Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

RAILWAY OCCURRENCE REPORT

COLLISION

CANADIAN NATIONAL
2 HI-RAIL VEHICLES
MILE 8.2, ALLANWATER SUBDIVISION
NEAR ARMSTRONG, ONTARIO
11 JANUARY 1996

REPORT NUMBER R96T0008

Canada

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- 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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Railway Occurrence Report

Collision

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2 Hi-Rail Vehicles
Mile 8.2, Allanwater Subdivision
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Synopsis

On 11 January 1996, at approximately 0915 Central standard time opposing Canadian National (CN) hi-rail vehicles collided in a curve at Mile 8.2 of the Allanwater Subdivision, near Armstrong, Ontario. The driver of one of the vehicles sustained serious injuries in the collision. The driver of the other vehicle sustained minor injuries on jumping from the vehicle prior to impact.

The Board determined that the opposing hi-rails, travelling in an area of restricted sight-lines and frosty rail conditions, were operated at speeds that did not permit them to stop before colliding. Contributing factors included the extremely limited braking ability of hi-rail vehicles on other-than-dry rail, the rail traffic control system that allows for multiple and overlapping Track Occupancy Permits, and the acceptance that a requirement for employees to comply with a speed restriction rule is a sufficient and effective means to prevent such accidents.

Ce rapport est également disponible en français.

1.0 Factual Information

1.1 The Accident

At approximately 0915, 11 January 1996, a westward CN hi-rail vehicle collided with an eastward CN hi-rail vehicle in a four-degree curve at Mile 8.2 of the CN Allanwater Subdivision near Armstrong, Ontario. Both vehicles were defined by the Rules for the Protection of Track Units and Track Work as heavy track units.

At 0840, the Rail Traffic Controller (RTC) had issued the operator of the eastward vehicle, Track Occupancy Permit (TOP) No. 67, providing main track authority between signal 217, Mile 21.7 (the west end of Collins, Mile 21.1), and signal 08, Mile 0.8 (the west end of Armstrong, Mile 0.0). TOP No. 67 was issued directly to the operator of the eastward vehicle at Collins. The operator was accompanied by one other CN employee.

It was the intention of the two employees in the eastward vehicle to travel to Armstrong removing snow from switch points en route. No particular difficulty was experienced stopping or slowing down at the siding switches at Pascopee (Mile 15.4 and Mile 14.3). Both employees, however, noted that the rail head was covered with frost.

At 0905, the RTC had issued the operator and sole occupant of the westward vehicle TOP No. 73, providing main track authority between signal 08, Mile 0.8, and signal 143, Mile 14.3, (the east siding switch at Pascopee). TOP No. 73 was issued directly to the operator of the westward vehicle at Armstrong. The operator then entered onto the main track at a public road crossing at Mile 1.1. The operator intended to travel to Jacobs, Mile 38.9, to exchange his vehicle for another in order that his vehicle could be taken to Winnipeg for servicing.

Neither operator was made aware of the opposing movement and neither heard any radio broadcasts relating to the other's movement.

The eastward movement was just starting to enter the curve at Mile 8.2, and the westward vehicle was just exiting a rock cut at the west end of the curve, when the hi-rails noticed each other. Both operators claimed to have been travelling at approximately 15 mph at the time.

The operators of both vehicles immediately applied the brakes but little deceleration was evident. As the collision became imminent, both employees in the eastward vehicle jumped out. The operator of the westward vehicle did not get out of vehicle before impact.

The collision derailed both vehicles, although they both remained upright on the roadbed.

1.2 Injuries

The operator of the westward vehicle sustained serious and life-threatening injuries.

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[1] All times are Central standard time (Coordinated Universal Time (UTC) minus six hours) unless otherwise stated.

The operator of the eastward vehicle sustained minor bruising and lacerations to the left knee. The other CN employee was not injured.

1.3 Emergency Assistance

The driver of the westward vehicle was placed into the rear seat of the eastward vehicle and wrapped in blankets. The other employees, using the still functioning radio in the eastward vehicle, were able to complete an emergency transmission to the RTC, who arranged for help. An air ambulance (helicopter) was initially considered; however, it would have been unable to land on the right-of-way (the only landing area in the rugged terrain) due to the wayside wires. A hi-rail vehicle with a nurse was then dispatched from Armstrong arriving at approximately 1040. First aid was administered at the site, after which both injured employees were transported by hi-rail to Armstrong where they were taken by air ambulance to hospital in Thunder Bay, arriving at approximately 1420.

1.4 Occurrence Site Information

Sight-lines were restricted to approximately 400 feet. The hi-rail vehicles collided near the west end of the curve at the approximate mid-point of the observed sight-line. A rock cut parallels the south side right-of-way. The track at this location is on a 0.24 per cent down grade in a westward direction.

As both vehicles were of similar weight and neither vehicle moved after the collision, it seems that both had been travelling at approximately the same rate of speed when they struck. Markings in the snow on both sides of the eastward vehicle indicate that the employees had jumped out of their vehicle approximately 15 feet before the point of impact.

Visible damage to the eastward vehicle included downward bending of the frame at the cab/box interface and distortion of the cab roof. The front hi-rail unit was torn off and the hood was slightly distorted but there was no other significant damage to the front of the vehicle. The windshield was cracked from the cab distortion. All damage appeared crash-related.

The windshield of the westward vehicle was broken and its condition prior to the accident could not be determined. The truck body had moved forward on the frame approximately 24 cm, the hi-rail assembly on the front was torn off and the front of the grill and radiator were pushed back. The forward ends of the frame beams were bent to the left and back approximately 15 cm on the left side and 24 cm on the right side. The front springs were bent so that the front wheels were pushed back, reducing the wheelbase by approximately 8 cm.

1.5 Vehicle Information

1.5.1 Eastward Hi-Rail Vehicle

The eastward hi-rail vehicle was a 1994 GMC, one ton welder's truck, "crew cab" design, rear-wheel drive with dual rear wheels. The Bridgestone 225/70R19.5 low-profile radial tires were partly worn but in good condition; the tread design was typical all-season pattern with zigzag circumferential grooves. All tires were inflated to approximately 80 pounds per square inch (psi) except the front right tire which was inflated to 51 psi. The vehicle was equipped with standard headlights and signal/parking lamps plus five small amber lights across the top front of the cab and an amber strobe beacon at the rear top of the cab. A small crane was mounted in the right rear of a custom box and hydraulic equipment was mounted on the left side.

The hi-rail equipment installed on this vehicle was identified as Fairmont Tamper HR2000 Series "A" Hy-Rail Guide Wheel Equipment. The front unit is hydraulically operated and incorporates a hook arrangement to hold the front vehicle suspension in the normal "weight on wheels" position so that as the guide wheels are lowered the front tires of the truck are raised slightly above the level of the rails. The gauge of the front tires is greater than that of the rails so there is no contact at any time. The rear hi-rail wheels are manually lowered and raised with the use of a portable lever. After inserting the lever end into the slot the operator obtains mechanical advantage by applying force at the end of the lever resulting in the transfer of weight from the vehicle wheels to the hi-rail wheels. The manufacturer's specification for "guide wheel load on track" for the rear guide wheels requires that they carry approximately one-half the vehicle rear axle curb weight or a minimum of 1,550 pounds. Only the inside set of truck tires are in contact with the rail surface to provide both tractive and braking effort for the vehicle.

1.5.2 Westward Hi-Rail Vehicle

The westward hi-rail vehicle was a 1990 Ford, model F250, three-quarter ton, four-wheel drive, Signals and Communications (S&C) hi-rail truck. The rear of this vehicle was customized with a fully enclosed tool and material compartment. This truck had standard lighting plus an amber coloured strobe/beacon mounted on the centre rear of the cab. The tires on this vehicle were Goodyear 8R19.5MS radial tires with a lug type of tread pattern. All four tires were in good shape. Inflation measured 100 psi on all tires except the right rear tire which measured 96 psi.

The hi-rail equipment installed on this vehicle was identified as Fairmont Tamper HR0307 Series "A" Hy-Rail Guide Wheel Equipment. The hi-rail equipment on both the front and rear of this vehicle is manually operated such that the guide wheels are lowered onto the tracks using a metal lever with sufficient pressure to transfer some of the vehicle weight from the truck tires onto the guide wheels. The manufacturer recommends that the hi-rail guide wheels carry between 350 and 400 pounds per axle. Braking effort is transferred to the rail through the portion of all four tires contacting the rail head. Tractive effort is transferred to the rail in the same manner as braking effort, but in two-wheel drive mode, only the rear wheels transfer tractive effort to the rail.

1.5.3 Hi-Rail General

It was not possible to determine the adjusted hi-rail guide-wheel load on track for either vehicle due to the damage sustained by the vehicles. Staff members at the railway maintenance facility with responsibility for installation and maintenance of the hi-rail equipment were well versed in the manufacturers' installation specifications, and there is no reason to believe that the guide-wheel loads were other than those recommended by the manufacturer. The preset loads are not adjustable by operators and the hi-rails are either deployed or retracted.

The hi-rail guide wheels on both vehicles were not equipped with optional independent brake systems. Both vehicles were equipped with seat belts but neither was equipped with air bags. None of the occupants of either vehicle had been wearing seat belts. The strobe beacons on both vehicles were operating prior to the accident, as required by company instructions. Both vehicles had operable daytime running lights, and the respective operators had turned on the four-way flashers for added visibility.

A comparison of the vehicle maintenance records for both vehicles and the manufacturers' recommended service schedule indicated all hi-rail equipment had been serviced within the recommended time limits.

1.6 Damage to Equipment

Both hi-rail vehicles were damaged beyond economical repair.

1.7 Personnel Information

The eastward hi-rail vehicle was being operated by a track maintenance foreman with approximately 29 years of service. He was accompanied by a track maintenance labourer with approximately 14 years of service. Both were familiar with the physical characteristics of the subdivision, and both had considerable experience with the operation of hi-rail vehicles under the protection of TOPs. The vehicle operator had attended the Manitoba District Hy-Rail Vehicle and Track Unit Safe Operation Course in April 1995.

The westward hi-rail vehicle was being operated by a signal maintainer. This employee had approximately 17 years of service. He had arrived on this territory one month before and had ridden with a supervisor for approximately one week to become familiar with hi-rail operation. He was familiar with the rock cut and curve at Mile 8.2. His past experience with the railway had not required an in-depth knowledge in the operation of hi-rail vehicles and TOPs. Prior to this accident, the Manitoba District Hy-Rail Vehicle and Track Unit Safe Operation Course was not provided to Signal Department employees.

All the employees in both vehicles had started their daily work shifts at 0800, after having completed work by 1800 hours the previous evening.

1.8 Method of Traffic Control and Track Unit/Track Work Protection

1.8.1 Method of Train Control

Train movements and track unit/track work activities on the Allanwater Subdivision are governed by the Centralized Traffic Control (CTC) system of the Canadian Rail Operating Rules (CROR) and supervised by an RTC located in Edmonton.

1.8.2 Protection of Track Units and Track Work

The movement of track units and the protection of track work are authorized by the Rules for the Protection of Track Units and Track Work sanctioned by Transport Canada. Rule 803 of these rules states:

> Before a heavy track unit is permitted to foul or occupy a main track the foreman must be authorized:
> ...
> (b) under the authority of CROR Rule 49

Rule 49 of the CROR states in part:

> When authorized by a TOP, track units may be operated and track work may be carried out on the main track without flag protection.

The RTC does not usually notify the foreman being issued a TOP that other foremen have been issued authority to occupy the main track in the same or overlapping limits. In this instance, the RTC alerted neither the occupants of the eastward vehicle nor the operator of the westward vehicle of the opposing hi-rail movement.

1.8.3 Track Unit Speed

Track unit movements on the main track within a TOP are governed by Track Unit Speed as defined in the Rules for the Protection of Track Units and Track Work as follows:

> A speed that:
>
> (a) permits a track unit to stop within one-half the range of vision of equipment or a track unit;
>
> (b) permits a track unit to stop short of a switch not properly lined or any obstruction or track defect that may prevent safe passage;
>
> (c) does not exceed the authorized freight train speed, and where applicable the authorized passenger train speed, whichever is less; and
>
> (d) does not exceed the maximum speed authorized for that track unit.

1.8.4 Maximum Track Unit Speed

The maximum authorized speed on the Allanwater Subdivision is 45 mph for freight trains and 55 mph for passenger trains. Management had established a maximum authorized speed for various types of track units in a directive issued by the District Engineer on 28 February 1995 that contained the following:

> Maximum rail speed of 35 mph (55 km/h), or subdivision track speed if lower, and maximum speed of 5 mph (8 km/h) over turnouts and interlockings:
>
> - All inspection hi-rail vehicles;
> - All workforce hi-rail vehicles;

- All welders hi-rail vehicles;
- All S&C hi-rail vehicles.

Maximum rail speed of 25 mph (40 km/h), or subdivision track speed if lower, and maximum of 5 mph (8 km/h) over turnouts and interlockings:

- All frog truck hi-rail vehicles;
- All boom truck hi-rail vehicles.

All other track units are restricted to “track unit speed” as defined in the “Rules for the protection of track units and track work-1990".

1.9 Communication Requirements

The Manitoba District Hy-Rail Vehicle and Track Unit Safe Operation Course sets the following communication requirements:

> Approximately every 5 miles on territories where there are excessive curves and/or reduced visibilities [sic] due to rock cuts, etc., and at every station on other territories, a broadcast announcement must be made over the Engineering Radio system (and repeated once), USING PROPER RADIO PROCEDURES, relaying the following information:
>
> - Type of track unit, present location and direction of travel;
>
> The purpose of this broadcast announcement is to alert other employees in the area to be on the lookout.
>
> This does not in any way provide protection against other Hy-Rail vehicles or track units, and the driver/operator must always proceed prepared to stop within ½ the range of vision.

The employees in the eastward vehicle indicated they had made a radio broadcast transmission advising of their location and movement when leaving the east siding switch at Pascopee. They had not overheard any radio broadcasts from, or relating to, the westward movement. The operator of the westward movement made the required radio broadcast on leaving the west siding switch at Onaping, Mile 8. A railway employee at Collins indicated he overheard the radio broadcast made by the operator of the westward vehicle. The operator of the westward vehicle did not hear any broadcasts to or from the eastward vehicle. There is currently no regulatory requirement for such communication by track units.

On the CN District east of Armstrong, the Northern Ontario District, the railway does not employ this radio broadcast procedure. It is thought that this information might encourage employees to travel faster than is considered safe if they felt assured that the position of all movements were known. Track blockages, etc., would not be known, nor would broadcasts be heard, if the intended recipient was using the radio on another channel.

1.10 Hy-Rail Vehicle and Track Unit Safe Operation Course, Manitoba District

The Manitoba District Hi-Rail and Track Unit Safe Operation course (the course) given to track maintenance employees stresses operating responsibilities, including: radio broadcasts in areas of excessive curves and/or reduced visibility, the need for frequent running-brake tests to ensure that the brakes are functioning and to determine stopping distances under differing rail conditions, and the requirement to slow down on curves and other areas of restricted sight-lines. It is emphasized throughout that the operator must always be prepared to stop in one-half the range of vision, and to slow down in any areas of restricted sight-lines. There was no apparent mention nor recognition of the extreme degradation to hi-rail braking experience on wet, icy or frost-covered rail.

1.11 Vigilance Performance

The safe operation of any track unit requires that the operator maintain an awareness of the operational environment and be attentive to information stemming from that environment. The ability of an individual to sustain this attention is referred to as vigilance.

Vigilance research has shown that a number of factors can affect an operator's ability to remain vigilant to the task of detecting environmental cues such as track conditions and the presence of other track equipment. One factor that can affect vigilance over time is the operator's expectation of an environmental cue. An operator's expectations are influenced by information provided to him and by his experiences, or both. If expectations are high, i.e., if there is a perceived high probability of an event occurring or a circumstance existing, vigilance performance will be enhanced. Conversely, the perceived low probability of an event or circumstance will tend to diminish vigilance performance.

1.12 Weather

At Armstrong, the temperature was recorded as minus 7.1 degrees Celsius at 0900 with a relative humidity of 93 per cent. At 0600, the temperature had been minus 8.2 degrees Celsius with a relative humidity of 85 per cent. Visibility was good.

1.13 Recorded Information

Radio transmissions of the TOP between the RTC and the operators of both vehicles, and the required repeats and acknowledgements were recorded in the RTC office in Edmonton. Local railway radio broadcasts from track units, and communication between the operators of track units, do not involve the use of repeater stations and are not heard or recorded at the RTC centres.

. Boff and J.E. Lincoln, eds., *Engineering Data Compendium, Human Perception and Performance* ight-Patterson Air Force Base, Ohio: Harry G. Armstrong Aerospace Medical Research Laboratory,1988).

1.14 Tests and Research

1.14.1 TSB Engineering Branch

Both vehicles were transported from the accident site to a vehicle maintenance facility in Winnipeg to be examined by the TSB Engineering Branch. The report (LP 7/96) concluded that:

1. There was no record of recent maintenance or uncorrected fault in either vehicle which was considered to be relevant to this occurrence.

2. There was no apparent obstruction to normal forward viewing from the driver's position of either vehicle.

3. Both vehicles were painted and equipped in a manner which made them reasonably easy to be seen.

4. The tires and braking systems of both vehicles were assessed as being in satisfactory condition.

5. The two-way radios in both vehicles were serviceable at the time of the occurrence.

6. The hi-rail systems on both vehicles were serviceable and, most probably, correctly adjusted at the time of the occurrence.

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

1.14.2 Brake Testing

A number of simulations were conducted in order to establish the variation in required stopping distance a hi-rail vehicle operator may encounter (see figures 1 to 4, below). These simulations were conducted on dry rail, wet rail, frost-covered rail, and on dry pavement.

The test vehicle was a 1994 Chevrolet one ton similar to the eastward vehicle, equipped with an identical hi-rail system.

Figure 1

CONDUCTED ON DRY PAVEMENT	
SPEED (mph)	**BRAKING DIS**
20	1
30	4

35	73

Figure 2

CONDUCTED ON DRY RAIL	
SPEED (mph)	**BRAKING DISTANCE (feet)**
20	**54**
20	**48**
30	**94**
30	**99**
45	**198**
45	**191**

Figure 3

CONDUCTED ON WET RAIL	
SPEED (mph)	**BRAKING DISTANCE (feet)**
20	367
20	321
30	880
30	963
31	923
40	1579
40	1641

Figure 4

CONDUCTED WITH THE RAIL HEAD COVERED WITH ICE FOR FIRST 800 FEET	
SPEED (mph)	**BRAKING DISTANCE (feet)**
15	245
25	548
35	1051

1.15 Independent Brake System

Independent brake systems, separate from the regular vehicle road brakes, that apply to the hi-rail guide wheels are available. The systems are not normally installed on lighter hi-rail vehicles in consideration of warranty issues with vehicle manufactures and uncertain braking improvement. Such braking systems are commonly applied to heavier vehicles such as boom trucks and hi-rail cranes.

1.16 Frequency of Occurrences

There were a total of seven collisions between railway maintenance and inspection
vehicles/machines reported for 1995. Ten such collisions were reported for 1996. CN literature notes that for every hi-rail collision there are ten “near misses”.

2.0 Analysis

2.1 Introduction

The two vehicles were operating at speeds that did not permit them to stop in the distance available, and they collided. The opposing movements entered the area of restricted sight-lines with mechanically fit vehicles, properly adjusted hi-rail equipment, and all available visibility-enhancing lighting systems operating. The respective operators noticed the opposing movement when first visible and immediately began to brake. Both vehicles then travelled approximately the same distance at approximately the same speed with little apparent braking until impact. Many factors other than speed, however, played a role in the accident.

In 1996, 10 similar accidents were reported. In view of the CN literature estimate of 10 “near misses” for each collision, there may have been another 90 that were narrowly averted. Therefore, it would seem that the manner in which hi-rail vehicles are operated is not without significant risk.

The analysis will explore operating variables, variations in stopping distances encountered, overlapping TOPs, communication issues, and training for the safe operation of track units.

2.1.1 General

In times of high humidity and below freezing temperatures, if the temperature rises but remains below freezing (as in the subject instance), the rail, remaining colder than the air, becomes covered in condensing water vapour, which quickly freezes. The result is a frost- or ice-coated rail.

On-track hi-rail use transfers significant vehicle weight from the tires onto the hi-rail wheels. Braking effectiveness is accordingly reduced as the force of friction producing braking effort is directly proportional to the force (weight) over the wheels. As well, in the case of the eastward hi-rail, the front wheels were outside gauge and lifted above the rail head, and braking effort for this configuration would be approximately 50 per cent less than that of a similar vehicle with four wheels on the rail head.

As the testing has shown, hi-rail use does not unduly affect braking effort on dry rail, as braking distances are approximately double to triple those experienced on dry pavement (Figures 1 and 2). Such increases could be accommodated through employee training and experience. However, braking ability is clearly compromised on wet rail (Figure 3) and on ice-covered and (by extension) frost-covered rail (Figure 4). Hi-rail operation on other-than-dry rail requires greatly reduced speeds and operator awareness of the hazards posed by such operation.

2.2 Operating Variables and the Safety Margin

Prevention of track unit collisions depends upon operator vigilance and adherence to the requirement that a vehicle be operated at a speed that permits stopping within one-half the range of vision (i.e., maximum allowable track unit speed). This requirement supports the notion that track units can be operated in opposing directions on the same track without the operators having to be aware of each other's location. If two such vehicles closing on one another narrowly avert collision, the maximum allowable track unit speed requirement has been met. However, if optimum speeds are maintained, such operation leaves no safety margin. In the absence of a safety margin, varying braking performance can make track unit operation, based solely on track unit maximum speed requirements, risky. The extent of the degradation of measured braking performance for this type of track unit on wet or ice-covered track places the risk at a high level while operating in such conditions.

2.2.1 Operator Expectation Factors

Although neither operator expected to meet the other vehicle—perhaps due in part to having not heard a radio broadcast—it is not believed that this lack of expectation influenced the operators of the respective vehicles. Their reported speeds (15 mph) in the area are indicative not of a reckless disregard for operating requirements but of the failure to realize that with the rail covered in frost, stopping distances were excessive.

Although it could be stated that the safety measure which applied on the Allanwater Subdivision (radio broadcasts required when approaching areas of restricted sight-lines), lowered the respective track unit operators' expectations of meeting an opposing track unit, and subsequently lowered their vigilance, such is not believed to be the case. Their immediate sighting of the opposing movement, and their relatively slow speeds, indicate attentive operation. Furthermore, it is believed that this safety measure does in fact reduce the risk of track unit collisions.

2.2.2 Communication Issues

The operators of both track units made the required radio transmission as they approached the area of the accident. These announcements were not heard by the respective operators although the radio equipment was operating as designed. Therefore, it must be concluded that the rugged terrain (rock cuts) blocked the intended warning transmissions. It is apparent that this well-intended procedure is jeopardized by the rugged terrain where its application is most useful.

The RTC did not inform the respective track unit operators that other vehicles were operating within the TOP. Such information is not usually provided. In fact, this type of communication is discouraged as it is believed that the absence of a formal protocol could result in inconsistent information, and thus, be misleading and degrade safe operation. The railway industry also believes that a system of advising hi-rail operators of the location of others would lead to a lessening of vigilance when a route was believed to be clear. This reduced vigilance would be particularly dangerous if the track was obstructed by broken rail, rock slides or other eventualities. Nevertheless, a railway person in a key role was privy to important operating information that he was expected to not disseminate.

It is considered impractical for an RTC to monitor the whereabouts of track units within their respective TOPs. It would also be extremely time-consuming to be constantly contacting those already working under one TOP when new and overlapping TOPs were issued. It would seem, however, that policies, procedures and protocols could be developed to enhance the safety of track unit operation through RTC involvement.

2.2.3 Training

The training on safe hi-rail operation received by the operator of the eastward vehicle properly stressed the need to slow down on areas of restricted visibility, and at all times, to meet the requirement to be able to stop in one-half the range of vision. However, mention should have been made of the extreme braking degradation on wet, icy or frost-covered rail.

While this accident may not have been averted had the operator of the westward vehicle received this training, it is believed that the completion of such a course should be mandatory for all hi-rail operators.

3.0 Conclusions

3.1 Findings

1. The respective vehicles were mechanically fit, with properly adjusted hi-rail equipment and functioning visibility-enhancing lights. The condition of the vehicles played no role in the accident.

2. The operators of both vehicles were attentive to vehicle operation and began braking when the respective opposing movements were first visible.

3. Both hi-rail vehicles were operated at speeds that did not permit them to be stopped before colliding.

4. The respective hi-rail speeds did not conform to track unit speed (i.e., able to stop within one-half the range of vision) but their operation was not considered to be in reckless disregard of such a requirement.

5. Frosty rail-surface conditions rendered the braking systems on the two opposing hi-rail vehicles ineffective.

6. The radio broadcast system designed to warn of an approaching track unit within a TOP did not assist the operators of either vehicle in this instance.

7. The method of authorizing track unit movements on the main track permits multiple track unit operation within the same or overlapping limits.

8. Those operating in, or receiving authority to operate in, the same or overlapping TOPs are not made aware of others also so authorized.

9. The railway industry believes that providing hi-rail operators with information respecting the location and movement of other hi-rail vehicles would lead to a lessening of operator vigilance.

10. Training in the safe operation of hi-rail vehicles was not intended for signal maintainers and had not been provided to the operator of the westward vehicle although, in this instance, it is not believed that lack of this training played a role in the accident.

11. The hi-rail safety training did not address the stopping distances required, given the ineffectiveness of the braking system

on wet, icy or frosty rail surfaces.

3.2 Causes

The opposing hi-rails, travelling in an area of restricted sight-lines and frosty rail conditions, were operated at speeds that did not permit them to stop before colliding. Contributing factors included the extremely limited braking ability of hi-rail vehicles on other-than-dry rail, the rail traffic control system that allows for multiple and overlapping Track Occupancy Permits, and the acceptance that a requirement for employees to comply with a speed restriction rule is a sufficient and effective means to prevent such accidents.

4.0 Safety Action

4.1 Action Taken

4.1.1 TSB Rail Safety Advisory

In July 1996, the TSB forwarded Rail Safety Advisory 03/96 addressing hi-rail collisions and concerning the braking and stopping distances under various conditions such as road-to-rail and dry-to-wet-to-frosty rails, with different types of hi-rail equipment.

4.1.2 Industry Initiatives

With the increase in incidents involving hi-rails in 1996, CN launched a new training course called “Track Unit Safety”. The course involves considerable group discussion on the hidden factors affecting hi-rail operation and the root causes of incidents. In addition, topics such as operator qualifications, types of track protection (TOP), restrictions regarding track unit speed, inspection, and preventive maintenance schedules are covered.

Also, the results of stopping distance tests performed in northern British Columbia have been integrated into the training material so that the program now includes a detailed section on the relationship between hi-rail speed, braking distance, and rail surface condition.

Furthermore, subsequent to this occurrence, CN produced a training video, entitled *Impact at Mile 8*, which is also based on this occurrence on the Allanwater Subdivision. The video outlines the circumstances leading up to the collision, with emphasis on the need to adhere to the requirements of track unit speed. The Chief Engineer of CN’s LaVerendrye District has also issued a directive to restrict the maximum speed of all hi-rail vehicles to 25 mph, or subdivision track speed, if lower.

In the meantime, CN is studying the incorporation into hi-rail vehicles of a device similar to a locomotive event recorder. The unit will record the driving characteristics and also possibly govern the maximum speed of the vehicle while on rails.

The Quebec North Shore and Labrador Railway (QNS&L) has proximity detection devices installed on its trains and maintenance-of-way machines. During normal operation, the proximity detection device provides an audible and visual alarm to the operator when another equipped vehicle is within eight, five and three miles of track range. The alarm must be acknowledged by the engineer within a certain amount of time or an automatic braking application will occur on the train. The Board views the development and implementation of technologies to detect proximity, and facilitate awareness of the work environment, as promising steps toward reducing the risk of collision in railway operations.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson Benoît Bouchard, and members Maurice Harquail, Charles Simpson and W.A. Tadros, authorized the release of this report on 17 March 1998.