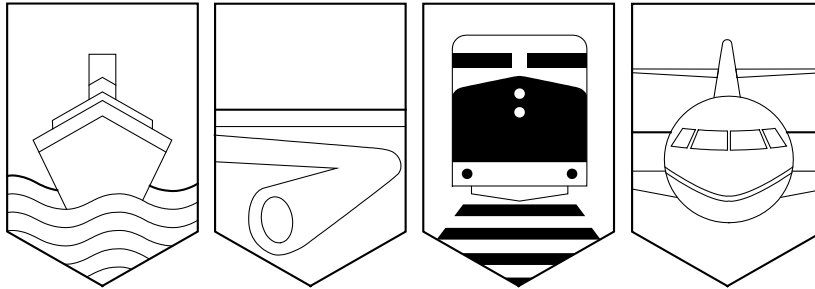




Transportation Safety Board
of Canada



RAILWAY OCCURRENCE REPORT

REAR-END TRAIN COLLISION

**CANADIAN PACIFIC LIMITED
CP FREIGHT TRAIN NO. 921-17 AND 3RD EMERY
MILE 1.5, NORTH TORONTO SUBDIVISION
TORONTO, ONTARIO
18 MAY 1995**

REPORT NUMBER R95T0152

Canada

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The *Canadian Transportation Accident Investigation and Safety Board Act* provides the legal framework governing the TSB's activities.

The TSB has a mandate to advance safety in the marine, pipeline, rail, and aviation modes of transportation by:

- conducting independent investigations and, if necessary, public inquiries into transportation occurrences in order to make findings as to their causes and contributing factors;
- reporting publicly on its investigations and public inquiries and on the related findings;
- identifying safety deficiencies as evidenced by transportation occurrences;
- making recommendations designed to eliminate or reduce any such safety deficiencies; and
- conducting special studies and special investigations on transportation safety matters.

It is not the function of the Board to assign fault or determine civil or criminal liability.

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

Railway Occurrence Report

Rear-end Train Collision

Canadian Pacific Limited

CP Freight Train No. 921-17 and 3rd Emery

Mile 1.5, North Toronto Subdivision

Toronto, Ontario

18 May 1995

Report Number R95T0152

Synopsis

A Canadian Pacific Limited (CP) westward train collided with the tail end of a stationary train at Mile 1.5 of the North Toronto Subdivision. The last two rail cars of the stationary train derailed and sustained considerable damage. The locomotive of the moving train was extensively damaged. Two crew members sustained minor injuries.

The Board determined that the collision resulted from the operation of the train at a speed at which the locomotive engineer at the controls was unable to stop the train short of stationary equipment. The effects of alcohol may have contributed to the locomotive engineer's decision to operate the train at an excessive speed. The other crew members did not apparently notice the condition of the locomotive engineer nor remind him that the train was travelling at an unsafe speed.

Ce rapport est également disponible en français.

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1.0 *Factual Information*

1.1 *The Accident*

Westward freight train No. 921-17 (train 921) originated at Toronto Yard, Mile 197.0 of the Canadian Pacific Limited (CP) Belleville Subdivision, and was destined for Windsor, Ontario. Train 921 departed the Toronto Yard and proceeded westward on the Belleville Subdivision for approximately nine miles. The Belleville Subdivision branches off at Leaside (Mile 206.3 of the Belleville Subdivision and Mile 0.0 of the North Toronto Subdivision) and the through route becomes the North Toronto Subdivision. Train 921 continued westward on the north main track of the North Toronto Subdivision. Train traffic was delayed due to congestion at a nearby switching facility and train 921 was stopped by a signal indication with the last car positioned at Mile 1.5. The train brakes had been released and the engine brake had been applied to hold the train in a stationary position.

The 3rd Emery train was a switching assignment that operated daily, servicing selected industries in and around Toronto. On the morning of 18 May 1995, the 3rd Emery was ordered at the Toronto Yard facility at 0930. The 3rd Emery departed the Toronto Yard at 1100 destined for Leaside, where the crew had switching to perform.

On approach to the Leaside Yard on the north main track, the 3rd Emery conductor realized that they were mistakenly lined to crossover to the south main track. The locomotive engineer brought the train to a stop, but not before having passed beyond Signal 2063-2. The rail traffic controller (RTC) was contacted by radio and advised of the mis-routing. The RTC was not aware that the 3rd Emery had switching to perform at the Leaside Yard. He subsequently authorized a reverse movement so that the train could physically clear the signal and crossover and be routed on the north main track. Access to the Leaside Yard is gained through an electrically locked, hand-operated switch located on the north main track approximately 1,500 feet west of Signal 2063-2.

The block immediately ahead of the 3rd Emery was occupied by the rear end of train 921. Signal 2063-2 displayed a stop indication. In order to generate a restricting signal indication that would permit movement of the 3rd Emery into that block, it was necessary for the RTC to activate a control known as a "call on" feature. The RTC activated the "call on" feature and a restricting signal was displayed. He did not advise the 3rd Emery crew that train 921 was ahead of them in the block, nor was he required to do so by rule

¹ All times are eastern daylight time (Coordinated Universal Time (UTC) minus four hours) unless otherwise stated.

or company procedure.

A restricting signal indication requires trains to move at restricted speed to the next signal. Restricted speed is "a speed that will permit stopping within one-half the range of vision of equipment" and in no case in excess of 15 mph.

The 3rd Emery crew accepted the restricting signal and entered the block, lined the switch at Leaside and moved clear of the north main track. When switching was completed, the train re-entered the main track and the switch was restored to the normal position. The switch had been left reversed while the 3rd Emery was clear of the north main track.

The 3rd Emery crew members then contacted the RTC and informed him that they were finished at Leaside and would eventually require routing onto the MacTier Subdivision. They resumed their westward movement and accelerated up to 26 mph, even though they believed that they were still operating under the restricting signal indication. At approximately 1220, the 3rd Emery rounded a two-degree curve and came upon the tail end of train 921 that was stopped ahead of them. The locomotive engineer placed the train brakes in emergency, but it was too late to avert the collision between the lead locomotive of the 3rd Emery and the rear-end car of train 921. The last two cars of train 921 derailed as a result of the collision.

1.2 Damage to Equipment

The 3rd Emery locomotive and the last car of train 921 were extensively damaged. The second last car of train 921 sustained minimal damage.

1.3 Other Damage

Approximately 100 feet of track sustained minor damage. The fence along the north right-of-way was destroyed for a distance of 100 feet.

1.4 Personnel Information

The crew of the 3rd Emery consisted of a locomotive engineer, a conductor, a train person and a conductor trainee. The conductor was located in the caboose and the rest of the crew members were in the locomotive operating compartment.

The locomotive engineer, conductor, train person and conductor trainee met the duty/rest and medical fitness requirements established to ensure the safe operation of trains. All the crew members also claimed to have been fit and rested for duty; however, the locomotive engineer admitted to alcohol consumption until just after midnight (about nine and one-half hours before reporting for duty).

1.5 *Train Information*

1.5.1 *CP Train 921*

Train 921 consisted of 3 locomotives, 32 loaded cars and 56 empty cars. The train weighed about 6,250 tons and was approximately 6,430 feet in length. There were 15 dangerous goods cars on the train: 13 loaded and 2 residue. The closest dangerous goods car to the tail end of the train was the 12th car from the tail end. It was a loaded car of sulphuric acid.

1.5.2 *CP Switching Assignment 3rd Emery*

Departing the Leaside Yard after switching, the train consisted of one locomotive, four loaded cars and a caboose, weighed approximately 430 tons and was nearly 300 feet in length. There were no dangerous goods cars on the 3rd Emery.

1.6 *Mechanical Information*

The brake system on the 3rd Emery was tested by the train crew before departure from the Leaside Yard and was found to be functioning as intended.

1.7 *Method of Train Control*

Traffic on the North Toronto Subdivision is controlled by the Centralized Traffic Control System (CTC) authorized by the Canadian Rail Operating Rules (CROR) and is supervised by an RTC located in Toronto.

1.8 *Speed Requirements*

The applicable timetable states that the maximum freight train speed, unless otherwise restricted, is 50 mph. Trains handling one or more full car loads, container loads or trailer loads of special dangerous commodities must not exceed 25 mph. Trains handling loaded cars containing other dangerous goods must not exceed 35 mph.

Special dangerous commodities are those commodities identified in the Transportation of Dangerous Goods Regulations as having a higher potential to adversely affect public safety in the case of release.

1.9 Weather

The temperature was 16 degrees Celsius and the skies were clear. Visibility was unrestricted.

1.10 Recorded Information

The event recorder data indicate that, after recorded information depicting switching moves, the 3rd Emery resumed forward motion at a time of 1217:33 and a distance of 393.156 miles. The throttle was increased to the No. 5 position and the speed increased to 26 mph. There was no change in brake pipe pressure until pressure was lost, signifying an emergency brake application at a time of 1221:30 and a distance of 394.453 miles. Forward motion continued for the next 11 seconds as the speed decreased to 18 mph. At a time of 1221:41 and a distance of 394.525 miles, the speed decreased from 18 mph to 0 mph over a one-second interval. The locomotive had moved forward a total recorded distance of 1.369 miles after switching and travelled a recorded distance of 0.072 miles (380 feet) between the location where the train brakes were placed in emergency and where the train eventually stopped.

1.11 Occurrence Site Information

The track leading up to the point of impact has a two-degree curve with sight-lines restricted to approximately 500 feet by curvature and foliage. The next block signal west of Leaside governing the 3rd Emery was approximately 150 feet beyond the point of impact. It was a high-mast, staggered, double-aspect CTC signal equipped with an "R" letter plate, identified as Signal 15-2. The most restrictive signal that Signal 15-2 is capable of displaying is a "Restricting Signal."

The two derailed cars travelled through a fence and came to rest about 29 feet to the north of the north main track and 17 feet from a city street, Carsaw Road. A pedestrian overpass supported by a steel frame structure is located approximately 200 feet east of the collision site. The vertical supports of the overpass meet the ground 19 feet to the north of the north main track. These supports are not protected by barriers of any kind. This overpass is known as the MacLennan Avenue pedestrian walkway. It is used by children to reach a neighbourhood school.

1.12 Medical and Toxicological Information

The 3rd Emery crew members volunteered to submit to urinalysis for controlled substances and alcohol as requested by the railway. Samples were given at approximately 1600 on 18 May 1995 (about 3 1/2 hours after the collision). The locomotive engineer tested

negative for controlled substances but positive for alcohol at a concentration of 0.048 per cent by volume. Test results for all other crew members were negative. The clinical test results provided to CP contained the following information:

... the concentration of alcohol in urine is generally taken to be approximately 1.3 times higher than in the blood at the time of sampling. Thus, if a urine sample was found to be 0.048% alcohol, the blood concentration could be estimated at 0.037% at the time of sampling.

Further, it is also believed that the rate of elimination of alcohol from the blood averages 0.01-0.02% per hour.... If the blood alcohol concentration [of the locomotive engineer] at 16:00 hours on 18 May 1995 was 0.037%, then at 09:00 hours the concentration would have been approximately 0.142%. This rate of elimination is fairly linear until the terminal phase is reached; that is, until the concentration in the blood becomes very low.

The *Criminal Code of Canada* provides a context for the above information on blood alcohol levels. It is an offence to operate railway equipment or be in care and control of railway equipment while impaired by alcohol with a blood alcohol level of 80 milligrams of alcohol in 100 millilitres of blood (0.080 per cent by volume). While any level of alcohol can have a detrimental effect on human performance, the 0.08 per cent level is familiar to most Canadians and it can be viewed as a level above which society does not accept the safety risks of alcohol impairment of a person operating a transportation vehicle.

CP advocates zero tolerance respecting the use or possession of intoxicants, narcotics, mood altering agents or drugs by employees subject to duty and employees on duty pursuant to general rule "G" of the CROR.

None of the crew members working in proximity to the locomotive engineer reported detecting any signs of intoxication or impairment.

1.13 Canadian Rail Operating Rules

The crew members and other railway personnel have expressed a concern respecting the interpretation of CROR Rule 570 (ENTERING BETWEEN SIGNALS) and Rule 575 (DELAYED IN THE BLOCK) as they relate to this accident.

Both Rule 570 and Rule 575 permit trains to move within the block without regard to the possibility of other equipment being present within the block. These rules do not recognize the exception presented by a train entering a block on a restricting signal. The restricting signal is the only permissive signal indication that may govern a movement into a block that is already occupied.

1.13.1 CROR Rule 570 - Entering Between Signals

In the course of switching at Leaside, the 3rd Emery cleared the main track and left the switch reversed and protected. If the crew members were to consider that the signal indication they entered the block on (restricting signal) was null and void at this point, they would then have to apply CROR Rule 570 to re-enter the main track and be governed by its provision when resuming movement.

This would result in movement under a lesser

provision of restriction than that originally imposed by the restricting signal. CROR Rule 570 states, in part:

A train or engine which has entered a block between signals at a hand operated switch, equipped with an electric switch lock, must approach the next signal prepared to stop, unless or until the track is seen to be clear to the next signal and such signal displays a more favourable indication than Stop or Stop and Proceed.

Under CROR Rule 570, a movement need only be prepared to stop at the next signal and could exceed restricted speed. Under a restricting signal, a movement must not exceed 15 mph and must be able to stop within one-half the range of vision of equipment and be on the lookout for broken rail.

1.13.2 CROR Rule 575 - Delayed in the Block

If the 3rd Emery crew members had considered themselves delayed in the block, it is possible that they would have resumed their movement under the provisions of CROR Rule 575.

Rule 575 states:

When a train or engine, which has entered a block on signal indication, is stopped or otherwise delayed in the block, it must approach the next signal prepared to stop, unless or until such signal displays a more favourable indication than Stop or Stop and Proceed.

Under these provisions, a movement could exceed restricted speed and need only be prepared to stop at the next signal.

2.0 *Analysis*

2.1 *Introduction*

The 3rd Emery was operated in a manner contrary to some key operating rules that would have ensured safety. The investigation also revealed that the locomotive engineer had alcohol in his blood.

The analysis will therefore focus on the operation of the 3rd Emery and the positive test for alcohol conducted on the locomotive engineer. The rule governing the movement of trains that enter a block between signals in CTC and the rule governing trains that are delayed in a block in CTC will also be discussed.

2.2 *Consideration of the Facts*

When the 3rd Emery crew members spoke to the RTC from the Leaside Yard requesting re-routing, the RTC did not elect to advise them that there was a train in the block ahead of them. Although it would appear to have been the appropriate thing to do, this is generally avoided because it leads to the possibility of crews making inaccurate assumptions should the RTC neglect to notify them. The signal system is relied upon to ensure safety by indicating that the next block is occupied.

When the RTC caused the electronic request to be transmitted to the field, the signal system responded with the display of a restricting signal. The CTC signal system functioned as intended. Restricted speed should have been applied all the way to the next signal; the crew should have expected to encounter equipment within that block.

When the 3rd Emery rounded the curve at 26 mph, 11 mph in excess of the maximum authorized "restricted speed," and the rear of train 921 came into view, there was approximately 500 feet of sight-line. The locomotive engineer made an immediate emergency application of the train brakes and, approximately 380 feet later, contact occurred at an estimated speed of 18 mph.

The next signal for westward trains on the north track, Signal 15-2, was approximately 150 feet west of the point of contact. A train approaching Signal 15-2 displaying a restricting signal would have had to be travelling at a speed enabling it to be stopped just past

the signal. Had the rear end of train 921 not been there, and judging by the deceleration rate before the collision, the 3rd Emery would have been travelling too fast to be stopped for Signal 15-2. The 3rd Emery was therefore travelling too fast to stop for either eventuality.

Leaving the switch at the Leaside Yard reversed while the train was moved clear of the main track was most likely done to circumvent the rule requirement (CROR Rule 568) to obtain permission to re-enter the main track. The reversed switch results in the display of a track occupancy on the RTC's office control terminal, exactly the same as if the train had been left on the main track. If the crew members had asked for permission, it is possible that the RTC would have reminded them of the train ahead of them even though he was not required to do so. The restricting signal on Signal 2063-2 still applied.

2.2.1 Alcohol Involvement

There is indisputable scientific evidence that alcohol impairs human performance and that judgement errors are one of the common effects. The 3rd Emery was operated at an excessive speed and the employee at the controls had alcohol in his blood.

The precise level of blood alcohol at the time of the accident (or at the start of duty) or the degree of performance impairment cannot be determined as both are a function of physiology and biology. The clinical test referred to in Section 1.12 estimated a blood alcohol level of 0.142 per cent at 0900, assuming a ratio of 1.3 for the urine test versus blood alcohol concentration and the mean elimination rate of 0.015 per cent per hour. Using the same assumptions, the blood alcohol level at the time of the occurrence (1222) would have been about 0.09 per cent. If the lower end of the range for the rate of elimination of alcohol from the blood is used (0.01 per cent per hour), the estimated blood alcohol levels are 0.074 per cent at the time of the accident and 0.10 per cent at 0900. Conversely, using the higher end of the range (0.02 per cent per hour), the corresponding blood alcohol estimates are 0.110 per cent and 0.177 per cent, respectively. It can be concluded from the above that the locomotive engineer's blood alcohol level was above the legal limit (0.08 per cent) for all, or most, of the period of duty before the occurrence and that his performance was probably impaired by alcohol.

Other employees who were in the cab of the locomotive and on the caboose shared the responsibility for the safe operation of the train. In the course of their duties, employees are in proximity to one another; however, no one reported the smell of alcohol on the locomotive engineer's breath or apparently noticed any other signs of impairment.

2.2.2 Crew Responsibilities

While travelling between Leaside and the collision site, there were two crew members in the locomotive cab with the locomotive

engineer: a train person and a conductor trainee. The conductor was located five cars back of the locomotive in a caboose. Each of the crew members carried valid certification for their positions. The caboose had no speedometer; therefore, when the train was accelerated above the 15 mph speed to 26 mph, the conductor could only guess at the speed, and the time for the train to so accelerate may not have been

enough for him to determine that the train was moving too fast and to notify the locomotive engineer with his two-way radio of the thought. In the locomotive cab, the speedometer is so located that the train person and conductor trainee would have had to stand behind the locomotive engineer to clearly see the actual speed at which the train was being operated. The perception of train speed should have been easier for the crew in the cab than for the conductor in the caboose. No crew member raised the issue of train speed and it is likely that they were all relying on the locomotive engineer to ensure that the speed was in accordance with operating rules.

2.2.3 Trains Entering a Block Between Signals in CTC Territory

Trains entering a block between signals (CROR Rule 570) at a hand-operated switch equipped with an electric lock, in compliance with current operating rules, are not restricted beyond the requirement to be able to stop at the next signal. Further, it is not contrary to CP's local operating practices to give trains permission to enter a block between signals with other trains within the block, provided that those other trains are authorized to move in one direction only and have passed the switch. Under these circumstances, it is entirely possible for a train to encounter another train within the block when not sufficiently restricted by the rules.

2.2.4 Trains Delayed in the Block in CTC Territory

During the investigation, it was suggested that the crew may have considered themselves delayed in the block, and applied CROR Rule 575 when they resumed their movement. The current wording of CROR Rule 575 permits resumption of movement with no speed restriction (other than maximum timetable speed) other than to be prepared to stop at the next signal. The rule makes no exception for train movements that originally entered the block on a restricting signal. Therefore, a train may resume movement within a block that is occupied by other equipment at an unsafe speed.

2.2.5 Other Signal Systems

Unrelated to this occurrence, but relevant to the rule issues discussed is the fact that, in Automatic Block Signal System (ABS) territory, corresponding CROR Rule 514 (ENTERING BETWEEN SIGNALS) requires that a train proceed sufficiently restricted to avert collision with other equipment in the block and corresponding CROR Rule 515 (DELAYED IN THE BLOCK) has provisions for the exception presented by a movement that has entered the block on a restricting signal.

3.0 Conclusions

3.1 Findings

1. The 3rd Emery was operated at a speed that made it impossible to stop short of the train ahead. Further, given the speed and location of the 3rd Emery when train 921 was first seen, the 3rd Emery would not have been able to respect Signal 15-2.
2. Based on urinalysis and accepted alcohol depletion rates, it has been calculated that the locomotive engineer's blood alcohol level was above the legal limit to operate a train at the time he reported for duty and probably at or just below the legal limit at the time of the accident. Notwithstanding the legal blood alcohol limits, the railway has a policy of zero tolerance for employees working in such circumstances.
3. Alcohol affects performance and may have played a role in the locomotive engineer's decision to operate the 3rd Emery at a speed that proved to be unsafe in the circumstances.
4. The other 3rd Emery crew members, working in proximity to the locomotive engineer, did not apparently detect the smell of alcohol or any signs of alcohol impairment.
5. No action was taken by any of the other crew members to require the locomotive engineer to slow the speed of the train when operating on the main track before sighting the rear of train 921.
6. CROR Rule 575 (DELAYED IN THE BLOCK) does not sufficiently restrict a train that enters a block on a restricting signal in the event that the train is delayed in the block and resumes movement.
7. CROR Rule 570 (ENTERING BETWEEN SIGNALS), in connection with CP's local operating practices, is deficient in that a train may be given permission to enter a block between signals while another train is within the block. Under these circumstances, a train that enters a block between signals is not sufficiently restricted by Rule 570 because its movement is not required to be prepared to stop short of other equipment in the block.

3.2 Causes

The collision resulted from the operation of the train at a speed at which the locomotive engineer at the controls was unable to stop the train short of stationary equipment. The effects of alcohol may have contributed to the locomotive engineer's decision to operate the train at an excessive speed. The other crew members did not apparently notice the condition of the locomotive engineer nor remind him that the train was travelling at an unsafe speed.

4.0 *Safety Action*

4.1 *Action Taken*

4.1.1 *Interpretation of Operating Rules*

In June 1995, a TSB Safety Advisory was forwarded to Transport Canada (TC), with a copy to Canadian Pacific Limited (CP), outlining potential problems with the interpretation and application of Canadian Rail Operating Rules (CROR) Rule 570 (ENTERING BETWEEN SIGNALS) and Rule 575 (DELAYED IN THE BLOCK). The advisory indicated that TC may wish to review these CROR rules.

Subsequently, both CP and TC initiated safety action to prevent recurrence. CP issued internal "Rule of the Week" communiques related to the interpretation and application of CROR Rule 570 and Rule 575. In addition, CP issued a system special instruction which read: "In the application of Rule 575, a train or engine governed by a Restricting Signal entering a block must proceed at restricted speed to the next signal." Also, at the request of CP, the Railway Association of Canada Rules Revision Team (RACRRT) concluded that a review of Rule 575 would be beneficial to clarify its intent.

4.1.2 *Alcohol Impairment*

A search of the TSB database indicated that alcohol impairment of operating crew members is only rarely identified as a contributing factor in railway occurrence investigations. There have also been occurrences where alcohol was suspected to have been a factor, but there was insufficient evidence to support a finding to that effect; however, those instances are also extremely rare. Notwithstanding the low frequency of alcohol involvement in investigated occurrences, any instances of alcohol impairment among operating crew members pose a risk to safety.

Various measures have been taken to address the issue of alcohol versus safety. Regulatory measures include the *Criminal Code of Canada* and the CROR. Railway companies have adopted a zero-tolerance policy with respect to alcohol and drugs, and they provide related training and promotional material to employees. The companies and unions have also worked together and implemented employee assistance programs whereby alcohol and drug problems can be reported and treated without disciplinary action.

Furthermore, TC recently addressed substance use in safety-sensitive transportation jobs and conducted a thorough review of the need for substance use legislation. The Minister of Transport decided not to introduce new legislation, but rather to exercise a facilitation role and allow the industry to develop programs tailored to its needs.

In view of the foregoing, the Board is not making any safety recommendations at this time. The Board supports the existing programs and hopes that increasing awareness will help to make alcohol-related occurrences even more rare. To that end, in addition to disseminating this investigation report, the TSB will include material from this investigation in an upcoming issue of its rail safety digest "Reflexions."

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson, Benoît Bouchard, and members Maurice Harquail and W.A. Tadros, authorized the release of this report on 10 September 1996.