RAILWAY OCCURRENCE REPORT
R96D0029

DERAILMENT

CANADIAN NATIONAL
TRAIN NO. A402-21-27
MILE 14.4, BÉCANCOUR SUBDIVISION
ST. GRÉGOIRE, QUEBEC
27 FEBRUARY 1996

Transportation Safety Board
of Canada

Bureau de la scurit des transports

du Canada

Railway Occurrence Report

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Synopsis

At approximately 1300 eastern standard time, 27 February 1996, 59 cars from Canadian National train No. A402-21-27 that had been left on the main track, standing unattended and secured with air brakes, rolled northward and struck the locomotive consist, which was in the process of being coupled to 6 cars on the Lama Warehouse Spur, Mile 14.6 of the Bécancour Subdivision, near St. Grégoire, Quebec. The impact derailed one locomotive and 13 cars. Eleven of the derailed cars were tank cars containing residues of regulated commodities. There was no release of product from the tank cars; however, a locomotive fuel tank was punctured and leaked approximately 9,000 litres (2,000 gallons) of diesel fuel. One crew member was seriously injured.

The Board determined that the 59 cars were left secured with air brakes and an unvented brake pipe, and the train brakes were released by the inadvertent activation of the cars' pressure-sensitive quick release feature by a pressure wave created in the train brake pipe at uncoupling.

Ce rapport est également disponible en français.

1.0 Factual Information

1.1 The Accident

Northward train A402-21-27 originated at Taschereau Yard in Montreal, Quebec, and was destined for Bécancour, Quebec. After adding cars and completing a crew change at Aston Junction, the relief crew proceeded to the Lama Spur located in a rural area at Mile 14.4 of the Bécancour Subdivision, near St. Grégoire. At approximately 1240, the train was stopped clear of the level crossing at Mile 13.58 and all 59 cars were uncoupled and left standing on the main track. The locomotive consist (3 locomotives) was then taken northward to perform switching at the spur. Shortly after they were uncoupled from the locomotives, the 59 rail cars began to move northward. They rolled unnoticed approximately 4,000 feet and, at about 1300, entered the spur and collided with the locomotives which had just been coupled to six cars in the spur. The collision resulted in the trailing locomotive and two tank cars containing a residue of caustic soda, UN 1824, a corrosive substance, being knocked onto their sides and seven other tank cars containing a residue of caustic soda and two containing a residue of chlorine, UN 1017, a poisonous gas, being derailed but remaining upright. Two box cars also derailed. At the time of the impact, the trainman was working between the second and third cars and was seriously injured.

A fuel tank on the overturned locomotive was punctured and approximately 9,000 litres (2,000 gallons) of diesel fuel leaked into a nearby ditch. The ditch contained the spill and most of the diesel fuel was recovered.

An inspection of the runaway cars revealed that the angle cock on the lead car was closed and hand brakes had not been applied to any of the cars. The air brakes were released.

1.2 Damage to Equipment

One box car was damaged beyond repair, one locomotive and seven cars were extensively damaged, and six cars were slightly damaged.

1.3 Other Damage

Approximately 200 feet of track was destroyed.

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

1.4 Personnel Information

The train crew consisted of a conductor, a locomotive engineer and a trainman. All crew members were qualified for their respective positions and met fitness and rest standards established to ensure the safe operation of trains.

1.5 Train Information

The runaway train included 29 mixed cars, loaded and empty, and 30 tank cars containing a residue of a regulated product. The train weighed approximately 3,600 tons and was about 3,000 feet long.

1.6 Particulars of the Track

The subdivision consists of a single main track, with a maximum descending grade of 0.16 per cent northward from Mile 13.58. The track is level at the switch leading into the Lama spur track. The Lama Spur is approximately 1,060 feet long with stop blocks installed at the end.

1.7 Occurrence Site Information

The spur is a private track connected to the main track in a nine-degree curve branching off to the west. The Lama Warehouse is located on the east side of the spur.

1.8 Method of Train Control

Train movements on the Bécancour Subdivision are governed by the Occupancy Control System (OCS) authorized by the Canadian Rail Operating Rules (CROR) and supervised by a rail traffic controller (RTC) located in Montreal.

1.9 Weather

The temperature was minus two degrees Celsius, and there was no wind or precipitation.

1.10 Other Information

1.10.1 Crew Actions

The crew had a pre-job briefing to discuss the work that had to be done on their tour of duty. These briefings do not normally include the method or procedures to be used in the securement of the cars to be left on the main track, and this briefing was no exception.

The locomotive engineer brought the train to a stop at Mile 13.58 by making a full service brake application. After being satisfied that the application was complete, the locomotive engineer advised the trainman by radio that he could proceed with uncoupling the train. The trainman then closed the angle cocks between the trailing locomotive and the lead car, uncoupled the train and rode the trailing locomotive to the spur. Before this movement, the conductor, who had been completing paperwork in the locomotive cab, moved into position on the forward platform of the lead locomotive. It was common practice for the trainman to leave the angle cock closed on cars left standing while switching.

The conductor lined the switch at Mile 14.4 and set the derail in the non-derailing position. The locomotives were moved onto the spur and coupled to the cars at the loading ramps. While the trainman was connecting the air hoses between the cars, the collision occurred.

The train was equipped with a Train Information and Braking System (TIBS) consisting of a Sense and Brake Unit (SBU) mounted on the last car of the equipment left standing on the main track and an Input and Display Unit (IDU) in the locomotive cab. The IDU displays the pressure in the brake pipe, emits an audible alarm when pressure drops below 48 pounds per square inch, and warns of zero brake pipe pressure. Also, movement of standing cars causes the display on the IDU to indicate the direction of movement of the car on which the IDU is mounted. The locomotive engineer did not notice that the cars were moving. The TIBS is equipped with an emergency braking feature that can be used to remotely trigger an emergency brake application.

1.10.2 Operating Rules and Instructions

1.10.2.1 Canadian Rail Operating Rules

At the time of the occurrence, CROR Rule 112 was in force, as stated in the following:

> *Unless otherwise directed by special instructions*, a sufficient number of hand brakes must be applied on *equipment left* at any point to prevent it from moving. If left on a siding, it must be coupled to other equipment, if any, on such track unless it is necessary to separate such equipment at a public crossing at grade or elsewhere. (*emphasis added*)

Also, at the time of the occurrence, there were no special instructions whereby employees were **not** to apply hand brakes in circumstances such as when setting out or picking up cars. It was, however, railway practice not to apply hand brakes when equipment was left for short periods if the equipment could be seen by the crew (such as when setting out or picking up equipment on spurs and sidings).

1.10.2.2 CN General Operating Instructions

CN General Operating Instructions (GOI) 7.2, *General*, item (k) states:

> Whenever a locomotive is detached from equipment, such equipment must be left with the angle cock fully opened and the air brakes applied in emergency or full service. If a full service application is used, the angle cock on the equipment to be left, must not be closed until the application is completed. The angle cock must then be opened slowly.

This instruction is designed to prevent train crews from closing the angle cocks between the locomotive(s) and the lead car before the brake pipe pressure reduction used to apply the service brake is completely exhausted (as determined by the locomotive engineer listening to venting from the service exhaust at the automatic brake valve). Closing the angle cocks prematurely can cause a pressure wave in the brake pipe, which can activate the quick release feature in the air brake control on the individual cars. These valves are designed to sense increases in brake pipe pressure (a brake release) and relay this signal with a burst of air from the auxiliary reservoir to speed up the brake release process. As little as 1.5 pounds of pressure differential can activate the quick release feature, and once activated on one car, it will trigger other control valves and propagate an unintended brake release throughout an entire train.

Opening the angle cock and exhausting the brake pipe after the brake application is complete will result in a full service brake application if one had not initially been made, or will reapply the brakes if they had been unintentionally released. Exhausting the brake pipe will also result in a condition in which a further change to the state of the air brake system is impossible as the brake pipe, or controlling mechanism, has no air pressure.

In addition, GOI 7.3, *Unintentional Release*, item (a) states:

> When uncoupling brake pipe whenever a locomotive is detached from equipment, such equipment must be left with the angle cock fully opened.

1.10.3 TSB 1992 Recommendation for Securing Standing Equipment

As a result of TSB's concern over the frequency of runaways on Canadian railways, and an investigation into a specific runaway occurrence (TSB report No. R90H0923), the TSB made the following recommendation which it forwarded to the Minister of Transport. The TSB recommended that:

> The Department of Transport conduct a field assessment of the adequacy of training and supervision by Canadian railways to ensure that personnel are correctly applying standard operating procedures when securing standing cars.
>
> (R92-14, issued September 1992)

In response, Transport Canada acknowledged its concern with respect to runaways and the apparent failure of railway employees to observe existing regulations and rules. Transport Canada advised that it had intensified the monitoring of railway performance in the areas of training and supervision to ensure that deficiencies were acted upon.

1.10.4 Recent Safety Initiatives

On 14 August 1995, CN issued Circular L-4797 to all running trades personnel, with specific reference to car securement practices, entitled *Runaway cars: Unintentional Release*. The circular reinforced compliance with CROR Rule 112 and items 7.2 (k) and 7.3(a) of the GOI as previously stated.

On 23 August 1995, CN issued instructions to Train Service Managers outlining a comprehensive plan to reinforce the GOI requirements. The plan included:

- Issuing a circular to all employees with regard to the articles in the rules pertaining to runaway cars.
- Putting up safety posters at all pertinent locations, well within view of employees.
- Conducting a rules awareness campaign aimed at train crews.
- Conducting random spot checks on the braking systems of cars left on the tracks.
- Posting the Safety Flash bulletin on runaway cars in a prominent area.
- Discussing the issue with the Occupational Safety and Health Committees and enlisting members' support to help raise awareness among employees.
- Conducting a second awareness campaign with the Safety Partners (Montreal area) to inform and make train service employees aware of proper work methods.

The managers were asked to meet with the train crews under their jurisdiction in order to discuss CROR Rule 112 and its Special Instruction, and GOI 7.2 and 7.3. It was outlined that it was important to not only explain the proper work methods to train crews, but also to determine whether these methods were indeed being applied. To this end, they were asked to check the condition of the braking system of cars left on the track.

It was also suggested that the managers discuss the problem of runaway cars at their next Safety and Health Committee meeting, and look at various ways of making employees aware of the issue and of ways of preventing the problem.

On 21 September 1995, CN issued a "Safety Flash" pertaining to runaway equipment, advising that there had been several runaway incidents during the preceding weeks, and that utmost caution had to be exercised to

eliminate accident risks. Common sense and adherence to rules and instructions had to be the guiding principles at all times.

CN management conducted impromptu spot checks among train/yard crews at 26 locations in the Champlain District on 15, 19 and 22 February 1996 to determine work practices for compliance with operating rules and GOI as directed by the 23 August 1995 plan. Two failures to comply with GOI item 7.2(k) were observed. The locomotive engineer recalled having been checked with regard to the 23 August 1995 initiative. The crew was conversant with GOI item 7.2(k) as conveyed by company publications.

1.10.5 Post-Edson Procedure

Following the main track collision near Edson, Alberta (12 August 1996), CN issued a special instruction pertaining to the securement of equipment (the "Minimum Handbrake Application Chart") and "guideline points" in respect of that special instruction. The "Minimum Handbrake Application Chart" removed the vagueness of "sufficient number of hand brakes" in Rule 112 by specifying the number of hand brakes in relation to the number of cars to be secured. One of the guideline points related to the interpretation of what "equipment left" meant, which also made the rule more specific. The subject guideline stated:

> Rule 112 is written in terms of "equipment left" and in this regard a train operating in pick up service or when a train is setting out cars, is not defined as "equipment left." To this end, if a train stops to pick up or set out cars, the train need not be secured by hand brakes when the requirements of GOI 7.2(k) have been complied with. However, in saying this, such is not the case when the train left standing on the main track is not viewed by the crew as such eliminates the ability to generate an emergency application of the air brakes from the IDU (the Information and Display Unit).

This guideline essentially exempts employees from having to apply hand brakes on equipment left under Rule 112 and the associated Minimum Handbrake Application Chart, if: a) the cars are being set out or picked up; b) the cars are left with an emergency or full service brake application with angle cocks operated in accordance with the provisions of GOI item 7.2(k); and c) the equipment can be seen by the crew so that the crew can initiate an emergency brake application on the equipment through the use of the TIBS.

This new procedure is in recognition of the efficiency of such a system (with no need to apply and release a number of hand brakes) and the realization that the application of hand brakes does not always guarantee that cars will not run away. Cars left with air brakes in a full service

application or in emergency will not move until the brakes are released or pressure in the brake cylinders leaks off, a process that takes hours if not days. Therefore, it would be important to identify a means of ensuring the fail-safe use of air brakes under such circumstances.

Information gathered during this investigation indicates that Transport Canada does not agree with leaving cars standing under any circumstances without an appropriate number of hand brakes applied.

2.0 Analysis

2.1 Introduction

This accident resulted in very serious injury to a crew member and heavy damage to tank cars containing residues of a dangerous product. As well, a locomotive fuel tank was punctured, leaking considerable diesel fuel.

Accidents of this type occur in spite of the railways' efforts to educate operating crews to follow safe procedures. The analysis will therefore discuss the issue of non-compliance with company instructions and the apparent ineffectiveness of company attempts to ensure that safe procedures are always followed. The susceptibility of locomotive fuel tanks to puncture and the subsequent release of products will also be explored.

2.2 General

Cars left with air brakes in a full service application or in emergency will not move until the brakes are released or pressure in the brake cylinders leaks off, a process that takes hours if not days. Therefore, it is important to identify a means of ensuring the fail-safe use of air brakes under such circumstances.

In this particular case, the standing cars were left on a grade, secured with a full service brake application and a charged brake pipe and were therefore susceptible to a self-propagating brake release and runaway. The unsafe manner in which the cars were left was not in compliance with the CROR or company instructions.

Although it is remotely possible that a malfunctioning brake valve in one of the cars resulted in an activation of the quick release feature throughout the train, no such malfunction was found. It is most probable that improper handling of the angle cocks at uncoupling precipitated the brake release. Closing the angle cock on the first car before the brake pipe pressure reduction was fully exhausted would have created a pressure wave in the brake pipe and, consequently, the pressure increase necessary to initiate the unintentional and unnoticed brake release and subsequent runaway.

2.2.1 Securement with Air Brakes

CN's attempts to educate its operating crews on the appropriate securement of equipment with air brakes have been extensive but have not had the desired result. Similarly, Transport Canada's monitoring has not had an apparent impact. It would appear that the ease with which a train can be left with a fully charged brake pipe and then recoupled in an almost ready-to-go state, combined with most crews' experience that such a procedure is safe, may have led to a widespread acceptance of an unsafe operating practice.
Canadian Pacific Railway (CPR) also has a procedure for leaving cars standing for short periods of time, but it specifies that such cars must be left in an emergency brake application. This procedure precludes the need to be careful in handling the angle cocks and ensures that the standing cars are left with maximum braking effort and a fully exhausted brake pipe to prevent any unintended signal propagation. From a procedural viewpoint, CPR

has seemingly overcome the propensity for train crews to leave cars standing with a charged brake pipe for the sake of efficiency (even though it can be time-consuming to recover train air pressure after an emergency brake application).

2.2.2 Secondary Defence Systems

The "defence in depth" philosophy advocated by safety specialists seeks multiple and diverse lines of defence to mitigate the risks of normal human errors. In this occurrence, one additional line of defence was in place but it too was subject to human error. The TIBS is, in effect, a secondary defence system which can be used to assist in identifying and stopping runaway cars. The SBU provides a display of the brake pipe pressure on the IDU which could be used by the locomotive engineer to ascertain whether the brake pipe on the standing equipment is charged or not charged. This allows the locomotive engineer to monitor the brake pipe pressure of equipment left standing and, if procedures are not followed, to intervene by triggering a remote application of the emergency brakes. The IDU may also indicate motion. If the cars are left standing under GOI item 7.2(k), the brake pipe pressure should be zero.

In this occurrence, this secondary system provided no additional safety margin when the primary system established by the GOI failed. In fact, it may be that, when train crews were provided with the means to stop a runaway by remote control, this had an impact on practices in that they may have been more likely to leave the brake pipe charged when securing cars.

The strict application of Rule 112 would have provided yet another means of securing the cars. However, for operational reasons, the industry has moved away from requiring the application of hand brakes when trains stop to pick up or set out cars.

While the application of hand brakes may not be the only means of ensuring that cars do not move in these circumstances, this occurrence demonstrates the need to develop effective operating practices which are more resistant to normal human error.

2.2.3 Fuel Tank Punctures

Although a significant amount of diesel fuel was released, it was easily contained and did not ignite. The locomotive fuel tanks involved in this occurrence were not designed to be puncture-proof and, when punctured, the design did not allow for the mitigation of fuel loss. The Railway Locomotive Inspection and Safety Rules, which came into effect on 18 March 1998, require that fuel tanks on new locomotives be of high impact resistant design, and meet or exceed current standards of the Association of American Railroads *Manual of Standards and Recommended Practices*. The new standards do not apply to the 3,000 locomotives that will remain in service on Canadian railways for approximately another 17 years.

3.0 Conclusions

3.1 Findings

1. The 59 cars were left standing on a grade with a charged brake pipe when the air brakes released unintentionally.

2. The brake release was most probably the result of a pressure wave being created in the brake pipe when the angle cocks between the locomotive consist and the first car were closed before the brake pipe had fully vented.

3. The brake release would not have occurred if there had been strict compliance with CN's General Operating Instruction requiring that the angle cock be left fully opened and that the air brakes be applied in emergency or full service.

4. The development of a means to ensure the fail-safe use of air brakes to secure cars left standing would improve safety.

5. A secondary defence system, available to the crew in these circumstances, proved ineffective when the locomotive engineer did not notice the Input and Display Unit movement display and did not, therefore, initiate a remote application of the emergency brakes.

3.2 Causes

The 59 cars were left secured with air brakes and an unvented brake pipe, and the train brakes were released by the inadvertent activation of the cars' pressure-sensitive quick release feature by a pressure wave created in the train brake pipe at uncoupling.

4.0 Safety Action

4.1 Action Taken

CN has re-issued the Job Aid/Special Instruction pertaining to CROR Rule 112 (Securing Equipment) for en route switching at main track or siding locations. CN has mandated that a portion of a train may be left on the main track or siding without hand brakes applied, providing that the standing portion left is 10 cars or more and has air brakes applied in full service or emergency, and the angle cock is left fully open. The grade must not be in excess of 1.5 per cent and the cars cannot be left in excess of two hours. If the above conditions cannot be met, hand brakes must be applied as per the Minimum Handbrake Application Chart during the switching process.

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 15 October 1998.