Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

RAILWAY INVESTIGATION REPORT

R99E0023

MAIN TRACK TRAIN COLLISION

BETWEEN
CANADIAN NATIONAL TRAIN NO. A-428-51-30
AND
CANADIAN NATIONAL 0830 EXTRA YARD ASSIGNMENT
MILE 0.2, ALBREDA SUBDIVISION
JASPER, ALBERTA
31 JANUARY 1999

Canada

Railway Investigation Report

Main Track Train Collision

Between
Canadian National Train No. A-428-51-30
and
Canadian National 0830 Extra Yard Assignment
Mile 0.2, Albreda Subdivision
Jasper, Alberta
31 January 1999

Report Number R99E0023

Synopsis

At approximately 1023 Pacific standard time on 31 January 1999, Canadian National train No. A-428-51-30 (train 428) entered the yard on the south main track at Jasper, Alberta, in a runaway condition and collided head on with the 0830 extra yard assignment. Eleven cars and five locomotives derailed. The conductor of train 428 received minor injuries.

Ce rapport est également disponible en français.

1.0 Factual Information

1.1 The Accident

On 30 January 1999, at approximately 2115 Pacific standard time (PST)[1], Canadian National (CN) train No. A-428-51-30 (train 428) departed Prince George, British Columbia, destined for Jasper, Alberta. Before the locomotives were placed on the train, the crew, a locomotive engineer and conductor, checked the locomotive documentation and performed the required equipment checks as per CN's General Operating Instructions (GOI). No anomalies were noted. The crew members then operated the train from Prince George to McBride, British Columbia, where they relinquished the train to another crew for operation to Jasper. During the trip from Prince George to McBride, no train handling or operating anomalies were encountered. The outgoing crew was advised accordingly.

Train 428 departed McBride at approximately 0300 on 31 January 1999. En route to Redpass Junction, Mile 43.7 of the Albreda Subdivision, the locomotive engineer used the train air brakes and dynamic brakes to meet subdivision maximum speed restrictions and to take a siding.

From Redpass Junction to Jasper, Mile 0.0, snow was above the rails resulting in the locomotive pilot ploughing snow. The locomotive windshield wipers were required to clear the blowing snow to enable the crew to see the track ahead.

Approximately 13 miles from Jasper, the locomotive engineer applied the train air brakes for a period of about two minutes by reducing the train line air by 16 pounds per square inch (psi). The locomotive engineer then released the brakes and recharged the air brake system. On a descending grade approximately 10 miles from Jasper, the locomotive engineer set up the locomotive dynamic brakes and was able to remain under subdivision maximum speed limits. His plan, and usual train handling methodology, was to use dynamic braking to control train speed into Jasper. Approximately 9 miles from Jasper, the crew used train radio channel 3 to request and receive yarding instructions from the Jasper Yard office. At about Mile 4.0, the locomotive engineer radioed the outgoing Jasper crew members on channel 5 to advise them that train 428 would arrive in about 10 minutes. After conversing with the relieving crew, the locomotive engineer changed the radio to channel 1—the train operating channel.

At about Mile 1.5, while travelling at approximately 34 mph on the south main track, both the locomotive engineer and conductor realized that their train was not slowing as anticipated. The locomotive engineer then initiated a 7 psi air brake application. Realizing that this was not sufficient, he then reduced the brake pipe air pressure another 6 psi. A few seconds after the locomotive engineer last increased the brake application, he noted no increase in braking and

[1] All times are PST (Coordinated Universal Time [UTC] minus eight hours) unless otherwise stated.

initiated an emergency brake application. The train exited a curve, and the locomotive engineer noticed a stationary yard movement on their incoming track. He then made a radio broadcast on the operating channel (channel 1) advising the yard movement to move out of the way as his train was not going to stop. This transmission was not heard by any railway employees in the Jasper Yard or the rail traffic control office. Immediately after this transmission, the locomotive engineer exited the locomotive. The conductor had already exited. Event recorder data indicate that impact occurred at a speed of 25 mph at 1023, 2.5 minutes after the train had travelled about 1.5 miles with the brakes applied in emergency.

The locomotive engineer on the yard assignment had not been in radio contact with train 428 before its arrival at Jasper nor had he heard the radio communication indicating that train 428 was entering the yard unable to stop. However, he saw that train 428 was approaching Jasper very rapidly and realized that his yard assignment, stationary at Mile 0.2, would be struck. He issued a warning over the radio on the yard channel (channel 8) to the brakeperson at the end of the cars they were handling and safely exited the locomotive. The brakeperson heard the radio warning and safely distanced himself from the cars before the collision. The conductor had been clearing snow from switches in advance of their movement and was not endangered by the derailing equipment.

As a result of the collision, 5 locomotives and 11 cars derailed.

1.2 Injuries

The conductor on train 428 received minor injuries while he was moving through deep snow in order to distance himself from the derailing cars.

1.3 Damage

1.3.1 Equipment Damage

The three locomotives and two cars on train 428 were extensively damaged, and two locomotives and one car on the yard assignment were also extensively damaged.

1.3.2 Track Damage

The collision damaged about 520 feet of track and four switches.

1.4 Personnel Information—Train 428

1.4.1 Locomotive Engineer

The locomotive engineer was based in Jasper, and qualified and experienced on the Albreda Subdivision. He reported for duty at Jasper at 2300 on 27 January 1999. He arrived at McBride at 0400 the next morning, where he immediately took another train to Jasper, arriving home at 0930 where he napped for about two hours. He then slept from 2200 to 0700 on 29 January 1999. On January 29 he reported for 0820 arriving in McBride at 1430. He did not rest and was ordered at McBride for 1850 arriving in Jasper at 2400. He slept from 0200 to 0900, January 30. He was then on duty travelling between Jasper and McBride between 1530 and 2230. On arrival in McBride, he took a nap in the bunkhouse, during a 3.5-hour break between shifts. He was again on duty on 31 January 1999, travelling between McBride and Jasper, from 0300 to 1030, the time of the occurrence.

1.4.2 Conductor

The conductor was based in Jasper, and qualified and experienced on the Albreda Subdivision. He was ordered at Jasper for 1400, 27 January 1999, arriving in McBride at 2040. He did not rest and was ordered at McBride for 2245 and off duty in Jasper at 0330, January 28. He then slept for approximately eight hours and was ordered at Jasper on January 29 for 0055 arriving in McBride at 0640. He then dead-headed from McBride to Jasper between 0640 and 1000. He remained awake for the remainder of the day and went to sleep at 2100 on January 29 and awoke at 0900 on January 30. He was on duty between Jasper and McBride from 1530 to 2230. The conductor did not nap during a 3.5-hour break between shifts. He was again on duty on January 31, travelling between Jasper and McBride from 0300 to 1030, the time of the accident.

1.5 Train 428 and Locomotive 5432

Train 428 consisted of 3 CN locomotives, 5410 (leading), 5432, and 2452, 81 loads and 4 empties. It weighed 9 445 tons and was 5 936 feet long. Locomotive 2452 was inoperative and being moved to Edmonton, Alberta, for repairs. The cars had received a certified car inspection and air brake test at Prince George with no irregularities noted.

The two functioning locomotives had arrived in Prince George from Jasper on a westward train (train 837), with locomotive 5432 leading, and had been designated to a storage track before being assigned to train 428. The Jasper-to-McBride crew of train 837 had reported to the diesel doctor supervising train movements in the rail traffic control Edmonton office that the No. 1 traction motor on locomotive 5432 was not working. Instructions regarding reporting to the diesel doctor are posted in the cab of the locomotive for crew reference. Diesel doctors are experts in locomotive mechanics who work in conjunction with the rail traffic controllers (RTCs) to provide 24-hour mechanical advice to operating crews. On the advice of the diesel doctor, the

crew had isolated the traction motor as per normal procedure in this circumstance. Once the traction motor was isolated, the dynamic brake feature on that locomotive became inoperative. The diesel doctor generates a defect notice which is conveyed to the next scheduled maintenance facility for the locomotive.

GOIs require that, when a locomotive is malfunctioning, a locomotive engineer's report (Form 538D), clipped on the locomotive console, be filled out to indicate the nature of the malfunction. This report is left on the locomotive. Subsequent crews would then be aware that the locomotive is malfunctioning and be advised of the nature of the malfunction. The form also provides shop personnel with a reference to ensure that necessary repairs are completed. The incoming train 837 crew members at McBride did not enter the information on Form 538D in the cab of locomotive 5432 and had no recollection as to why they did not complete this task. Both were aware of the requirement to complete this form. The incoming and outgoing crew of train 837 at McBride did not discuss the inoperative dynamic brake on locomotive 5432, although this condition was apparent to the relieving crew by viewing the positioning of switches on the electrical panel. The McBride outgoing crew did not make note of the malfunction on Form 538D when leaving the locomotives on the storage track back at Prince George.

When crew members take charge of a running locomotive from a storage track, company procedures require them to check the locomotive air brake control devices, air compressor and air gauges and to apply and release the air brakes to confirm that they function as intended. Additionally, they are instructed to check the condition of the headlights, classification lights, back-up light, bell and whistle, and ensure that a fire extinguisher and flagging equipment are in the locomotive. The instructions do not specify that all the locomotives in the consist be checked. The outgoing crew of train 428 at Prince George advised that company teaching on this matter outlined that only a check of the lead locomotive was required.

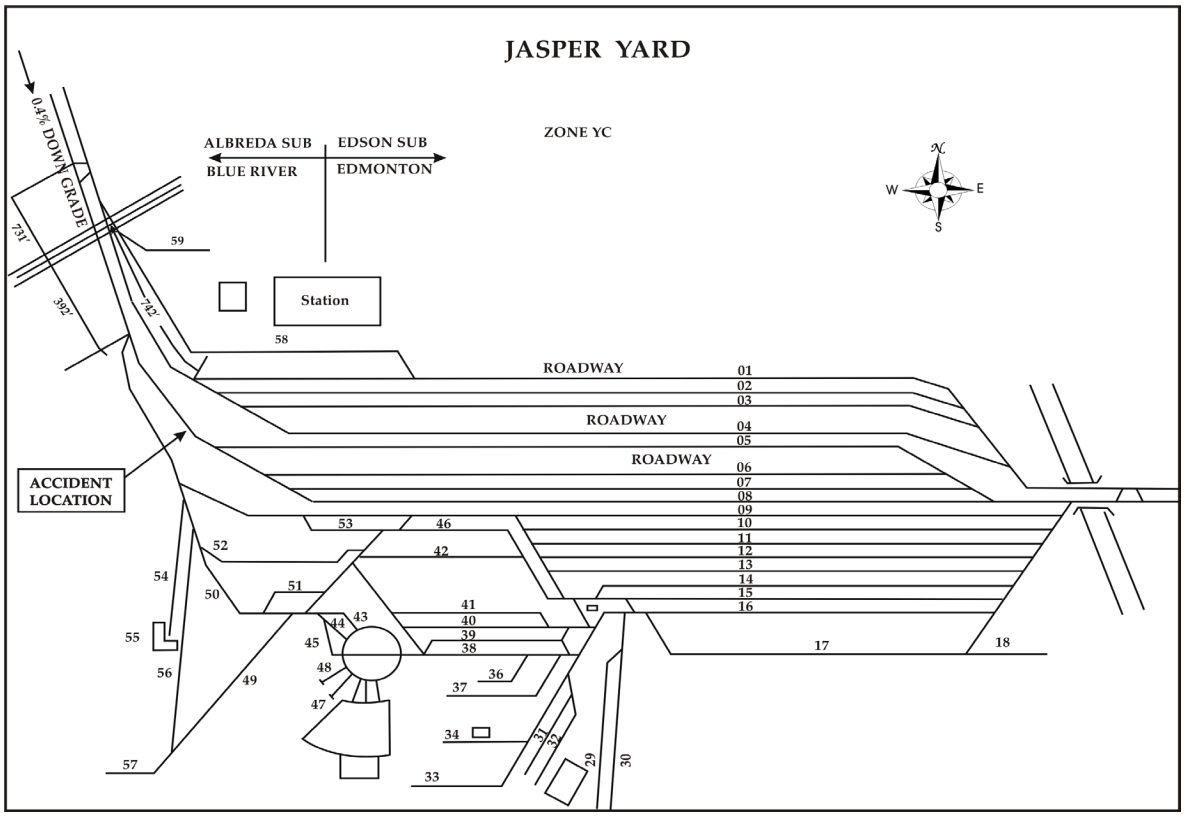
The required checks and tests were conducted on locomotive 5410. The air brakes were verified to work as intended and the exterior features of the entire locomotive consist were visually inspected with no exceptions noted.

The incoming crew of train 428 at McBride had not noticed the malfunctioning nature of locomotive 5432. The outgoing crew members assumed responsibility for the train while it was sitting in the vicinity of the bunkhouse. They believed that all aspects of the motive power were operating as intended.

1.6 Occurrence Site Information

1.6.1 Track Information

The Albreda Subdivision consists of double main track west from Jasper Yard to Mile 43.7. Between Mile 0.4 and Mile 1.7, the subdivision speed is 30 mph for freight trains and, between Mile 1.7 and Mile 5.2, the subdivision speed is 35 mph. There is a 0.4 per cent descending grade entering Jasper with a one-degree curve at Mile 0.9.



1.6.2 Accident Site

The first six cars of train 428 derailed to the south with two cars coming to rest on their side. The locomotives derailed but remained upright. The next five cars remained on the tracks and the following five cars derailed with three completely off the track and coming to rest upright in deep snow on the roadbed.

The two locomotives on the 0830 extra yard assignment derailed.

The air brake rigging and undersides of the cars of train 428 were heavily packed with snow. The brake piston rods were fully extended with piston travel within acceptable limits. At this time, the brake shoe surfaces were noted to be tightly applied against the wheel treads and were free of snow and ice as a result of the heavy brake shoe-to-wheel forces generated by the emergency brake application initiated at about Mile 1.5. Post-accident testing by CN of the air brake system indicated that it was functioning as intended.

1.7 Method of Train Control

Train movements on the Albreda Subdivision are governed by the Centralized Traffic Control System (CTC). CTC ends at Mile 0.4. The supervising RTC is located in Edmonton.

The method of train control on the main track in Jasper Yard (Mile 0.4 to Mile 0.0) is Canadian Rail Operating Rules (CROR) Rule 105 Special Instruction (1) which requires train movements to operate at a speed not exceeding 10 mph. All train movements are governed by CROR Rule 105 which requires that ". . . a train or engine using other than a main track must operate at reduced speed and be prepared to stop short of the red flag or the red light . . . ." Reduced speed is "A speed that will permit stopping within one-half the range of vision of equipment."

1.8 Communications

1.8.1 Jasper Yard Radio Communications

Railway operations in and around Jasper use designated radio channels for specific tasks. Channel 1 was designated as the standby (general operating) channel for train movements operating through Jasper Yard, and channel 3 was designated as the channel in which the train movement clerks and senior service centre clerks communicate with all operations in and around the Jasper Yard. Channel 5 was designated as the radio channel used by incoming and outgoing train crews to communicate with each other regarding train information. Channel 8 was designated as the channel used by yard crews to communicate amongst themselves to facilitate yard movements. In addition to these radio channels, trains could contact the RTC on channel 2.

1.8.2 Emergency Radio Communications Procedures

GOIs directed that, when initiating an emergency call, the "designated standby channel(s) assigned to road and yard service" was to be used to alert other trains and engines in the vicinity. The person initiating the call was then to immediately repeat the emergency communication on the "designated standby channel of the RTC." In this instance, these instructions were applicable to both road and yard crews.

1.9 Weather

The temperature was minus five degrees Celsius and about 41 cm of snow had fallen in and around Jasper over the previous three days.

The track between McBride and Jasper was in a condition of heavy snow build-up. The snow was approximately 30 cm above the rail head and waist-deep at the tie ends.

1.10 Other Information

1.10.1 Dynamic Brake Operation

Dynamic braking uses the retarding effect of the traction motors when used as "generators" of electrical power rather than motors consuming electric power. The generated power is converted to heat in ventilated grids within the body of the locomotive.

Dynamic brakes are used as a supplement to train air brakes and have a positive impact on fuel consumption, locomotive and car wheel and brake shoe wear, and control train speed and slack. Most railways, including CN, require them to be used as much as possible. Locomotive engineers may use the dynamic brake either alone or in conjunction with the train and locomotive air brakes. The dynamic brake feature is designed in such a manner that it requires all the traction motors on a locomotive to be operative or the dynamic brake on that locomotive will not function.

The locomotive engineer uses the amperage load meter to reference the operation of the dynamic brake feature in the controlling locomotive. However, there is no indication in the cab of the controlling locomotive to show the operating condition of trailing locomotives. There are no requirements in the design standards or regulations requiring that such information be available in the cab of a controlling locomotive.

1.11 Other General Operating Instructions

1.11.1 Train Handling Instructions

GOIs direct crews to use throttle manipulation as the primary means of controlling train speed. The dynamic brake is to be used as the initial braking force as it would ensure less wear/damage to equipment components and improve fuel efficiency. GOIs direct locomotive engineers to comply with fuel conservation instructions and to employ train handling techniques consistent with efforts to reduce fuel costs.

GOIs also direct that "Under winter conditions, the locomotive engineer shall make periodic use of the air brakes at sufficient intervals to keep the braking surfaces free of ice and snow and the brake equipment conditioned for service."

1.11.2 Taking Charge of or Leaving Locomotives

GOIs require that, at a run-through point such as McBride, outgoing locomotive engineers examine Form 538D on the lead locomotive and check the headlight and classification lights. There is no requirement to inspect the locomotives on the train or to test any of the operating features, or complete or sign off any documentation.

GOIs also require that, when a locomotive is to be stored with the engine running at a location such as Prince George where no shop staff is available, Form 538D be completed before the locomotives are left. GOIs also outline the proper manner of securing the locomotive to prevent movement and ensure continued mechanical fitness.

1.11.3 Rest Requirements

Railways under federal jurisdiction in Canada operate within regulatory requirements specifying both maximum hours of service and mandatory time off-duty for train crews.

The occurrence crew was governed by mandatory time off-duty requirements. Employees covered by these requirements who have been on duty in excess of 10 hours will not be required to go on duty in pool service for at least eight hours.

Maximum hours of service requirements are applicable to railway operating employees in any class of train service. These requirements specify that no employee shall be on duty in excess of 18 hours in a 24-hour period; the maximum time on duty in a single tour of duty is 12 hours, and 16 hours in case of work train service or in case of emergency.

2.0 Analysis

2.1 Introduction

From the time train 428 left McBride until it approached Jasper Yard, there were few occasions where the locomotive engineer used the fully functional train air brakes for train control. The dynamic braking seemed to work as intended. However, when called upon for heavy braking effort, neither system met the locomotive engineer's expectations.

While the reasons for the train's ineffective brake system will be explored, factors such as train handling, fatigue, an undocumented mechanical defect, and radio communication procedures also played a role and will be discussed.

2.2 Train Operation and Braking Strategy

Train 428 approached Jasper after having travelled in extreme blowing snow conditions for about 30 miles. Under such conditions, and without periodic conditioning of the train air brakes to melt accumulated snow on the brake shoes, the principal means of braking was rendered ineffective. The strategy to use dynamic braking was unknowingly compromised by the inoperative dynamic braking feature on the second locomotive. The locomotive engineer's strategy for entering Jasper Yard could not be executed.

2.3 Assessment of Effectiveness of Brake Application

Lengthy exposure to extreme blowing snow conditions should heighten an operating crew's concern for its train's braking capabilities. It should prompt attention to the process of conditioning the brakes both en route and when preparing to stop. The operating crew members of train 428 did not apparently appreciate the effect of the blowing snow on their train. The two-minute brake application conducted about 13 miles west of Jasper did not ensure that the braking surfaces were free of ice and snow. It is possible that this relatively brief application only served to create a layer of water on the brake shoe surfaces which then turned to ice, further degrading the effectiveness of the brakes.

2.4 Fatigue and Work/Rest Scheduling

Fatigue can lead to crews forgetting or ignoring normal checks or procedures, reversion to old habits, and inaccurate recall of operational events. Fatigue can also reduce attention, the effects of which are that people overlook or misplace sequential task elements, become preoccupied with a single task, and are less vigilant. When alertness is impaired, people may fix their focus on a minor problem (even when there is risk of a major one), they may fail to anticipate danger, and they may display automatic behaviour syndrome. Problem solving can also be affected and flawed logic may culminate in the application of inappropriate actions.

Even though fatigue may not necessarily explain the train handling actions of the locomotive engineer, his actions are consistent with errors involving reduced attention and memory typical of the fatigued state. The conductor would also have been at a significant risk for committing errors near the latter part of his shift.

Two causes of fatigue are inadequate quantity or quality of sleep and disruption of circadian rhythms. These can result from the combination of and the interaction between the work schedule (irregular work schedules, extended duty, or altered work/rest schedules) and the social and domestic pressures that impinge upon an individual's lifestyle. Fatigue has been identified as a contributing factor in many industrial accidents[2].

Research suggests that it is not possible to store sleep. As a person remains awake, a sleep need develops, notwithstanding how well rested the individual was at the beginning of the wake cycle. Most people need between 7.5 and 8.5 hours of sleep per day. A person who does not obtain required sleep will develop a sleep debt and will be subject to performance degradation.

Based on his work/rest pattern over the previous three days, it is estimated that the locomotive engineer had accumulated about seven hours of sleep loss at the time of the occurrence. Notwithstanding the fact that the locomotive engineer took a nap on the night of January 30 he would have been beginning his shift on 31 January 1999 with a sleep debt.

At the time of the occurrence, the conductor had been awake for 26.5 hours. The need for sleep generally recurs after about 15 to 16 hours of being awake, even for someone who is well rested.

The irregular rest/work schedules and subsequent sleep debt are consistent with fatigue, but not sufficient to prove that the errors were necessarily fatigue-induced.

2.5 Rest Regulations

The crew members of train 428 were within the parameters of mandatory time off-duty and maximum hours of service prescribed for operating crews; yet, at the time of the collision, the locomotive engineer had had about 3.5 hours of sleep in the previous 25 hours and the conductor had had no sleep in the same period. The current mandatory time off-duty and maximum hours of service requirements are intended to ensure that railway employees in train service are rested and fit before duty and do not continue on duty for excessive periods of time. Time off-duty is not necessarily restorative rest, and the fact that the person least likely to make an accurate assessment of his/her condition—the individual—is charged with the task of

[2] Mark R. Rosekind, Philippa H. Gander, Linda J. Connell, and Elizabeh L. Co (1994). *Crew Factors in Flight Operations X: Alertness Management in Flight Operations*. NASA Technical Memorandum DOT/FAA/RD-93/18 (NASA Ames Research Center).

making that assessment makes it possible for fatigued employees to be operating trains while in full compliance with the current regulatory requirements and while under the impression that he/she is fit to perform his/her duties.

2.6 Transfer of Information

Form 538D is intended to provide succeeding crews and ultimately mechanical department personnel with a record of all locomotive malfunctions. While in most cases this information is of most importance to those charged with locomotive repair, some malfunctions, such as seen in the subject instance, may be of a safety-sensitive nature. The continued use of locomotive 5432 without dynamic braking capability did not compromise safe train operation until an occasion arose when full dynamic braking was required and expected, and the locomotive engineer was unaware that he did not have this capability. While the failure of a crew to fill out Form 538D could be cited as the obstacle to the transfer of this information, the manner in which the locomotive consist was checked at Prince George; i.e. the outgoing crew did not check the cab of trailing locomotive 5432, would have precluded the outgoing crew from becoming aware of the malfunction even if the form had been completed. It would seem, therefore, that not only has the requirement and importance to complete Form 538D not been sufficiently emphasized but an erroneous and potentially unsafe notion that only the lead locomotive need to be checked when assuming power at locations such as Prince George has become accepted procedure.

It can also be noted that malfunctioning locomotive 5432 was handed off en route to succeeding crews at McBride on two occasions without due consideration of the mechanical condition of the locomotive consist. While, in the first instance, knowledge of its operating restriction was quickly obvious; in the second, it was not known. The process of crew exchange and the manner of assuming control of a highly complex piece of machinery is unstructured and does not foster safe train operations.

2.7 Locomotive Displays

When the subject locomotive engineer used the throttle or the dynamic brake to control train speed, his only indication of the operating function of the entire locomotive consist was his feel of train response to control inputs. Since the train was capable of maintaining an appropriate speed and appeared to respond to dynamic braking, due in part to the heavy snow conditions, he had no reason to suspect that one traction motor and the entire dynamic braking capability of locomotive 5432 was not available.

While the malfunction of certain mechanically sensitive systems of trailing locomotives such as oil pressure will trigger an alarm in the cab of the controlling locomotive, current standards do not require that the operating status of the trailing locomotives' systems be displayed, although such displays are technically feasible and are available on some new locomotives.

It is apparent that, in this instance, both crews of train 428 operating from Prince George to Jasper would have benefited from instrumentation showing that motive power was reduced and dynamic braking capability significantly diminished. This would have aided the locomotive engineer's situational awareness and as a result he would have been better informed and therefore able to make better operating decisions.

2.8 Communications

Train 428's urgent radio broadcast on the operating channel for train operation was not heard by other railway employees. It would seem that there was no one within radio range tuned to this channel. In this instance, the train crew did not have sufficient time to contact the RTC who could have used multi-channel capabilities to warn all in the yard with radios of the approaching runaway train. Many emergency situations restrict a crew's ability to make a protracted emergency broadcast. While it is appreciated that the intent of using the operating channel is to protect main track operations, this accident demonstrates that radio warnings of a risk to safety could be directed towards other facets of railway operations. In such circumstances, the radio system as designed is not able to provide a warning of an unsafe condition to all potentially affected employees.

It is also noted that the 0830 extra yard assignment was switching on the inbound track in direct conflict with train 428. While CROR Rule 105 requirements govern such activity and theoretically protect switching operations, radio contact between the two operating crews could have ensured that the south main track was cleared in advance of the incoming train. It is noted that the crew of train 428 used the train radio on channel 5 to converse with the outbound crew and channel 3 to determine yarding instructions from the yard office. It would have been an easy matter, for example, for a yard office clerk, to alert any switching movement on channel 8 of their pending arrival. It would seem, therefore, that better use of the available radio communication system could improve safety in Jasper Yard.

3.0 Conclusions

3.1 Findings as to Causes and Contributing Factors

1. Without periodic conditioning by the crew of train 428, the extreme blowing snow conditions rendered the air brake system ineffective.

2. The detrimental effect of the weather conditions on air brake operation and the unknown condition of the dynamic braking system rendered the locomotive engineer's strategy for entering Jasper Yard impossible to execute.

3. The requirement to complete the locomotive engineer's report has not been sufficiently emphasized and the potentially unsafe notion that only the lead locomotive needs to be checked when assuming power has become accepted procedure.

4. The process of crew information exchange and manner of assuming control of a train at a run-through point is unstructured and does not foster safe train operation.

3.2 Findings as to Risk

1. Because train 428 had no instrumentation showing that motive power was reduced, the crew was unaware that the dynamic braking capability of the locomotive consist was significantly diminished.

2. The radio system, as designed, does not always provide a warning of an unsafe condition to all potentially affected employees.

3. Better use of the available radio communication system could improve safety in Jasper Yard.

4. The rest/work cycle and sleep pattern of the crew, especially the conductor, were conducive to fatigue and a consequent risk of performance impairment.

4.0 Safety Action

4.1 Safety Concern

The investigation into this accident identified safety deficiencies that are of concern to the Board.

The matter of locomotive defect identification and defect information transfer, the unstructured manner of crew change-off and the cursory nature of pre-departure locomotive consist inspection are seen as requiring review. Irregular work scheduling, extended duty times and identified rest needs were once again of concern and tend to be a safety issue in many occurrences.

The Board is also concerned that locomotive engineers are not aware of the operating condition of trailing locomotives and that there is no instrumentation on the controlling locomotive to provide this information. This accident has again prompted the Board to examine the concept of situational awareness among railway employees, especially as it relates to the various groups of employees and the manner in which a communication system, such as modern portable radios, can be used to improve awareness and increase safety.

The Board will continue to monitor occurrences where these areas of concern surface with a view to developing safety action if warranted.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 21 August 2001.

Appendix A - Glossary

cm	centimetre
CN	Canadian National
CROR	Canadian Rail Operating Rules
CTC	Centralized Traffic Control System
GOI	General Operating Instructions
mph	mile per hour
psi	pound per square inch
PST	Pacific standard time
RTC	rail traffic controller
TSB	Transportation Safety Board of Canada
UTC	Coordinated Universal Time