Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

RAILWAY OCCURRENCE REPORT

DERAILMENT

CANADIAN NATIONAL
TRAIN NO. 724-20
MILE 82.2, LA TUQUE SUBDIVISION
GOUIN, QUEBEC
21 JANUARY 1995

REPORT NUMBER R95D0016

Canada

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- reporting publicly on its investigations and public inquiries and on the related findings;
- identifying safety deficiencies as evidenced by transportation occurrences;
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Railway Occurrence Report

Derailment

Canadian National
Train No. 724-20
Mile 82.2, La Tuque Subdivision
Gouin, Quebec
21 January 1995

Report Number R95D0016

Synopsis

Canadian National (CN) train No. 724-20 derailed 28 loaded cars of sulphuric acid at Mile 82.2 of the La Tuque Subdivision, near Gouin, Quebec.

Approximately 230,000 litres (51,000 gallons) of sulphuric acid was released, causing environmental damage. There were no injuries.

The Board determined that the derailment was caused by gauge loss. The condition of the ties in the area immediately to the north of the derailment led the Board to conclude that the gauge loss was likely attributable to deteriorated ties.

Ce rapport est également disponible en français.

1.0 Factual Information

1.1 The Accident

At approximately 0955, 21 January 1995, eastward Canadian National (CN) train No. 724-20 experienced a train-initiated emergency brake application while negotiating a curve at Mile 82.2 of the La Tuque Subdivision, near Gouin.

After conducting the necessary emergency procedures, the crew determined that 28 cars had derailed, commencing with the 17th car behind the locomotives and extending to and including the 44th or last car.

Eleven derailed cars were leaking sulphuric acid (UN 1830) into the Petit lac Masketsi and the Tawachiche River.

No one was injured. Provincial authorities instructed local residents to refrain from using lake water until the contamination was neutralized.

1.2 Damage to Equipment

Twenty-two of the derailed cars were extensively damaged and six were scrapped.

1.3 Other Damage

Two thousand feet of track was destroyed and five hundred feet was slightly damaged. A small railway bridge sustained substantial damage.

1.4 Personnel Information

The operating train crew included a conductor, a locomotive engineer and a trainman. They were familiar with the physical characteristics of the subdivision and met mandatory fitness and rest standards established to ensure the safe operation of trains.

A dead-head crew consisting of a conductor and locomotive engineer were riding in a trailing locomotive.

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

1.5 Train Information

The train, a unit train of 44 loaded sulphuric acid cars, was powered by three locomotives. It was about 2,030 feet in length and weighed approximately 5,610 tons.

A pre-departure inspection and brake test had been conducted at Parent, Quebec, Mile 118.9 of the Saint-Maurice Subdivision, with no exceptions noted. Train inspections by train crews at two meet locations between Parent and the accident site did not identify any equipment defects.

1.6 Particulars of the Track

The track at Mile 82.2 is oriented in a north/south direction and consists of a single main track in a 3-degree 30-minute curve on a descending grade of 0.6 per cent. The curve has three inches of superelevation. The maximum permissible speed for freight trains between Mile 71.6 and Mile 98.0 is 35 mph.

The high rail (east rail) in the curve was 100-pound continuous welded rail (CWR) installed new in 1970. The low rail (west rail) was relayed with partly worn 100-pound CWR in 1989. The combined head and flange rail wear on the high and low rails was within standards.

There were approximately 2,900 No. 2 hardwood ties per mile. The tie plates were double-shouldered, with six 6-inch spikes per tie. The rail was box-anchored every third tie.

A track geometry car test run, on 06 September 1994, indicated that there was wide gauge in the vicinity of Mile 82.18 and Mile 82.3. Gauge rods had been installed to temporarily correct wide gauge at Mile 82.15 on 15 June 1994. The track defects, as identified by the track geometry car, had not been permanently corrected before the derailment.

Post-derailment track measurements immediately north of the area of track destruction revealed gauge to be 58 ½ inches at one location, and 58 ⅜ inches at several locations. Transport Canada's (TC) Track Safety Rules stipulate a maximum allowable gauge of 58¼ inches for this class of track. Standard gauge is 56 ½ inches.

On 21 January 1995 the assistant roadmaster had inspected the track before the train's passage with no exceptions noted.

1.7 Method of Train Control

Train movements on the La Tuque Subdivision are governed by the Occupancy Control System (OCS) of the Canadian Rail Operating Rules (CROR) and CN's Special Instructions, and supervised by a rail traffic controller (RTC) located in Montreal.

1.8 Weather

The temperature was minus five degrees Celsius; the winds were moderate from the east with light snow falling.

1.9 Recorded Information

The event recorder transcript indicated that train speed immediately before the train-initiated emergency brake application was 38 mph with the throttle in the No. 2 position.

1.10 Occurrence Site Information

1.10.1 General

Three cars fell to the west into Petit lac Masketsi, 14 lay inverted near the lake shore and 11 were lying on their sides near the west side of the roadbed.

The west rail was displaced and broken in several pieces from Mile 82.2 to Mile 81.16. The east rail remained in place and intact. There were no rail or tie markings to the north of the derailment area, although tie plates were marked on the gauge side under the intact west rail at Mile 82.2. An examination of the track for approximately one-half mile north of the derailment location revealed that, for every grouping of 100 ties, an average of 27 were noted to be in poor condition. As many as 50 poor ties per 100 ties were observed. It could not be said that all the "poor" ties were "defective" ties as defined by CN although it appeared that many were sufficiently deteriorated to have met that criterion.

In the area of track destruction, many of the ties strewn about were noted to be in poor condition. It was not possible, however, to quantify their number in relation to the number of good ties. It is reasonable to assume that, in this area, the general tie condition was similar to that which existed on the unaffected track north of the derailment location. Several pieces of broken rail found in the area of track destruction were recovered and forwarded to the TSB Engineering Branch for study. Their examination (lab report LP 13/95) revealed that all the fractures were overstress in nature, with no defects present.

1.10.2 Track Maintenance Standards - Ties

TC's Track Safety Rules (effective 03 September 1992) indicate that, for this class of work (class 3), each 39-foot segment of track shall have:

a) a sufficient number of ties to hold gauge and maintain surface and alignment;
b) 10 ties which are not broken through, plate-cut to more than 40 per cent of the tie thickness; or deteriorated to the point to allow the rail to move ½ inch relative to the ties.

CN specifies that the number of non-defective ties in a 39-foot length must be sufficient to hold line, surface and gauge within CN's standards for class 3 track, and that the number of non-defective ties shall never be lower than 10.

Industry standards stipulate that a 39-foot panel be installed with 21 to 23 ties.

1.10.3 Product Loss

Eleven cars leaked product. Two lost all their lading, six lost approximately 50 per cent, and three others lost up to 20 per cent. Approximately 230,000 litres (51,000 gallons) of sulphuric acid escaped and

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

settled on the bottom of Petit lac Masketsi in about 33 metres (100 feet) of water.

Ten cars leaked from damaged top fittings and one car lost product when a bottom outlet valve turned open at derailment before the valve stem sheared off. The design of the valve stem included an approximately 18-inch handle and protruding pipe protected by a skid plate. The valve handle was turned longitudinally to the car body when closed and secured by a pin mechanism.

CN immediately notified the local fire department, provincial and federal government agencies, and the consignee of the spill. Emergency Response Forms were in the possession of the conductor and were available to the first responders. CN immediately ordered crushed limestone to contain and neutralize the spilled product. It was later determined that 11 cars were leaking sulphuric acid.

CN established its command posts and a security perimeter approximately 450 metres (1,500 feet) north-west of the derailment location. Entry to the site was restricted by CN police.

Removal of sulphuric acid from the derailed cars commenced on 23 January 1995 and continued until 31 January 1995. It took over three months to bring the pH level of the water in the lake back to its normal level. Approximately 725 tonnes of limestone was used to neutralize the acid. There has been no apparent long-term effect on aquatic life.

1.10.4 Sulphuric Acid Trains

Unit trains of sulphuric acid were introduced into service in the 1950s. Sulphuric acid cars are usually loaded to the maximum allowable car weights. Loaded unit sulphur trains, with every car carrying maximum loading, present a severe concentration of mass over a relatively short length of track.

Cars in sulphuric acid service are equipped with protected bottom outlet valves of varying design.

1.10.5 Sulphuric Acid

Sulphuric acid (Transportation of Dangerous Goods Regulations – Packing Group II, Class 8 and 9.2) is a colourless oily liquid with a permissible exposure limit of one milligram per cubic metre. It is moderately toxic if ingested, a severe eye irritant and is extremely corrosive and irritating to living tissue. It is a very powerful acidic oxidizer which can ignite or explode on contact with many materials. When heated, it emits highly toxic fumes and will react with water or steam to produce heat. Sulphuric acid has a specific gravity nearly twice that of water.

The sulphuric acid did not readily mix with water but rather unexpectedly flowed along the waterway to its lowest (deepest) point. This development enabled environmental experts to monitor constantly both its mass and strength while limiting the environmental impact.

1.11 Other Information

1.11.1 Class 111A Tank Cars

The 11 rail cars that released product were standard series CTC-111A tank cars. This type of tank car, referred to as DOT-111A in the United States and CTC-111A in Canada, is used to transport flammable liquids, acids and other corrosives. These tank cars are non-pressure, and can be insulated or non-insulated. They do not have head shields and are pressure-tested at relatively low pressures (60 pounds per square inch (psi) to 100 psi, depending on the type). They can be constructed of carbon steel, aluminium alloy, or alloy steel (stainless). They do not have protective housings to safeguard the top fittings from impact damage. Bottom fittings are permitted by exception only. They are all equipped with double-shelf couplers. Cars built to standard are not considered to provide the same degree of derailment protection against loss of product as the series 112 and 114 cars designed to carry flammable gases and equipped with head shields and thermal protection.

Some 111A tank cars have been built with tank shell thickness exceeding the minimum requirement and are equipped with head shields. It is not known how many cars are so built, but they are not believed to constitute a significant proportion of the 111A tank car fleet.

In consideration of the vulnerability of minimum standard Class 111A tank cars to product release in an accident, especially due to top fitting damage, the Board was concerned that the carriage of certain dangerous goods in such cars might be putting persons and the immediate environment at risk in the event of an accident. Those dangerous goods that exhibit high inhalation toxicity (a characteristic dependent on liquid toxicity and volatility) were of particular concern. The Board believed that these risks could be mitigated by reducing the probability of product release through design improvements to protect the cars, especially the top fittings, and/or by limiting the types of products that can be carried. Therefore, 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.
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> (R96-13, issued November 1996)

In February 1997, TC advised that it was prohibiting the movement, in Class 111A tank cars, of chemicals that satisfy the condition of Packing Group I of Class 6 of the Transportation of Dangerous Goods Regulations, and that full head shields would be added as a requirement this year for aluminium and nickel low pressure tank cars in dangerous goods service. (Of note, there are currently no nickel Class 111A tank cars in service and there are very few aluminium Class 111A tank cars in service.)

TSB accident data suggest that over 60 per cent of product releases from Class 111A cars were from damaged top fittings; over 25 per cent were due to structural failure of the tank, mainly from punctures in the head or shell; and about 10 per cent were from damaged bottom fittings. TC has stated that it is undertaking an active role in various research and development projects aimed at identifying and classifying critical tank car anomalies. In the meantime, Class 111A tank cars carrying dangerous goods remain particularly vulnerable to product release from damaged top fittings in the event of a collision or an upset.

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3 report No. R94C0137

2.0 Analysis

2.1 Introduction

Although the train was travelling at a speed slightly higher than the allowable maximum speed, the small overspeed is not considered to have played a role in the derailment. No evidence of equipment malfunction was found, and it is therefore concluded that the track failed in the vicinity of Mile 82.2, derailing the 28 cars. Product then leaked from tank cars known to be susceptible to product loss at derailment.

The analysis will explore the manner of track failure and the release of the dangerous good.

2.2 The Derailment

2.2.1 Track Condition

Markings on the tie plates under the west rail at Mile 82.2 are attributable to wheel flange damage from a derailed car (most probably the 17th car in the consist). It is uncertain if the poorly secured rail shifted under the train or if the wide gauge allowed a wheel to drop between the rails. The derailed car displaced the west rail from its securement, ultimately derailing the 28 cars.

The train derailed at a location prone to wide gauge. Poor tie conditions had compromised rail securement to the point that gauge rods were used to maintain gauge. The use of gauge rods to maintain gauge on the main track only provides a temporary remedy and is symptomatic of the need for renewal.

Although it cannot be said that the number of defective ties per 39-foot panel (up to 50 per 100 feet of track north of the derailment location) exceeded regulatory dictates or CN's standards, it is apparent that their condition was such that gauge could not be maintained. The track likely did not meet these requirements.

2.2.2 Class 111A Tank Cars

For the most part, the product was released through the damaged top fittings. The top fittings on this class of tank cars are not protected from damage from roll-over.

One tank car leaked product from a damaged bottom fitting. This leak was attributable to the design of the valve handle which allowed it to be turned open at derailment, before breaking off. This design can result in damage and loss of product.

2.2.3 Environmental Aspect

The containment of the dangerous good and the control and clean-up of the derailment site were accomplished in a timely and efficient manner, considering the magnitude of the spill, the chemical involved, and the extremely cold winter conditions that prevailed. The protection of the site and the procedures in place to ensure the safety of the containment and clean-up personnel were appropriate and well executed.

3.0 Conclusions

3.1 Findings

1. When the train approached the derailment location, it was operated in accordance with company instructions and government safety standards with the exception of a slight overspeed.

2. The train derailed in an area experiencing gauge maintenance problems probably attributable to poor ties.

3. The derailment is attributable either to a pre-existent wide gauge condition which allowed a wheel to drop to the roadbed and displace the rail or to the fact that the poorly secured rail shifted under the train, precipitating the same process.

4. The number of defective ties north of the derailment area likely exceeded Canadian National's (CN) maintenance standard.

5. Product escaped from damaged top fittings on 10 of the 11 tank cars that leaked. The other leak is attributable to an inappropriate bottom fitting design.

6. The tank cars that lost product were all Class 111A cars, a class known to be susceptible to product loss at derailment.

7. The unexpected behaviour of the sulphuric acid, which acted as one mass and flowed to the deepest area of the lake where it could be neutralized, mitigated the environmental impact.

8. The containment and control of the dangerous good and the clean-up and control of the derailment site were conducted in a professional manner.

3.2 Cause

The derailment was caused by gauge loss. The condition of the ties in the area immediately to the north of the derailment led the Board to conclude that the gauge loss was likely attributable to deteriorated ties.

4.0 Safety Action

4.1 Action Taken

4.1.1 Regulatory Overview - Condition of Track Infrastructure

In 1996, Transport Canada's (TC) infrastructure monitoring program was revised to include a verification of the railways' inspection logs and the action taken when safety defects had been identified. Samples of track geometry car and rail flaw detector car data are checked against the railways' records of corrective action which in turn is verified by field inspection to provide a sense of the overall state of compliance with TC's Track Safety Rules. The Board believes that this approach will undoubtedly reduce the probability of this type of occurrence and could be more effective if the enforcement and the corrective actions go beyond the defects identified in the samples and address systemic deficiencies.

The Board is also aware that the regulator has a mechanism to tailor and adjust the level of its monitoring activities on subdivisions where safety deficiencies have been identified. As such, TC has indicated that its monitoring activities in the La Tuque subdivision are continuing at an increased level because of the number of derailments and safety deficiencies identified in past years.

4.1.2 Class 111A Tank Cars

As previously stated in the report, TC is taking an active role in research and development projects to identify and classify tank car anomalies. TC has determined that a retrofit of the top fittings of all Class 111A cars would be cost-prohibitive (in excess of one billion dollars), especially given the age and remaining life of the cars. Therefore, while tank car standard CAN/CGSB-43.147-94 currently restricts the use of Class 111A tank cars and removes over 80 dangerous goods previously authorized for transportation in these cars, TC has indicated that it is examining, on an ongoing basis, thousands of other products that are transported in order to categorize them with respect to adverse characteristics and to update the list of products prohibited from being transported in Class 111A cars.

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 16 December 1997.