RAILWAY OCCURRENCE REPORT
NUMBER R96C0086

RUNAWAY TRAIN

CANADIAN PACIFIC RAILWAY
FREIGHT TRAIN NO. 607-042
MILE 133.0, LAGGAN SUBDIVISION
FIELD, BRITISH COLUMBIA
13 APRIL 1996

Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

Railway Occurrence Report

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Synopsis

On 13 April 1996, Canadian Pacific Railway (CPR) freight train No. 607-042 was travelling from Calgary, Alberta, to Field, British Columbia, on the Laggan Subdivision. After the train departed the east switch at Cathedral, Mile 131.9, it began to accelerate and the locomotive engineer made several unsuccessful attempts to control the train speed. The train continued out of control on the steep downgrade for approximately four miles and eventually was brought to a stop at Mile 0.15 of the adjoining Mountain Subdivision, at approximately 0335 mountain daylight time. No injuries or damage resulted from this occurrence.

The Board determined that the train was inappropriately set in motion with a depleted air brake system under circumstances which precluded regaining effective braking while under way. Several factors,

including the decision not to use retainers, lack of adherence to related instructions, the many brake applications, and the conductor's lack of understanding of Locotrol operation, may have contributed to this occurrence.

Ce rapport est également disponible en français.

1.0 Factual Information

1.1 The Incident

On 12 April 1996, Canadian Pacific Railway (CPR) train No. 607-042 departed Calgary, Mile 0.0 of the Laggan Subdivision, at approximately 1725, travelling westward and destined for Field, Mile 136.6. The trip between Calgary and Stephen (Mile 123.0) was without incident.

At Stephen, the train was brought to a stop at Signal 1229 to comply with a "Stop" signal indication. The rail traffic controller (RTC) advised the train crew that the signal code line was out of service between Mile 92.7 and Mile 136.6. The RTC issued authorization, under Canadian Rail Operating Rules (CROR) Rule 564, for the train to proceed after the required stop at signals 1275, 1287 and 1319. The RTC further instructed the train crew not to pass Signal 1331, despite the indication displayed, until authorized by the RTC.

After the train had negotiated the Upper Spiral Tunnel (Mile 128.8), the locomotive engineer had difficulty maintaining a constant speed and the train eventually began to travel out of control. The train was brought to a stop at Mile 0.15 on the adjoining Mountain Subdivision.

1.2 The Occurrence Site

The Laggan Subdivision is a single main track that extends from Calgary to Field. The track traverses rugged mountainous terrain, tunnels, steep grades and many sharp curves. From Stephen to Field, the descending grade varies between 1.7 per cent and 2.4 per cent. This portion of the track is commonly called Field Hill. At Field, the track joins onto the Mountain Subdivision (see Appendix A).

The authorized westward speed between Mile 122.9 and Mile 136.6 is 20 mph for freight trains.

1.3 Train Information

The train, powered by 4 locomotives, was hauling 112 loaded cars. It was approximately 6,900 feet long and weighed about 14,800 tons. The train was operating as a Locotrol locomotive train, with two head-end locomotives and two remote locomotives located behind the 56th car from the head end.

After the incident, the train was inspected and tested by CPR shop personnel. The train brakes were determined to be in satisfactory working condition and the Locotrol system functioned as intended.

1.4 Locotrol System

1.4.1 General

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times are mountain daylight time (coordinated universal time (UTC) minus six hours) unless otherwise
ed.

Locotrol is a system to control remote locomotive consists located within the body of a train. Command signals are transmitted via a radio link from the head-end locomotive. The system can be used in either the multiple-unit mode or the independent mode. When the multiple-unit mode is used, train operation control signals used by the locomotive engineer are mirrored in the remote locomotives. When conditions require the operation of the head-end consist and the remote consist at different throttle levels and/or dynamic braking levels, the independent mode is used. A mode selector switch and independent controls on the head-end locomotive control console provide for this method of control.

1.4.2 Safety Features

The Locotrol system is equipped with safety features including:

a) Low Brake Pipe Pressure Sensor

Should the brake pipe pressure be reduced to less than 45 pounds per square inch (psi), the low brake pipe pressure feature causes an emergency brake application.

b) Communication Interrupt Alert

A "COMM INT" indicator on the locomotive control console is illuminated if radio communication between the head-end locomotives and the remote locomotives is interrupted. The head-end locomotive will declare a communication interrupt 45 seconds after the last successful check (the system automatically checks radio signal continuity every 20 seconds) or 10 seconds after an unsuccessful automatic brake application message. In a state of communication interrupt, the remote locomotives assume a state of automatic override and remain in the state of throttle and/or dynamic braking that existed just before the loss of radio communication. An attempt to initiate an automatic brake release (brake pipe pressure rise) during a state of communication interrupt will be sensed in the remote locomotives and will result in an emergency brake application. A 10 psi or greater brake pipe reduction (automatic brake application) will circumvent the override feature and allow air brake operation throughout the train.

While travelling through the Upper and Lower Spiral Tunnels, radio communication is typically interrupted between the head-end locomotives and remote locomotives. This situation is expected by locomotive engineers and taken into account when they operate on Field Hill.

1.5 Pneumatic Control Switch

The pneumatic control switch (PC) is an air-operated electrical switch that may automatically reduce the locomotive engine speed to idle and/or nullify power. An illumination of the PC light on the locomotive control console shows that a power cut-off has been initiated in the remote locomotives, usually after an emergency brake application.

1.6 Air Brake Operation

Canadian railways employ a braking system actuated by compressed air. The air brake system consists of sub-systems connected to each other and the locomotives by means of a pipe (brake pipe). Car sub-systems consist of pneumatic and mechanical components capable of translating air pressure, directed into brake cylinders, into mechanical force at the wheels. The locomotive supplies the compressed air. The locomotive engineer operates the brakes by adjusting the air pressure in the brake pipe through manipulation of the automatic brake valve.

Control valves on the individual cars and locomotives respond to controlled changes in brake pipe pressure. A reduction in brake pipe pressure causes the control valves on the individual cars to release air from auxiliary reservoirs, located on each car, to the brake cylinders. The level of braking is directly proportional to the reduction of brake pipe pressure through the automatic brake valve.

Every car is equipped with an auxiliary reservoir and an emergency reservoir. The auxiliary reservoir provides stored air for normal brake applications. The emergency reservoir is to provide additional air for emergency braking. Both reservoirs are connected through the control valves. Recharging the system with compressed air directed through the brake pipe from the locomotives replaces air in both reservoirs.

Freight train brakes are of the direct-release style; therefore, no partial release of brake cylinder pressure is possible unless retainers are set. Whenever the automatic brake valve is moved to the release (charging) position, the brake cylinder pressure is exhausted.

The retainer valve controls the exhaust of brake cylinder pressure and may be manually set either: a) to allow brake cylinder pressure to exhaust to the atmosphere; or b) to retain a portion of the brake cylinder pressure to aid in retarding the train on descending grades while the air brake system is being recharged, or to allow a slow direct and complete exhaust of the brake cylinder pressure. All freight cars are equipped with retainer valves. The valve is located at the “B” end of the car, or at the side of the car near the control valve.

1.6.1 Recharging the Air Brake System

Use of the Automatic Brake Valve, Section 16, Item 3.5, of CPR's General Operating Instructions states that:

> Should locomotive brake pipe pressure be reduced below 48 psi during service brake operation, the train must be stopped and the brake system recharged.

Emergency Brake Application Recovery, Section 17, Item 19.1, of CPR's General Operating Instructions states that:

> If considered necessary, a sufficient number of handbrakes must be applied to prevent train movement while attempting to recover the emergency PC and recharge the train air brake system.

Retainer Valves, Section 19, Item 5.9, of CPR's General Operating Instructions states that:

> The retainer valve . . . may be used . . . to retain a portion of the brake cylinder pressure to aid in retarding the train on descending grades while the air brake system is being recharged . . . .

Section 15, Item 28.4 also pertains to use of retainers, stating:

b) Retaining valves must be used on any downgrade where in the judgement of the locomotive engineer their use is considered necessary. Handles should be placed in high pressure position on loaded cars and in slow direct position on empty cars.

When recharging the air brake system, sufficient time must be allowed to permit the air to flow through the associated pipes and ports and into the reservoirs in the entire air brake system. The approximate time required to recharge a depleted air brake system in a 50-car train is about 15 minutes, and in a 150-car train, about 40 minutes. Cold ambient temperature can adversely affect charging times. Repetitive applications of the air brakes, without recharging, will deplete the auxiliary reservoirs. Should the emergency reservoirs also be depleted, the ability of the air brake system to stop a train is lost.

1.7 Central Locomotive Specialist

A central locomotive specialist (CLS) helps, through radio communication with train crews, in reducing train delays when on-line locomotives and Locotrol failures occur. The role of a CLS is to provide ongoing expertise and technical support to locomotive engineers dealing with those failures. The services of the CLS are available to train crews through contact with the RTC.

The CLS is also responsible for analysing and recording locomotive and Locotrol defects, as well as identifying locomotives that are potential problems.

1.8 Train Movements

1.8.1 Method of Train Control

Train movements on the Laggan Subdivision are governed by the Centralized Traffic Control System authorized by the CROR and CPR's General Operating Instructions, and are supervised by an RTC in Calgary.

1.8.2 CROR Rule 564: Stopped by a Stop Signal

A train must have authority to pass a signal indicating "Stop" and, when so authorized, a stop must be made at each such signal. The train must then move at restricted speed, maximum of 15 mph, to the next signal.

The RTC issued authorization to the locomotive engineer to pass signals 1275, 1287 and 1319 under the authority of CROR Rule 564.

1.9 The Runaway

At signals 1275 and 1287, the train was successfully brought to a stop without incident. Towards the Upper Spiral Tunnel, the locomotive engineer was controlling train speed in independent mode by applying the air brakes on the train and by using the dynamic brakes on the head-end locomotives. As the train started to slow, the locomotive engineer increased the throttle level on the remote locomotives. When the head-end locomotive entered the Upper Spiral Tunnel, train speed began to increase. To slow the train, the locomotive engineer reduced the throttle level on the remote locomotives; however, the signal was not received and the throttle position and the train speed did not decrease because a communication interrupt had occurred when the head-end locomotive entered the tunnel.

The locomotive engineer then switched the Locotrol setting from the independent mode to the multiple-unit mode and continued dynamic braking on the head-end locomotives. Radio communication was momentarily restored as the head-end locomotive exited the tunnel. The remote locomotives immediately duplicated the dynamic braking that was on the head-end locomotives. As the remote locomotives entered the tunnel, radio communication was again interrupted with the remote locomotives in dynamic braking. The train began to stall and the locomotive engineer released the air brakes which resulted in an emergency brake application because of the brake pipe pressure rise during a state of communication interrupt. The train came to a stop with the remote locomotives inside the tunnel.

The locomotive engineer informed the RTC of the stopped train and requested the assistance of the CLS. The CLS radioed the train crew and suggested that the remote locomotives be cut out to recover from the emergency brake application. The remote locomotives could then be pulled out of the tunnel and radio communication would then be restored.

After receiving instruction from the locomotive engineer, the conductor walked back to cut out the remote locomotives. Upon arrival, the conductor closed the angle cock behind the remote locomotives to maintain the brake pipe pressure and the emergency brake application on the rear of the train. While cutting out the remote locomotives, he unintentionally triggered two emergency brake applications and was uncertain if he had successfully carried out the task as intended. He then returned the angle cock behind the remote locomotives to the open position which resulted in the release of the train brakes. The locomotive engineer was then able to pull the remote locomotives out of the tunnel.

Locotrol radio communication was then restored and the locomotive engineer prepared to proceed. As the train began to move, another emergency brake application occurred as the brake pipe pressure was now below 45 psi on the remote consist. At this point, the conductor asked the locomotive engineer if the retainer valves should be used while the air brake system was recharging. The locomotive engineer replied that he would recover from the emergency brake application and recharge the air brake system while under way.

Once the brakes were released and as the train travelled towards Cathedral, the locomotive engineer had difficulty in controlling train speed and he initiated an emergency brake application. At Signal 1319, the locomotive engineer used another emergency brake application to bring the train to a stop. At this point, the RTC advised the locomotive engineer that the signal code line was now restored and that the CROR Rule 564 requirement to stop at Signal 1331 was cancelled. Once the brakes were released (Mile 131.9), train speed increased rapidly. The locomotive engineer unsuccessfully attempted to control the speed of the train by initiating emergency brake applications, each time attempting to recharge the air brake system. During this time, the locomotive engineer announced via the radio that the train was out of control. The conductor then contacted the RTC and advised him of the situation. The RTC, in turn, notified the RTC on the adjoining Mountain Subdivision, and requested that the switches be lined to allow the train to pass through Field along the Mountain Subdivision main track. The train was finally stopped three car lengths west of Signal 15 at the west end of Field Yard on the Mountain Subdivision.

1.10 Injuries

There were no injuries.

1.11 Damage

There was no damage to railway equipment or to the railway track.

1.12 Personnel Information

The train crew consisted of a locomotive engineer and a conductor who were both positioned in the lead locomotive. The crew members were qualified for their respective positions and met fitness and rest standards established to ensure the safe operation of trains.

The locomotive engineer qualified as a locomotive engineer in 1983 and was promoted in 1993. He had eight years' experience on the Field Hill as a conductor and locomotive engineer and had completed an estimated 1,000 trips without incident, of which over 100 were with Locotrol trains. He had last operated a

Locotrol train on the Field Hill on 01 April 1996.

The conductor was qualified in 1989. For the past two years he had worked mostly on the Laggan and Red Deer subdivisions, and had very little experience on Locotrol trains operating on Field Hill. He did not have any formal training in the operation of Locotrol trains.

The company does not train conductors in Locotrol operation, as locomotive engineers are responsible for the operation of the engines on a train. A train will, however, run under the direction of its conductor.

1.13 Event Recorder Information

The event recorder transcript supports the sequence of events as described by the train crew.

1.14 Weather

The temperature was 10 degrees Celsius. The skies were clear with light winds.

1.15 Other Information

1.15.1 Respirators

1.15.1.1 Monthly Operating Bulletin

The following is information provided to all CPR operating employees in the Monthly Operating Bulletin:

> In the event of a train stopping in the Upper and Lower Spiral Tunnels (miles 128.8 and 131.0), it may be necessary for the train crew to enter the tunnel during adverse atmospheric conditions (from the exhaust of the diesel locomotives). Respiratory Protection has been installed in both tunnels, and must be used when the conditions warrant. (The procedures and instructions to be followed are detailed as part of this bulletin).

CPR Company Respiratory Protection Policy, Safety & Health and Accident Prevention Policies (Form 300-4), outlines the directives for employees when operating in confined space areas where the possibility of exposure to substance hazards (e.g. exhaust from diesel locomotives) is likely.

Respirators are required for employees performing work in a confined space. They are available at the entrance and exit of the Upper Spiral Tunnel, and 1,000 feet inside each end of the tunnel.

The conductor did not feel he needed to use a respirator when he entered the Upper Spiral Tunnel to cut out the remote locomotives. He had been trained in the use of respirators and had been instructed in the need for their use.

2.0 Analysis

2.1 Introduction

Since the decisions and actions of the locomotive engineer ultimately resulted in the train's air brakes becoming ineffective as the train travelled down Field Hill, the analysis focussed primarily on those areas that likely affected the locomotive engineer's ability to slow the train.

2.2 Consideration of the Facts

2.2.1 Effectiveness of the Air Brake System

When the remote locomotives were pulled out of the Upper Spiral Tunnel, the locomotive engineer had the choice of recharging the air brake system either by setting retainers to retard the train while it continued down Field Hill and recharging the brake system, or by stopping the train, applying a sufficient number of hand brakes and recharging the train. However, rather than setting retainers or applying hand brakes, he attempted to recharge the system while descending Field Hill. He continued to deplete the auxiliary air reservoirs through braking action. At Signal 1319, the west end of Cathedral, the train came to a stop and it was at this point that the locomotive engineer made a critical judgement error. He had another opportunity to recharge the brake system by applying hand brakes, but he continued to attempt to recharge while under way. At this point, the effectiveness of the air brakes was lost as the air in the reservoirs had been depleted. By the time the train exited Cathedral, there was not enough air in the system to even respond to operator-initiated emergency brake applications, leaving the train out of control. The locomotive engineer should have quickly realized, after the first couple of emergency brake applications, that the braking effectiveness was substantially reduced, and then taken appropriate action to fully recharge the air brake system.

2.2.2 Locomotive Engineer's Actions

The following factors are pertinent to the locomotive engineer's decision making:

1. Multiple Stop Requirements

   The requirement to operate the train at restricted speed (15 mph) as well as stop at signals 1275, 1287 and 1319, especially under the geographic conditions at Field Hill, would have created a relatively novel situation for the train crew. The locomotive engineer did not effectively adapt available instructions and procedures to the circumstances. Unfortunately, his decision to recharge the air brake system while travelling downhill was not correctly evaluated prior to its implementation.

2. The Loss of Radio Continuity within the Upper Spiral Tunnel

The interrupted communications between the head-end and the remote locomotives and the associated train-handling actions would have added to the complexity of the situation facing the crew, and increased their cognitive workload. This additional workload may have had a negative impact on the ability of the locomotive engineer to assess the choices available to him when developing his plan to proceed from the tunnel, i.e. whether to recharge the air brake system in situ or while under way.

3. Emergency Brake Applications

As the train travelled down Field Hill, it experienced numerous emergency brake applications, both train-initiated and operator-initiated. With each emergency brake application, the emergency air reservoir was further depleted. The locomotive engineer would have been aware that the air in the brake system was being depleted; however, his assessment that the required braking power could be maintained was faulty. His assessment was probably influenced by the fact that he had been able to slow down and then stop the train when approaching Signal 1319.

4. Conductor Training

The conductor was not required to be either trained as a locomotive engineer or familiar with the Locotrol system of operation. Such knowledge, reinforced with periodic refresher training and supported by supervisory activity, might have been helpful in these circumstances. The conductor was not well prepared to identify and assess situational cues, and assist in the formulation, implementation and assessment of plans based on such information. For example, with formal training, the conductor would have known exactly what to do during the stall in the tunnel when he walked back to cut out the remote locomotives, thereby easing the responsibility from the locomotive engineer. Had the conductor been more familiar with the Locotrol system, he also might have been more successful in convincing the locomotive engineer that the retainer valves should be used to assist in recharging the air brake system. As it was, the conductor's suggestion was dismissed by the locomotive engineer, although this suggestion was appropriate for the circumstances. In the absence of formal conductor training in this regard, the decision making rested largely with the locomotive engineer operating in isolation.

2.2.3 Rail Traffic Controller's Actions

It cannot be said categorically that issuing multiple Rule 564s is an unsafe decision, but on Field Hill, it may have represented a greater risk than the RTC understood. Notwithstanding that the multiple 564 requirements should have reinforced the need to maintain a charged brake system, it would have been safer to stop the train until the signal code line was restored to service.

If the locomotive engineer had detailed to the RTC the problems he was having, particularly the many train-initiated emergency brake applications, the RTC could have become aware that the situation was far from normal. He could then have further consulted the appropriate operating specialist.

2.2.4 Radio Continuity in Upper and Lower Spiral Tunnels

If a radio communication system existed within the Upper and Lower Spiral Tunnels, radio continuity would not have been interrupted as a train passed through. If such a system had been in place in the Upper Spiral Tunnel, the change in operating mode from the independent mode to the multiple-unit mode could have been immediately corrected, thus avoiding the stall.

The company had previously assessed this issue. It determined that the cost of repeaters in tunnels to remove the short communications outages in Locotrol could not be justified and that the equipment design is adequate to compensate for the short outages under normal circumstances.

2.2.5 Use of Respirators in Tunnels

Although respirators were available for use at the entrance to the Upper Spiral Tunnel, the conductor did not use one when he went into the tunnel to cut out the remote locomotives. He had been instructed on the use and requirements of respirators, but made the decision not to make use of one while in the tunnel. In doing so, he may have jeopardized his safety, and that of the locomotive engineer.

3.0 Conclusions

3.1 Findings

1. The air brake system became ineffective as the train descended Field Hill because the air reservoirs were depleted.

2. The air reservoirs became depleted as a result of the repetitive braking action on the train.

3. The air brake system was not recharged once the air reservoirs were depleted.

4. The locomotive engineer attempted to recharge the air brake system while under way rather than setting retainer valves (as suggested by the conductor) or applying hand brakes while recharging.

5. Locotrol radio communication within the Upper and Lower Spiral Tunnels is intermittent, and failed in this occurrence.

6. The conductor was not trained in, or knowledgeable of, Locotrol operation and could not deal with tasks assigned by the locomotive engineer.

7. The conductor chose not to use a respirator when he entered the Upper Spiral Tunnel to cut out the remote locomotives, although it was required.

3.2 Cause

The train was inappropriately set in motion with a depleted air brake system under circumstances which precluded regaining effective braking while under way. Several factors, including the decision not to use retainers, lack of adherence to related instructions, the many brake applications, and the conductor's lack of understanding of the Locotrol operation, may have contributed to this occurrence.

4.0 Safety Action

Following this occurrence, CPR conducted a "Safety Blitz", from 01 to 03 May 1996, with the train crews operating on Field Hill, to deal with the following:

- the circumstances of the incident on 13 April 1996, regarding the uncontrolled movement of train 607;
- the Locotrol II system; and
- the use of air brakes and train handling on grades.

In addition, a team of managers accompanied all Laggan Subdivision crews over a 72-hour period immediately following the incident to highlight correct operating procedures.

CPR also distributed a Locotrol questionnaire to all crews on the Laggan Subdivision for both educational purposes and to evaluate additional training requirements.

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 27 May 1998.

Appendix A - Schematic of Field Hill