Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

RAILWAY INVESTIGATION REPORT
R05H0011

RUNAWAY AND MAIN-TRACK TRAIN COLLISION

OTTAWA CENTRAL RAILWAY
FREIGHT TRAIN NO. 441
MILE 34.69, ALEXANDRIA SUBDIVISION
MAXVILLE, ONTARIO
02 MAY 2005

Canada

Railway Investigation Report

Runaway and Main-Track Train Collision

Ottawa Central Railway
Freight Train No. 441
Mile 34.69, Alexandria Subdivision
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Report Number R05H0011

Summary

On 02 May 2005 at 0150 eastern daylight time, Ottawa Central Railway freight train No. 441 left 74 cars on the main-line track at Mile 34.65 of the Alexandria Subdivision, in Maxville, Ontario, while the head-end movement went to switch 2 cars into a customer's spur. As the movement entered the spur, the 74 cars rolled uncontrolled and collided with the movement. As a result of the collision, a low-pressure tank car loaded with denatured alcohol was punctured, and about 98 000 litres of product was released. Approximately 200 people were evacuated for eight hours. There was no derailment and there were no injuries.

Ce rapport est également disponible en français.

Other Factual Information

The Accident

On 02 May 2005 at 0031 eastern daylight time,[1] Ottawa Central Railway (OCR) freight train No. 441 (the train) departed Coteau, Quebec, on VIA Rail Canada Inc.'s (VIA) Alexandria Subdivision destined for Ottawa, Ontario. The crew consisted of a locomotive engineer and a conductor. Both were qualified for their respective positions, and met established fitness and rest standards. The train consisted of 3 locomotives and 78 cars (19 loads, 59 empties), weighed 4528 tons, and was 4818 feet long. En route, the train stopped at Mile 7.63 to set off one car at De Beaujeu, Quebec. While setting off the car, the crew left a cut of 77 cars standing on the main-line track with the air brake pipe charged. The setoff was performed without incident, the train recoupled and departed.

The train subsequently stopped at Maxville, Ontario (see Figure 1), and left 74 cars on the main-line track blocking the Main Street (Mile 34.23) and Prince Street (Mile 34.48) crossings. The head-end movement pulled westward to set off two cars into the MacEwen grain spur and stopped clear of the switch located at Mile 34.69, which leads into the spur. The conductor lined the switch for the spur and climbed on the lead car of the movement. As the movement was entering the spur, the conductor saw the 74 cars that had just been left on the main-line track rolling towards the head-end movement. He alerted the locomotive engineer who immediately initiated an emergency brake application on the head-end movement. The conductor jumped clear of the movement just before impact. The car leading the cut of 74 cars, box car CN 557596, collided with the lead car of the reversing head-end movement, tank car ADMX 29571, which was carrying a load of denatured alcohol (UN 1987). As a result of the collision, the tank car was punctured in the tank head, releasing product.

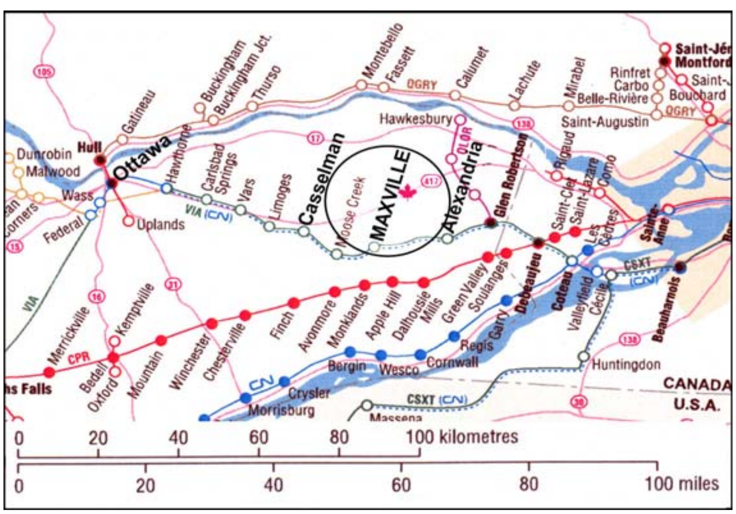

Figure 1. Maxville, Ontario (Source: Railway Association of Canada, *Canadian Railway Atlas*)

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[1] All times are eastern daylight time (Coordinated Universal Time minus four hours).

The *2004 Emergency Response Guidebook* identifies denatured alcohol (ethanol blended with 3 to 5 per cent gasoline) as a highly flammable liquid, easily ignited by sparks or flames. It is clear and colorless with a characteristic odour and a flashpoint near -20°C (-5°F). Its vapours are heavier than air and may become explosive. In liquid form, it is soluble in water. The guidebook advises to keep sources of ignition away from the material, build dykes to prevent entry into water systems, and consider evacuating people located 300 metres downwind of a large spill. The evacuation area may be extended depending on circumstances.

At the time of the accident, the temperature was approximately 3°C with a clear sky. The relative humidity was 85 per cent, the wind was from the west at 22 km/h, and visibility was 24 km.

Site Examination

The two cars that collided, box car CN 557596 and tank car ADMX 29571, sustained impact damage. The B-end truck of the box car was displaced and pushed about 20 feet inward. The tank car head was dented and sustained a six-inch-long by two-inch-wide puncture (see Photo 1) caused by the box car's coupler.

Photo 1. Coupler of box car CN 557596 and punctured tank car ADMX 29571

No pre-derailment damage of the equipment was observed and there was no track damage. It was noted that the angle cock on the B-end of the box car was fully closed (see Photo 2).

Photo 2. Closed angle cock of box car CN 557596

Track Information

Train movements on the subdivision are governed by the Centralized Traffic Control system as authorized by the *Canadian Rail Operating Rules* (CROR) and supervised by a rail traffic controller (RTC) located in Montréal, Quebec. Daily rail traffic consists of 10 VIA passenger trains and 2 OCR freight trains per day.

In the area of the accident, the track has an average descending grade of 0.5 per cent between Mile 33.0 and the MacEwen spur switch at Mile 34.69. West of the switch, the track levels off for about 280 feet. A signalled siding runs along the north side of the track from Mile 34.43 to Mile 35.73. There is an eight-foot-deep drainage ditch on the south side of the track (see Figure 2).

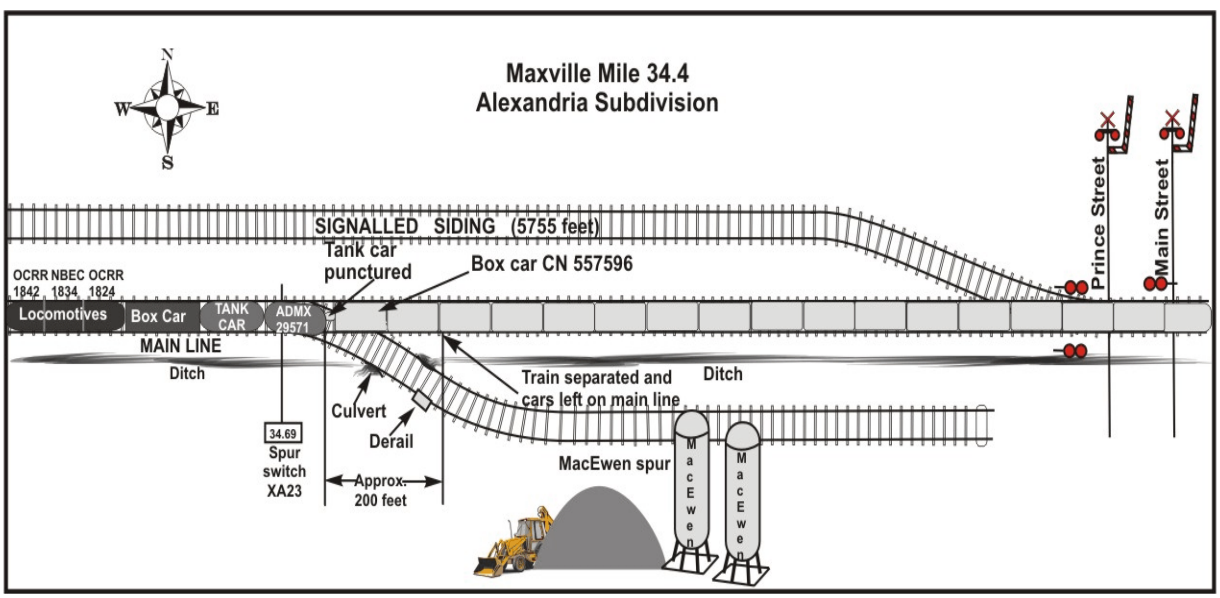

Figure 2. Accident site diagram

The track was in good condition, and was inspected and maintained in accordance with the *Railway Track Safety Rules* approved by Transport Canada (TC).

Locomotive Event Recorder Information

A review of the locomotive event recorder (LER) revealed that a full service reduction of the train air brakes was initiated at 0148:06, and the train was brought to a controlled stop. The train air brakes were released 58 seconds later, at 0149:04. The head-end movement began to move forward at 0149:13. At 0150:23, the locomotive engineer initiated an emergency brake application. The head-end movement came to a stop at 0150:44. TSB calculations, based on LER timing and brake system characteristics, determined that the minimum time required for a full service air brake application on the accident train, from the initial application until the brakes were fully applied and the brake pipe pressure was stable on the last car, would have been at least 68 seconds.

OCR's LERs do not record the end-of-train (EOT) air brake pipe pressure, nor are they required to by the *Railway Locomotive Inspection and Safety Rules*. However, this information is available on most LERs and is recorded by some railways.

Securing Unattended Cars While Performing En Route Switching

While setting off the cars at Maxville, the conductor closed the angle cocks on the adjoining ends of the cars to be separated and did not vent the air, leaving the air brake line charged on the 74 cars left unattended on the main line. This practice is known in the industry as "bottling the air." During a train service brake application, the head-end air brake pipe pressure is reduced below the tail-end air brake pipe pressure, creating a pressure differential. When the angle cock on a car is closed before the air pressure equalizes in the brake pipe, a pressure wave is created. This wave can initiate a brake release on the car, which will then cause the brakes to release on subsequent cars.

Since the train was equipped with a Train Information and Braking System (TIBS), the air brake pipe pressure was displayed on the input and display unit (IDU) in the locomotive cab. There was no drop in the air pressure, and the air brake line remained charged on the 74 cars left behind. Several OCR locomotive crews, including the crew involved in this occurrence, believed that the sense and braking unit (SBU) motion detector, located at the EOT, would activate the motion alarm on the IDU if cars moved. However, when TSB investigators monitored train movements in OCR's Walkley Yard in Ottawa, they observed a delay in the alarm activation when cars were set in motion with a slow and smooth acceleration. The TIBS manufacturer indicated that the motion detection feature was designed to assist train handling by indicating buff or draft movement of cars at the EOT. It was not designed to protect against runaway rolling stock.

Paragraph 7.2(d), General, of Canadian National's (CN) General Operating Instructions (GOIs), which OCR uses, states in part that the locomotive engineer must ensure that the pressure reading on the IDU indicates 0 psi after uncoupling from equipment. If a 0 psi reading is not indicated, the locomotive engineer must take immediate corrective action by informing the employee making the cut that air is still present and/or initiating an emergency brake application on the standing cut of cars using the IDU emergency brake feature.

CN's System Special Instructions regarding CROR Rule 112 and CN's GOIs permit two methods of securing cars left standing without hand brakes applied while en route switching is performed: a full service brake application and an emergency brake application.

Section (v) of CN's System Special Instructions regarding CROR Rule 112 states the following:

> While enroute switching, setoff or lift is being performed, that portion of the train that isn't being set off may remain on the main track or siding without handbrakes applied if such portion:
>
> (a) is 10 cars or more,
>
> (b) has air brakes applied in full service or emergency,
>
> (c) has angle cock fully opened,
>
> (d) is not on a grade in excess of 1.5%, and
>
> (e) will not be left in excess of 2 hours.

Subparagraph 7.4 (b)(i) of CN's GOIs states, in part, that whenever a locomotive is detached from equipment, the angle cock on the equipment left must remain fully open and the air brakes applied in full service or emergency. If left in full service, the angle cock must not be closed until the full service application is completed. The angle cock must then be opened slowly and left in the fully open position. This exhausts all the air from the brake pipe but does not affect the air remaining in the auxiliary and emergency portions of each car's air reservoir. It ensures that the brakes fully apply and prevents further changes to the state of the air brakes. This procedure can take 30 seconds to 1 minute to complete. A full service application takes less time to complete than an emergency brake application because only the air brake pipe needs to be recharged upon recoupling the train.

When the emergency brake application method is used, cars left standing are placed into emergency braking by activating the TIBS emergency braking feature on the IDU from the locomotive, or by separating the train. Air from the brake pipe and reservoirs is automatically released, and the angle cock remains in the fully open position. While some air remains in each car's air reservoir, most of the air brake system must be recharged upon recoupling the train.

TC's Train Operations Monitoring Program records indicated that the OCR has been monitored 17 times since 2000. The monitoring is performed by observing train crews from a distance on the ground; in-cab monitoring is performed while riding trains. OCR transportation supervisors conduct 15 efficiency tests per month. No in-cab tests are performed; all observations are made from a distance on the ground. Train crews are aware of the times and locations where they are likely to be observed as most observations occur during the day and early evening near originating or arriving terminals. In addition to the monthly efficiency tests, OCR evaluates two random LER downloads each month to evaluate train crews for rules compliance and train handling.

Bottling the air is prohibited by CN's System Special Instructions to CROR Rule 112 and CN's GOIs because it can lead to an unintentional release of the air brakes and ultimately to runaway rolling stock. However, the practice continues to be used sporadically during switching operations. Previous TSB investigations into occurrences R95M0072 and R96D0029, and four uninvestigated occurrences identified issues related to air brake lines not properly vented during main-line switching operations. In addition, TC inspection records for Ontario indicate that, since 2000, two incidents of bottling the air and two incidents of leaving an angle cock partially open (instead of fully open as required to secure cars left standing unattended) were observed. None of these occurrences took place in railways that record the EOT air brake pipe pressure and that require using the emergency brake application method to secure cars left standing unattended during en route switching.

Tank Car Information

Tank car ADMX 29571 was an uninsulated, non-pressure tank car built in 1985 to specification DOT 111A100W1 (Class 111A). The tank shell was constructed with 7/16-inch-thick Association of American Railroads (AAR) TC-128 Grade B steel, while the heads were made of 15/32-inch-thick American Society for Testing and Materials (ASTM) A-515 Grade 70 steel. The car was not equipped with head shield protection. It had a capacity of 114 229 litres with a gross weight of 263 000 pounds.

A similar accident was investigated by the TSB (R99D0159) in August 1999. A CN crew was switching in Cornwall, Ontario, when six tank cars ran away on track CB17. The cars rolled eastward for 475 feet and struck the stop block at the end of the track. Upon impact, the stop block punctured the tank head, leaving a hole about 30 square inches. Approximately 22 500 litres of product was released, prompting the evacuation of a nearby shopping mall. The Board concluded that "In general, Class 111A tanks cars do not have sufficient protection against punctures, even in a low-speed impact due to the thinness of the tank shell and the absence of a head shield."

TSB investigations R94C0137 and R95D0016 also identified this type of car as susceptible to puncture and more likely to release content when involved in an accident. As a result of TSB investigation R94C0137, the Board recommended that:

> The Department of Transport take immediate action to further reduce the potential for the accidental release of the most toxic and volatile dangerous goods transported in Class 111A tank cars – for example, require design changes to improve tank car integrity in crashes or further restrict the products that can be carried in them. (R96-13, issued November 1996)

TC agreed with the recommendation and has overseen design improvements on newly constructed cars that provide better protection to valves in the event of roll over. In addition, the *Transportation of Dangerous Goods Regulations* have been amended to restrict the number of products that can be carried in Class 111A tank cars. To date, there have been no changes in car design to improve the puncture resistance of Class 111A tank cars with a gross weight of 263 000 pounds.

Current United States Federal Railroad Administration (FRA) and Canadian *Transportation of Dangerous Goods Regulations* limit tank car gross weight to 263 000 pounds; however, Class 111A tank cars may be built to 286 000 pounds gross weight under special permits issued by TC. In 1999, construction standards for Class 111A tank cars with a gross weight of 286 000 pounds were established. They include higher puncture resistance through better material selection and half-head shields. The new standards do not apply to Class 111A tank cars with a gross weight of 263 000 pounds even though they represent the majority of newly constructed and in-service cars.

Emergency Response

The locomotive engineer contacted the RTC at 0157 and reported that tank car ADMX 29571 was leaking at a rate of five gallons per minute. The RTC made a series of phone calls to railway and regulatory authorities before contacting the Ontario Provincial Police (OPP). The OPP called the Hawkesbury Fire Dispatch, who in turn contacted the Maxville Fire Chief at 0234. The Fire Chief arrived on site at about 0250 and determined that 45 to 50 gallons per minute were leaking from the punctured tank. The released product had seeped into the roadbed and much of it had migrated to the ditch, south of the track. Dykes were built to contain the spilled product in the ditch. About 98 000 litres of product was released and 11 000 litres of product was recovered.

The Fire Chief ordered evacuation of approximately 200 nearby residents including 120 residents from a senior citizens' residence. The evacuation order was lifted at 1300 the same day. A stop drinking water order was issued to the residents. It was lifted on 05 May 2005 after testing revealed that there was no contamination.

Analysis

Neither the condition of the rolling stock nor the track infrastructure played a role in this accident. The analysis will discuss the methods of securing unattended cars while en route switching is performed, and company and regulatory monitoring of train crews. The crashworthiness of Class 111A tank cars and the emergency response to the dangerous goods (DG) release will also be explored.

The Accident

The train crew left a standing cut of 74 cars on a 0.5 per cent descending grade with the air bottled. These actions were not in compliance with either CN's System Special Instructions regarding CROR Rule 112 or the company GOIs. While bottling the air does not always lead to adverse consequences, the practice increases the risk of premature brake release that results in uncontrolled runaway cars.

According to the LER, 58 seconds elapsed from the time the train air brakes were initiated for the stop at Maxville to the time the brakes were released on the head-end movement to pull westward to set off the cars into the MacEwen grain spur. However, TSB calculations, based on LER timing and brake system characteristics, determined that the minimum time required for a full service air brake application on the accident train would be at least 68 seconds. Therefore, the angle cock must have been closed on the cut of cars before the air brake pipe pressure had equalized and the brakes had fully applied. This created a pressure wave that initiated an undesired release of all brakes on the standing cut of cars. With the air brakes released, the cars rolled downgrade uncontrolled and collided with the reversing head-end movement, which resulted in the puncture of tank car ADMX 29571 and the release of denatured alcohol.

Ottawa Central Railway and Regulatory Monitoring

Two previous TSB investigations identified the practice of bottling the air as causal in a number of uncontrolled runaways. Section (v) of CN's System Special Instructions regarding CROR Rule 112 and Section 7.4 of CN's GOIs are the primary defences against the practice of bottling the air. Because they are administrative (that is, compliance cannot be enforced through physical or mechanical means), they are only effective when train crews voluntarily comply. Therefore, company and regulatory compliance monitoring of train crews is critical.

Company and regulatory compliance monitoring is performed by observing train crews from a distance on the ground or while riding trains, and/or through evaluating LER downloads. Ground observations and riding trains are ineffective at detecting bottling the air because it is unlikely that a train crew would bottle the air when they knew they were being observed, either from the ground or in cab. Moreover, the position of the angle cock is hard to see from a distance. OCR's LERs do not record EOT air brake pipe pressure nor does OCR monitor air brake pipe pressure with portable IDUs. Therefore, it is not possible to identify if the air has been bottled. Consequently, train crews can continue to bottle the air during main-line en route switching despite regulatory and company monitoring.

Securing Unattended Cars While Performing En Route Switching

CN's GOIs used by OCR permit the use of either a full service or emergency brake application to secure unattended cars while performing en route switching. When given a choice, crews are more likely to select a method that they think is advantageous. Since the service brake application method reduces brake system recharge time when recoupling the train, train crews tend to use this method. Additional time savings can be achieved by bottling the air on the standing cars. However, this practice has led to uncontrolled runaways that resulted in several accidents. The emergency brake application method takes slightly more time to complete, but is not conducive to bottling the air since air is released automatically from the air brake line and reservoir. Moreover, the procedure is less complex as it does not require manipulation of the angle cock, which remains fully open on the standing cut of cars. Nevertheless, both methods of car securement can be used safely provided that proper procedures are consistently followed.

There are no TSB records of a runaway accident related to bottling the air occurring on railways that use the emergency brake application method to secure cars during en route switching. This might be due to the fact that this method is not conducive to bottling the air and is less complex than the service brake application method. However, railways that use the emergency brake application method also record the EOT air brake pipe pressure. These railways can more effectively monitor train crews by using the LER downloads to identify when the air has been bottled. Train crews are less likely to bottle the air when they are aware that this information is recorded. Therefore, it is likely that recording the EOT air brake line pressure also plays a role in deterring train crews from bottling the air.

Several OCR train crews thought that, when the air was bottled on a standing cut of cars, the motion alarm on the IDU would activate and warn them if the unattended cars moved. They believed that, upon hearing the alarm, they could remotely put the cars into emergency using the emergency brake feature on the IDU. However, the SBU motion detector was not designed for such a function, and TSB field testing indicated that it is possible for cars to move without immediately activating the SBU motion detector. Relying on the SBU motion detector and the IDU alarm to perform a function for which they were not designed increases the risk of runaway cars.

Class 111A Tank Car Crashworthiness

Even though tank car ADMX 29571 was struck at low speed, the tank head did not withstand the impact of the box car's coupler and was punctured. This type of car has been involved in accidents previously investigated by the TSB, and its weaknesses have been acknowledged by the regulator and industry. The *Transportation of Dangerous Goods Regulations* have been modified to restrict the products these cars can carry, and design improvements that provide better valve roll-over protection have been implemented on newly constructed cars.

The construction standards for tank cars require that new Class 111A tank cars with a gross weight of 286 000 pounds be constructed to more stringent criteria that include improved puncture resistance through better material selection and the inclusion of half-head shields. However, these criteria do not apply to Class 111A tank cars with a gross weight of 263 000 pounds even though they represent the vast majority of newly constructed cars and carry the same products. Therefore, the majority of the Class 111A tank car fleet will remain vulnerable to punctures and will continue to present risks, even in low-speed accidents.

Emergency Response

The Maxville Fire Chief was contacted 44 minutes after the incident occurred. Once on site, emergency responders determined that the leak was more substantial than initially reported. While there did not appear to be any adverse consequence to the delay in contacting emergency responders, when DGs are involved, it is imperative that accurate information is obtained from the site to ensure an appropriate response. Once notified, the Maxville Fire Department responded quickly and performed their tasks safely. The evacuation of inhabitants in the vicinity of the accident minimized the risk of exposure to DGs.

Findings as to Causes and Contributing Factors

1. The 74 cars, left unattended with the air bottled, rolled downgrade and collided with the reversing head-end movement, which resulted in the puncture of tank car ADMX 29571 and the release of 98 000 litres of denatured alcohol.

2. The angle cock was closed before the air brake pipe pressure had equalized and the brakes had fully applied at the tail end. This initiated a pressure wave within the train air brake line and resulted in the undesired release of air brakes.

3. Because train crews are unlikely to bottle the air when they know that they are being observed and the end-of-train (EOT) air brake line pressure is not being recorded, regulatory and company monitoring did not adequately deter train crews from bottling the air.

Findings as to Risk

1. As the service brake application method of securing standing cars is more conducive to bottling the air, it has an increased risk of uncontrolled runaways.

2. Using the emergency brake application method and recording the EOT air brake pipe pressure appear to be effective deterrents to the practice of bottling the air, thus reducing the risk of uncontrolled runaways.

3. When train crews rely on the sense and braking unit motion detector and the input and display unit alarm to perform a function for which they were not designed, there is an increased risk of runaway cars.

4. Because the more stringent puncture resistance criteria of the new construction standards for Class 111A tank cars do not apply to new cars with a gross weight of 263 000 pounds, which represent a large portion of the tank car fleet, the majority of the Class 111A tank car fleet will remain vulnerable to punctures and will continue to present risks, even in low-speed accidents.

Other Finding

1. While there did not appear to be any adverse consequences to the delay in contacting emergency responders, it is imperative that accurate information is obtained from the site to ensure an appropriate response.

Safety Action Taken

On 11 May 2005, Ottawa Central Railway (OCR) held a safety meeting that was attended by all employees. The events surrounding the accident were discussed to raise awareness about the risks associated with the practice of bottling the air.

For two months after the accident, OCR doubled the number of train crew observations, emphasizing the securing of unattended cars while performing en route switching. The number of safety audits performed was doubled for 2005.

OCR purchased a portable input and display unit (IDU) to install in a vehicle for transportation supervisors. The IDU will be used to remotely monitor the end-of-train air brake pipe pressure while transportation supervisors observe train crews perform en route switching.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 01 March 2006.