, it does not display the train's exact location within a block; it indicates only the block that the train is in. CTC does not provide any indication that a train may be about to pass beyond an authorized point.

When CTC fails, trains are issued written authorities by the RTC centre to proceed. These written authorities rely on both crew and RTC knowledge and correct application of operating instructions contained in the CROR and *RTC Manual.* In CN's RTC system, some restrictions contained in authorities, such as follow-behind track occupancy permits, can be auto-populated. However, the system does not auto-populate any restrictions for CROR Rule 564 (e) authorities.

Battery Backup for Signal System

Certain signal control locations, such as Jones, will power other signals. In such cases, the signal bungalow is hooked up to rechargeable backup batteries that can power the system and keep it working during limited power outages. The generator at Jones is not an auto-start generator. Therefore, after the batteries have been depleted, the signal system receives no power until a maintainer manually starts the generator. In situations in which the power has been off for an extended period of time, backup batteries in the field may fully deplete. Battery depletion can result in the extinguishing of signal aspects in the field, causing track occupancies to appear on RTC screens and preventing the RTC from clearing signals.

Once power is restored by generator after an extended power outage, there is a slight delay before the signals display on the RTC screen. Also, there is a slightly longer delay before signal aspects display in the field. After the power has been off for an extended period, batteries may take up to 10 minutes to charge to a level that will ensure reliable operation of the control circuits. During that time, the signal aspects initially appear extinguished in the field even though power is supplied.

Positive Train Control

Since 1990, the National Transportation Safety Board has had positive train control (PTC) on its "most wanted list" of safety improvements. PTC refers to automated technology that can prevent train collisions, overspeed derailments, overlaps of authority, and other human factors–related occurrences. Most PTC systems are based on global positioning system technology and can either operate in dark territory or be linked into existing signal systems. The train reports its position to the control centre over a wireless data link. The control centre's safety interlocking logic uses data from all trains to issue limits-of-movement authority and speed limits to each train, keeping safe separation between trains.

The train's onboard computer monitors the data against actual train location and speed to determine potential and actual unsafe conditions. If one train is approaching another, is nearing the end of its limits, or is exceeding its speed limit, the onboard computer warns the locomotive engineer, who is expected to take appropriate action. If action is not taken, the onboard computer automatically initiates a safety brake application to either slow or stop the train.

PTC technology is currently in limited use on at least two Class 1 railways in the United States. In the U.S., it has been mandated that by 2015, railways must install PTC on all rail lines used by passenger trains and lines used by freight trains that move toxic inhalation hazardous materials. In Canada, PTC systems have not been implemented on any Class 1 railway, except on a limited trial basis. However, the Quebec North Shore and Labrador Railway has conducted a pilot project using a proximity detection device that initiates a train brake application if a locomotive engineer fails to respond to an alert.

Other Related Occurrences

On 27 October 2007, a collision between CN trains 417 and 342 at Peers, Alberta, derailed 1 locomotive and 27 cars and damaged an additional 14 cars. There were no serious injuries. The TSB investigation determined that intervention from a PTC-type system would have compensated for the locomotive engineer's loss of situational awareness and prevented the collision (R07E0129).

On 07 April 2008, a collision between CP trains 498 and 292 at Ralph, Saskatchewan, derailed seven cars on Train 292 and two cars on Train 498. A subsequent fire involving dangerous goods resulted in the evacuation of local residents. The investigation determined that PTC has the potential to significantly reduce collisions between trains (R08W0058).

Analysis

No equipment or track defects were considered causal in this occurrence. The analysis focuses on train operations in CTC territory during extended power outages, the use of CROR Rule 564 (e), railway signal systems, and training for operating crews and RTCs.

The Accident

On the day before the accident, severe weather had resulted in power outages along the Redditt Subdivision for extended periods of time. It was determined that the block occupancy was caused by a power-off condition. Before the accident, after several trains had traversed the subdivision at restricted speed on a CROR Rule 564 (d) authority, a decision was made at the RTC centre to issue CROR Rule 564 (e) authorities and to permit trains to travel the subdivision at reduced speed rather than restricted speed. Train 101 was the first train to receive and proceed under a CROR Rule 564 (e) authority in which they were advised that there was no equipment in the block. This authority permitted the train to travel at track speed while approaching the next signal prepared to stop. The collision occurred after an extended power outage, when Train 101, travelling westward at track speed (40 mph) on a CROR Rule 564 (e) reduced speed pass stop authority, exited a curve and was unable to stop before colliding with the tail end of Train 301, which was ahead in the controlled block.

Once power was restored at Jones East (Mile 105.30), the RTC gave authority to Train 301 to depart westward. However, the signal aspects remained extinguished in the field. Consequently, Train 301 remained stopped waiting for the signal aspects to display. The interval from the time the signal appeared permissive on the RTC display to the time the signal was sufficiently bright for identification by the crew was about 10 minutes. Once power was restored, the signal batteries, which were fully depleted, had to recharge before the signals could be displayed in the field. However, the signal indications appeared almost immediately on the RTC screen, and the RTC expected Train 301 to depart. The RTC could see on the display that Train 301 had not yet departed Jones East, but was unaware that the signal aspects at Jones East remained extinguished, further delaying the train.

The RTC had advised Train 101 that Train 301 was ahead in the block, and yet, a couple of minutes later, the RTC issued Train 101 a CROR Rule 564 (e) authority indicating that there was "no equipment ahead in the block." The RTC did not consider "EQUIPMENT" to mean a train. The crew of Train 101 understood "no equipment in the block" to mean that there were no trains or movements ahead. Consequently, the crew believed that they were clear to the next control signal at Jones (Mile 105.70) and, as permitted by the authority, that they could proceed at track speed. The crew neither questioned the new information provided by the RTC nor considered that they were governed by the advance signal at Jones East.

CROR Rule 564 ("Authority to Pass a Stop Signal") states, in part, that once authorized to pass a block signal indicating stop, the train may operate to the next signal (in this case 1043) prepared to stop at that signal. In this occurrence, although the authority was from Favel (Mile 99.7) to Jones East (Mile 105.70), there was a restricting signal indication at the advance signal to Jones

East located at Mile 104.30. Train 101 was therefore also governed by the advance signal, which authorized it to proceed at restricted speed, not exceeding 15 mph beyond Mile 104.30 to Jones East.

To be compliant with CROR Rule 564 and to be able to stop within one-half the range of vision of equipment, TSB calculations determined that, under ideal conditions, at a speed of 40 mph, Train 101 required at least 1833 feet to stop after an emergency brake application. The crew of Train 101 would therefore need to be able to see Train 301, which was just west of the advance signal at Mile 104.30, from a distance of approximately 3700 feet. However, as Train 101 exited the curve, that signal was visible only for 1200 feet. Consequently, while travelling at 40 mph, the crew of Train 101 did not have sufficient distance to safely stop the train at the advance signal and before colliding with the tail end of Train 301.

CROR Definitions of "Equipment" and "Train"

CROR defines the term "EQUIPMENT" as one or more engines and/or cars that can be handled on their own wheels in a movement. The term "MOVEMENT" means trains, transfers, or engines in yard service. The definition of equipment does not specifically include the word "trains." In contrast, the definition of "TRAIN" is specific and includes a locomotive that is intended to operate at speeds greater than 15 mph, with or without cars and equipped with a train information and braking system or remote control locomotive at the rear. A "TRAIN" is always considered to be equipment, but "EQUIPMENT" may not always be a train. Consequently, the CROR definition of "EQUIPMENT" can be subject to interpretation and as such presents a risk that that the term may not be clearly understood, which increases the risk of collision.

CN Rules Training

In this occurrence, the term "EQUIPMENT" was incorrectly used by the RTC, and the crew of Train 101 did not consider that they were still governed by the advance signal to Jones East. This situation suggests that CN RTCs and train crews may not fully understand CROR definitions or the requirements associated with CROR Rule 564, "Authority to Pass Stop Signal."

RTCs receive no specific instruction on interpretation of CROR definitions. CN instruction on the application of CROR Rule 564 indicates that a train must move at the prescribed speed to the next signal or block end sign. However, at the time of the occurrence, the instruction did not define that the next signal could be an intermediate, advance, or control block signal in the direction of movement. Some minimal instruction deals specifically with CROR Rule 564 (e), "Authority to Pass Stop Signal at Reduced Speed."

CN supervisors receive rules instruction once every three years. In addition to mentoring, they are tasked with providing answers to employee questions concerning a rules interpretation or application. However, in some cases, the supervisors may not have worked in the craft for an extended period of time, if at all. In such cases, they have limited experience in applying CROR. Unlike the pre-2004 instructor-led rules classes, the CN mentoring process provides less opportunity to review various rule scenarios that may emerge in classroom discussion. The

current mentoring process follows a predetermined curriculum with a focus on rules associated with productivity. In addition, all material provided in both the year one and the year two review sessions closely mirrors the exam that the employees receive in year three. This training approach limits employee exposure to every area of the CROR. Without in-depth rule instruction led by experienced rule instructors, employees may not gain the required knowledge from discussing various operating scenarios associated with proper application of the rules, increasing the risk that a rule will not be fully understood and correctly applied.

Mitigating the Risk of Collisions

Because of extended power outages, train crews could no longer operate on signal indications and were required to receive written pass stop authorities from the RTC to proceed at restricted or reduced speed in the block from Favel (Mile 99.70) to Jones East (Mile 105.70). The proper application of these administrative defenses requires that all parties involved have the same understanding of the instructions and that they take appropriate action. Otherwise, as in this case, the administrative defenses are rendered ineffective with no failsafe backup.

In contrast, when implemented in conjunction with existing administrative defenses, physical defenses, such as a PTC, offers a backup system. The onboard computer in these types of backup warns the locomotive engineer if a train is approaching another train, is near the end of its limits, or is exceeding its speed limit. The locomotive engineer is then expected to take appropriate action. If the locomotive engineer does not respond appropriately, the onboard computer will automatically initiate a safety brake application to either slow or stop the train. PTC has the potential to significantly reduce the risk of collision between trains.

CROR Rule 564 (e), "Authority to Pass Stop Signal at Reduced Speed"

As compared with CROR Rule 564 (d), CROR Rule 564 (e) can be used to minimize operational delays by permitting higher train speeds through an affected block under certain situations. At CN, before a CROR Rule 564 (e), "Authority to Pass Stop Signal at Reduced Speed" can be issued, the RTC must ensure that a known condition is preventing lining of the signals for a train. In addition, one of three options must be fulfilled: the block must first be patrolled by a track foreman, or a preceding movement must have operated through the block at RESTRICTED SPEED and reported that there are no misaligned switches or broken rails, or a station re-check must be performed.

In this occurrence, the power outage was considered to be the known condition, and Train 301 had already proceeded through the block at restricted speed. CN's criteria for issuing a CROR Rule 564 (e), "Authority to Pass Stop Signal at Reduced Speed" had therefore been met. However, other Class 1 railways do not use CROR Rule 564 (e) authorities, except in very specific circumstances, because of the associated risks.

Automatic Updates on RTC Screen for Operating Restrictions

In CN's RTC system, some restrictions contained in authorities (for example, follow-behind track occupancy permits) can be auto-populated. This system feature significantly minimizes the possibility of omission or misinterpretation of the restriction. However, the RTC system

does not auto-populate restrictions for CROR Rule 564 (e) authorities. When applying a reduced speed pass stop authority, the RTC must determine whether there is equipment in the block and then manually enter the relevant information. Without automatic updates to the RTC screen to indicate CROR Rule 564 (e) restrictions when equipment is in the block, the RTC must make a determination and manually enter the information, increasing the potential for misinterpretation and incorrect application of the rule.

Findings as to Causes and Contributing Factors

1. The collision occurred after an extended power outage, when Train 101, travelling westward at track speed (40 mph) on a *Canadian Rail Operating Rules* (CROR) Rule 564 (e) reduced speed pass stop authority, exited a curve and was unable to stop before passing the advance signal and colliding with the tail end of Train 301, which was ahead in the block.

2. After issuing Train 301 an authority to proceed westward, the rail traffic controller (RTC) had expected the train to depart and was unaware that the signal aspects at Jones East remained extinguished, further delaying the train.

3. The RTC advised Train 101 that Train 301 was ahead in the block, and yet, shortly after, the RTC issued Train 101 a CROR Rule 564 (e) authority indicating that there was "no equipment ahead in the block." The RTC did not consider "EQUIPMENT" to mean a train.

4. The crew of Train 101 understood the new RTC information to mean that there were no trains or movements in the block ahead. Train 101's crew members neither questioned the new RTC information nor considered that they were governed by the advance signal at Jones East.

5. At 40 mph, Train 101 required 1833 feet to stop safely in an emergency. Because Train 301 was just west of the advance signal at Mile 104.30 and was visible only for 1200 feet as Train 101 exited the curve, Train 101 did not have sufficient distance to stop safely at the advance signal and before colliding with Train 301.

Findings as to Risk

1. Without in-depth rule instruction led by experienced rule instructors, employees may not gain the required knowledge from discussing various operating scenarios associated with proper application of the rules, increasing the risk that a rule will not be fully understood and correctly applied.

2. Without automatic updates to the RTC screen to indicate CROR Rule 564 (e) restrictions when equipment is in the block, the RTC must make a determination and manually enter the information, increasing the risk for misinterpretation and incorrect application of the rule.

Other Findings

1. Positive train control has the potential to significantly reduce the risk of collision between trains.

2. Other Class 1 railways do not use CROR Rule 564 (e) authorities, except in very specific circumstances, because of the associated risks.

Safety Action Taken

On 29 June 2009, Canadian National (CN) issued Notice 9014 to all chief dispatchers and rail traffic controller (RTCs) concerning Rule 564 (e) and *RTC Manual* Items 759 and 760. The notice prohibits the use of reduced speed Rule 564 authority when there is equipment (including trains/transfers) ahead in the block.

All other requirements governing the issuance of reduced speed Rule 564 remain in effect.

On 08 September 2009, the TSB issued Rail Safety Advisory 04/09, "Reduced Speed Pass Stop Authority during Power Outage Situations." The Rail Safety Advisory acknowledged CN's issuance of CN's Notice 9014, but it also identified that during a power outage it is not possible to perform some of the checks necessary to verify the status of the block before issuing the *Canadian Rail Operating Rules* (CROR) Rule 564 (e), "Reduced Speed Pass Stop Authority." Specifically, it is not possible for the prior train to verify that there are no broken rails or misaligned switches behind their train, and it is not possible to do a station recheck from either end of the block.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 22 July 2010.