Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

RAILWAY INVESTIGATION REPORT
R08M0002

LEVEL CROSSING ACCIDENT

CHEMIN DE FER DE LA MATAPÉDIA ET DU GOLFE INC.
FREIGHT TRAIN 403
MILE 181.24, MONT-JOLI SUBDIVISION
SAINT-ARSÈNE, QUEBEC
19 JANUARY 2008

Canada

Railway Investigation Report

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Summary

On 19 January 2008, at approximately 1105 eastern standard time, Chemin de fer de la Matapédia et du Golfe inc. freight train 403, travelling westward on the Mont-Joli Subdivision, struck a northbound minivan at the Highway 291 level crossing in the town of Saint-Arsène, Quebec. The minivan spun around and struck the signal mast in the northwest quadrant of the crossing. Two of the five occupants were fatally injured and a third was critically injured.

Ce rapport est également disponible en français.

Other Factual Information

The Accident

On 19 January 2008, Chemin de fer de la Matapédia et du Golfe inc. (CFMG) westward freight train 403 (the train) was travelling on the main track of the Mont-Joli Subdivision, en route from Mont-Joli, Quebec, to Rivière-du-Loup, Quebec. The train consisted of 3 locomotives and 38 freight cars; it weighed 5250 tons and measured 2710 feet in length.

The train crew, located in the locomotive cab, consisted of a locomotive engineer and a conductor. They were qualified for their positions and met established rest and fitness requirements.

While the train was approaching the Highway 291 (rue de l'Église) crossing at Mile 181.24 in Saint-Arsène (see Figure 1), the conductor saw a blue minivan entering the crossing from the south. Before he could warn the locomotive engineer, the locomotive struck the vehicle. The locomotive engineer, whose view to the south was obstructed by the locomotive control stand, did not see the vehicle, and had no time to apply the brakes until after striking the vehicle. The locomotive sustained light damage to its front end.

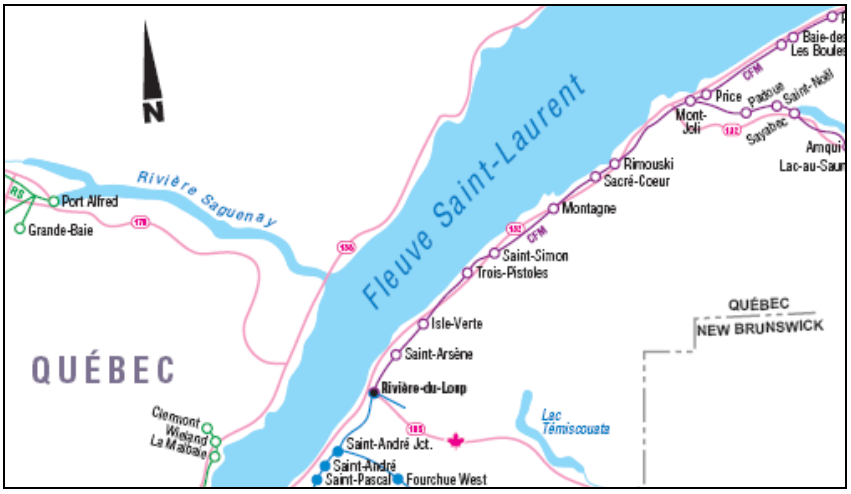

Figure 1. Location map (Source: Railway Association of Canada, *Canadian Railway Atlas*)

Locomotive event recorder data indicate that, as the train approached the crossing, at 1105:36 eastern standard time,[1] the crew sounded the locomotive whistle and the throttle was in the maximum position (notch 8). While the train was travelling at 51 mph, it was placed into emergency at 1106:03 and came to a complete stop at 1107:30, 4360 feet west of the crossing.

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

It was a bright day, with thin cloud and a temperature of around -6°C, with a southwesterly wind at 20 km/h. There was intermittent blowing snow, but the visibility was good. The road was covered with a thin layer of compacted snow.

The Driver and the Vehicle

The minivan was en route from Saint-Clément to Rivière-du-Loup, via Saint-Arsène. It was not the driver's normal route, but he had passed over the crossing several times before. He had never seen the lights operating and had never seen a train at that location. The driver was well rested. The minivan was in good mechanical condition and its windshield was clean. The heater and the radio were on. The driver was conversing, occasionally, with the front seat passenger. Three children were sitting quietly in the back seat of the van. All of the occupants were wearing seat belts.

As he approached the crossing, the driver was unaware of the oncoming train until the front seat passenger cried out that there was a train. He saw the train, and at the same time, heard the whistle and saw the signal lights. He hesitated, then accelerated to try to clear the track. A TSB simulation with a train travelling at 51 mph indicated that the signals would have been operating for 33 seconds.

The minivan was struck just behind the rear wheel on the passenger side, spun twice as it slid westward and struck the mast of the cantilever signals in the crossing's northwest quadrant. The vehicle was heavily damaged, with its passenger compartment caved in where it had struck the mast. There was no event recorder on the minivan. As the van was spinning, one of the children was ejected from the van. The secondary impact with the cantilever signal mast resulted in severe injuries to the front passenger; two of the children sustained fatal injuries.

Road Information

Provincial Highway 291 is a two-lane, undivided, arterial road. In the municipality of Saint-Arsène, the posted speed limit is 50 km/h and the average daily traffic is around 1800 vehicles per day. The highway runs in the north-south direction before crossing the Mont-Joli Subdivision main track. The level crossing angle was 90 degrees, and the surface was asphalt.

Track Information

The Mont-Joli Subdivision consists of a single main track that extends from Campbellton, New Brunswick (Mile 0.00), to the junction with Canadian National near Rivière-du-Loup (Mile 190.1). There were five trains per day, including two passenger trains. Through the municipality of Saint-Arsène, the track is tangent, with a maximum allowable speed of 70 mph for passenger trains and 60 mph for freight trains. The insulated joints of the east approach circuit were located at 2550 feet from the centreline of the crossing, which would provide for 25 seconds of signal operation for a train operating at the maximum allowable track speed of 70 mph. A private siding switch was located 1500 feet east of the crossing.

Level Crossing and Northbound Approach

The rue de l'Église crossing warning system, installed in 1959 under Board of Transport Commissioners for Canada Order 98554, consisted of cantilever signals equipped with flashing lights and bell. The configuration of the lights on the cantilever structure was as per a Board plan dated 04 October 1979, approved by the Canadian Transport Commission. For northbound traffic, there was one set of front and back lights, mounted on the cantilever and focused at a distance of approximately 140 metres. Because of the presence of two access roads parallel to the rail line, in 1979, the mast lights below the crossbuck were rotated and aimed along those two roads, leaving the signals on the cantilever aimed towards northbound traffic (see Photo 1).

Photo 1. View of the crossing looking north (photo taken the day after the accident)

The flashing light signals used the standard railway power supply, with 18-watt incandescent bulbs. These lights use searchlight-style beams, to ensure high light visibility for approaching drivers. They were flashing around 50 flashes per minute (that is, 0.8 flashes per second (Hz)). In bright weather, sunlight shining on the light units can wash out, or diminish, the lights' visibility. During a TSB simulation, where a similar minivan was operated under similar conditions, it was observed that the front and back lights of the automatic warning device were visible during an approach from the south. The light units were clean.

Northbound vehicle drivers approaching the crossing cannot hear the sound of westward train whistles until they are within two seconds (30 metres) of the crossing, due to the presence of residential buildings along the road. From this distance (30 metres), the sight-lines were clear. There was a diamond-shaped advance warning sign on the right-hand side of the roadway on the highway approach 77 metres from the crossing.

The TSB has a record of one previous accident at this crossing, in March 1984, when an automobile struck a freight train. There was no record of any injuries.

Regulatory Overview

Under the *Railway Safety Act*, Transport Canada (TC) is responsible for monitoring the safety of railways under federal jurisdiction. TC uses a ranking system to identify risk levels for the approximately 25 000 public level crossings in Canada. The system can vary by region. In Quebec, it is based on four mathematical models: a model developed by the University of Waterloo; another, modified version of that model; the United States Federal Railroad Administration's model; and a model developed by TC's Quebec regional office. The reasons for differences between the models are the variables used, as well as the weighting put on the variables, which include road geometrics, road speed, number of passenger trains and train speed. The four models are blended to produce a provisional list of crossings ranked by risk, which is finalized following site inspections. According to TC, crossings situated lower on the list may actually have more potential for cost-effective improvements, such as a flashing light crossing being improved by the addition of gates. In 2005, depending on the model used, the crossing in Saint-Arsène was ranked between 321st and 627th out of the 1900 public crossings in Quebec.

Regulations governing the installation and testing of signals at highway crossings at grade are in General Order E-6, *Highway Crossings Protective Devices Regulations*. These regulations were last updated in 1978. In 2002, TC issued a draft technical document, RTD 10,[2] which is now used for new installations and the upgrading of crossing signals. While General Order E-6 requires one set of front and back lights to be aimed along each approach, RTD 10 requires at least two sets of lights for crossings equipped with cantilevers. Section 13.5(a) requires additional pairs of light units to be provided where there are intersections within the crossing approaches.

Planned Signal Enhancement

TC has no statutory authority to order the upgrade of crossing warning systems. However, under the Grade Crossing Improvement Program, TC contributes around $7.5 million annually to the capital cost of grade crossing improvements, with the Quebec Region receiving approximately $1.75 million of this amount. This latter amount varies, as regional funding depends on the relative proportion of crossing fatalities in each region. The Quebec Region has formal annual meetings with the railways, the Ministère des Transports du Québec (Quebec's Ministry of Transportation) as well as municipal road authorities to discuss grade crossing safety issues.

TC and the various parties make site visits to reassess the actual level of risk and to harmonize the results of the mathematical risk models with the situation in the field. TC's headquarters reviews the region's plans before a financial contribution to the upgrading is finally approved.

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[2] RTD 10 - Road/Railway Grade Crossings: Technical Standards and Inspection, Testing and Maintenance Requirements.

The final decision on whether to go ahead with any crossing upgrades depends on the agreement of the railway and the road authority, and it can be contingent on TC's providing a contribution.

In 2002, the railway company applied to TC for a contribution towards the estimated $165 000 cost to install automatic gates at the rue de l'Église crossing. Although the involved organizations reached a consensus on the proposed project, it was shelved in 2003 because of issues related to the required acquisition of private land to realign the access road just to the south of the tracks. TC and the other parties did not examine other options for this crossing.

Advance Warning of Railway Crossing

The purpose of a standard advance warning sign is to warn highway vehicle operators that there is a railway crossing ahead and that they should be aware of the possibility of an approaching train. There are several other warning systems available to alert drivers about upcoming hazards. For example, active advance warning signs, crossing illumination, rumble strips, or enhanced delineation with retro-reflective signs are helpful at appropriate sites. Research on active advance warning sign indicates that, when active yellow flashers were added to a slightly enlarged advance warning sign and were activated by an approaching train, motorist recognition and speed reduction improved significantly.[3]

Most crossing signal lamps use the 18-watt incandescent bulbs. However, LED (light emitting diode) lamp units have been installed at some signalized crossings. They have a much higher light output and have more "spread" than the incandescent lamps and are therefore more visible.

Analysis

The signals were operating as intended. The train was operated in accordance with company and regulatory requirements. Therefore, the analysis will focus on human factors related to driver awareness, signal design and TC's crossing improvement program.

Driver Awareness

Driver awareness of impending danger is critical at level crossings for several reasons. If a train is approaching, its mass and speed give it a momentum far higher than that of a highway vehicle. There is no way for the train to stop quickly and therefore the only possible evasive action has to be by the highway vehicle driver. Drivers have to recognize firstly that they are approaching a level crossing, secondly understand the type and intent of the warning system, thirdly assess the risk, and fourthly take the appropriate action to eliminate the risk.

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[3] R.A. Maher, Chairman of Committee; F. Coleman III, Consultant, University of Illinois at Urbana-Champaign; R.W. Eck, West Virginia University; E.R. Russell, Kansas State University, *Transportation in the New Millennium, Railroad-Highway Grade Crossings: A Look Forward*, 2000, published by the Transportation Research Board.

In this accident, the driver was unaware that the warning signals were activated and he proceeded towards the crossing, unaware of the approaching train. The other cues that could have alerted him were either the sound of the train whistle or a clear view of the approaching train. However, the whistle sound was masked by residences on the east side of the northbound approach as well as by the sound of the radio and heater fan in the vehicle. Additionally, there was no clear view of the train until the minivan was close to the crossing. Therefore, because the driver did not see the lights operating, there was no other compelling cue to alert him to the approaching train. He became aware of the approaching train when the front seat passenger alerted him, at which time it was too late to avoid the collision.

While people believe they see everything within their visual field, research shows that natural visual scenes are complex and contain much more information than people can consciously attend to. Therefore, people unconsciously select what they will pay attention to, and much of the rest is not perceived. People focus their attention both "bottom-up," according to the visual characteristics of objects (for example, contrast, size, colour, change over time), and "top-down," according to their ongoing goals and under the direction of their unconscious recognition memory.[4]

Recognition memory is acquired through experience, and it strongly influences visual search without conscious awareness. Applied to the typical signalized level crossing situation, most drivers will unconsciously learn from exposure to the road environment that signals are located just below the crossbuck. Because the mast-mounted crossing lights under the crossbuck were aimed towards the access roads, it is possible that the driver unconsciously identified them as not operating, resulting in the assessment that no train was approaching.

The flashing cantilever signals may not have been perceived for several reasons:

- The driver may already have determined from the apparently inactive mast-mounted lights that no train was coming, making the state of the cantilever signals irrelevant.
- The slow flash rate, which was well below the most attention catching flash rate of 10 Hz,[5] would have allowed the driver to fixate on the signals and look away before either light changed (a fixation can be as short as 200 milliseconds).
- The winter sun was low in the sky and could have had an effect on the relative brightness of the cantilever-mounted flashing signals.

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4 M.M. Chun, "Scene Perception and Memory," in D. Irwin and B. Ross (editors), *Psychology of Learning and Motivation, Volume 42: Cognitive Vision*, Academic Press, San Diego, California, 2003, pp. 79-108.

5 H.S. Bartley, "Some Factors in Brightness Discrimination," *Psychological Review, 46*, 1939, pp. 337-358.

Crossing Improvements

Using four different risk assessment models, TC's Quebec Region risk indicators ranked the crossing at Saint-Arsène between 321st and 627th out of 1900.Nevertheless, the crossing was assessed by TC as meriting upgrading. Although TC's Quebec Region uses four models to rank crossings and identify risk levels, the lists generated by each model are not consistent. As a result, site inspections by TC officers and feedback from other parties is required to finalize the ranking list.

The crossing warning system met the requirements of General Order E-6 since the crossing's cantilever was equipped with one set of front and back lights. However, it was not in accordance with the new standards in RTD 10. In addition, the presence of the adjacent access roads, and the orientation of the mast lights, led TC to assess the crossing as meriting upgrading.

Because TC had no formal authority to order upgrades to the crossing warning system, the Saint-Arsène project was shelved when the road alignment issue could not be resolved. TC and the other parties did not examine other options for this crossing. When one approach to the upgrading of signal systems is deemed unfeasible for engineering or jurisdictional reasons, parties involved could explore the feasibility of alternative systems before deferring the project in order to mitigate the risks to the travelling public.

There are several alternative warning systems available to alert drivers about upcoming hazards and facilitate motorists' recognition and speed reduction. Their purpose is to raise driver awareness levels in traffic areas where caution is necessary. An ideal signal system will alert even the most inattentive or unaware driver to the impending approach of a train. Had a reassessment taken place, some alternatives to the planned upgrade, which would not require a road realignment, could have been examined. For example, the addition of more lamp units; improvement of light output using LEDs and an increased flash rate; and the use of active advance warning signs would have been some possible options.

Findings as to Causes and Contributing Factors

1. The driver only became aware of the approaching train when the front seat passenger alerted him, at which time it was too late to avoid the collision.

2. The minivan was struck because the driver was unable to stop safely before the track, or to accelerate clear from the track.

3. Because the mast-mounted crossing lights under the crossbuck were aimed towards the access roads, it is possible that the driver unconsciously identified them as not operating, resulting in the assessment that no train was approaching.

4. The internal noise level in the minivan, along with the masking of the train and whistle sound by houses along the road, removed additional cues that could have alerted the driver to the presence of the approaching train.

Other Findings

1. Because Transport Canada had no formal authority to order upgrades to the crossing warning system, the Saint-Arsène project was shelved after the road realignment issue could not be resolved.

2. Although Transport Canada's Quebec Region uses four models to rank crossings and identify risk levels, site inspections and feedback from other parties is required to finalize the ranking list and eliminate inconsistencies between models.

3. The presence of the access roads and the aiming of the mast light along those roads increased the risk at the crossing and led Transport Canada to assess the crossing as meriting upgrading.

4. When one approach to the upgrading of signal systems is deemed unfeasible for engineering or jurisdictional reasons, parties involved could explore the feasibility of alternative systems before deferring the project.

Safety Action Taken

Several meetings were held after the accident with the aim of improving the crossing. Specifically, the following action was taken:

- Chemin de fer de la Matapédia et du Golfe inc. added extra mast lights.

- The province of Quebec agreed to perform street realignment.

- Transport Canada is considering funding the grade crossing improvement from its Grade Crossing Improvement Program.

As part of its annual meeting with interested railways on potential improvements to crossings, the Transport Canada Quebec Region raised the issue of the lack of lights on the mast with the intent that the railway companies identify similar crossings.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 17 September 2008.

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