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RAIL SAFETY IN TRANSPORTING DANGEROUS GOODS IN CANADA
What are the needs for changes to the regulatory framework?
by Malcolm Cairns

BACKGROUND

The principal freight railways in Canada are subject to federal jurisdiction – although there are some regional and shortline railways subject to the jurisdiction of the province in which they operate.[1] The overall responsibility for federally regulated railways lies with the Minister of Transport and Transport Canada, while some specific regulatory authority is vested with the Canadian Transportation Agency (Agency) and the Transportation Safety Board of Canada (TSB). The principal legislation concerned with the safety of the rail industry is the Railway Safety Act (RSA): initially enacted in 1989, it has been subsequently reviewed and amended three times, with the latest review in 2007 resulting in amendments in 2012.

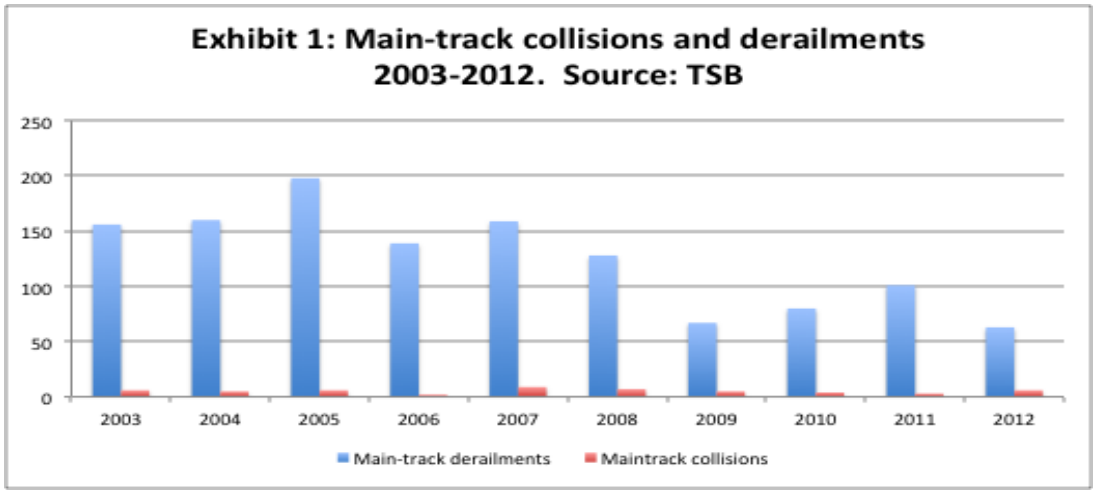
The RSA is complemented by several other Acts, and there are numerous rail safety regulations, standards and rules, including the Railway Safety Management System Regulations. It should also be noted that the rail industry in North America is highly integrated, and that many operating and equipment standards in North America are researched and managed by the American Association of Railroads based in Washington DC. The Transportation of Dangerous Goods Act is also of particular note: it applies to all modes of transport, not just rail, and addresses the means of containment and packaging of dangerous goods, the uniform marking of dangerous goods (placarding) and the need for emergency response assistance plans in order to import, offer for transport or handle and transport dangerous goods.

Under this rail safety regime, which combines strong and extensive regulatory oversight with modern approaches to safety management, safety results have been steadily improving over time. As reported by the TSB in their general overview in respect of 2012:

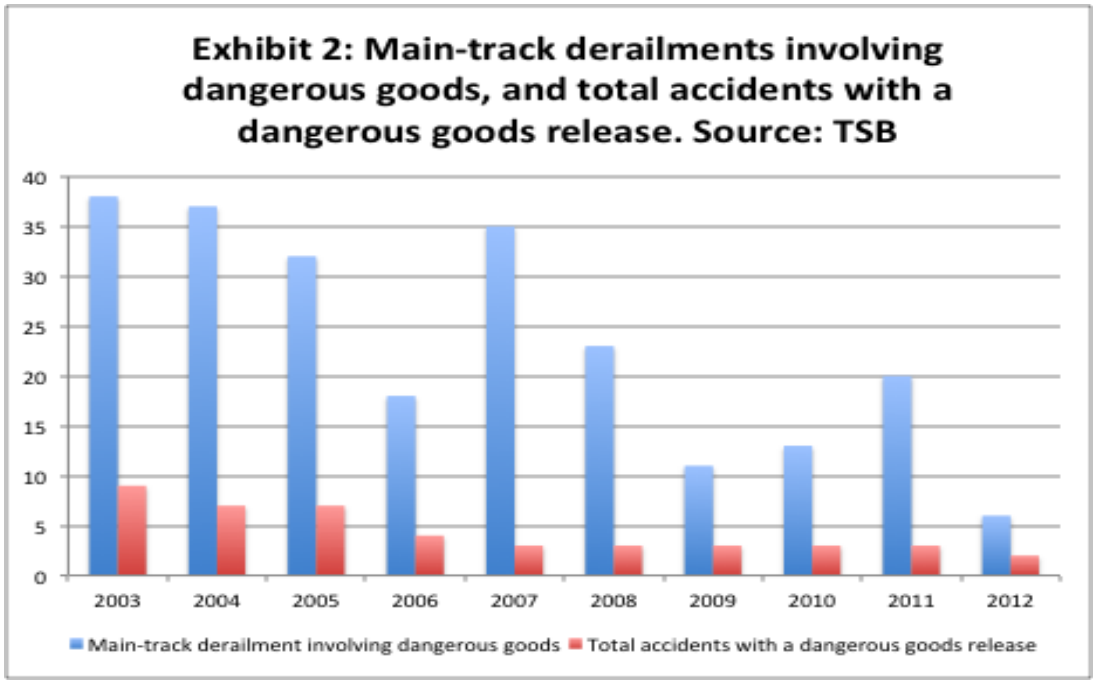
"Freight trains accounted for 69% of all trains involved in rail accidents in 2012. A total of 48 were passenger trains (4%) with the remaining 27% comprising mainly single cars/cuts of cars, locomotives and track units. The largest proportion of reported rail accidents are non-main-track related. In 2012, these accounted for more than half of the total. Typically, most non-main-track accidents are minor, occurring during switching operations at speeds of less than 10 mph. Main-track collisions and derailments are the most serious categories of rail accidents in terms of potential risk to the public and financial loss."

In Exhibit 1 is presented the number of main-track collisions and derailments between 2003 and 2012. The number of collisions is few and the number of derailments has declined significantly over the period. Over the whole ten-year period the number of fatalities associated with these accidents was 13 and the number of serious injuries was 25. This can be contrasted with crossing and trespasser accidents: these resulted in at least 70 fatalities every year, and at least 35 serious injuries every year.

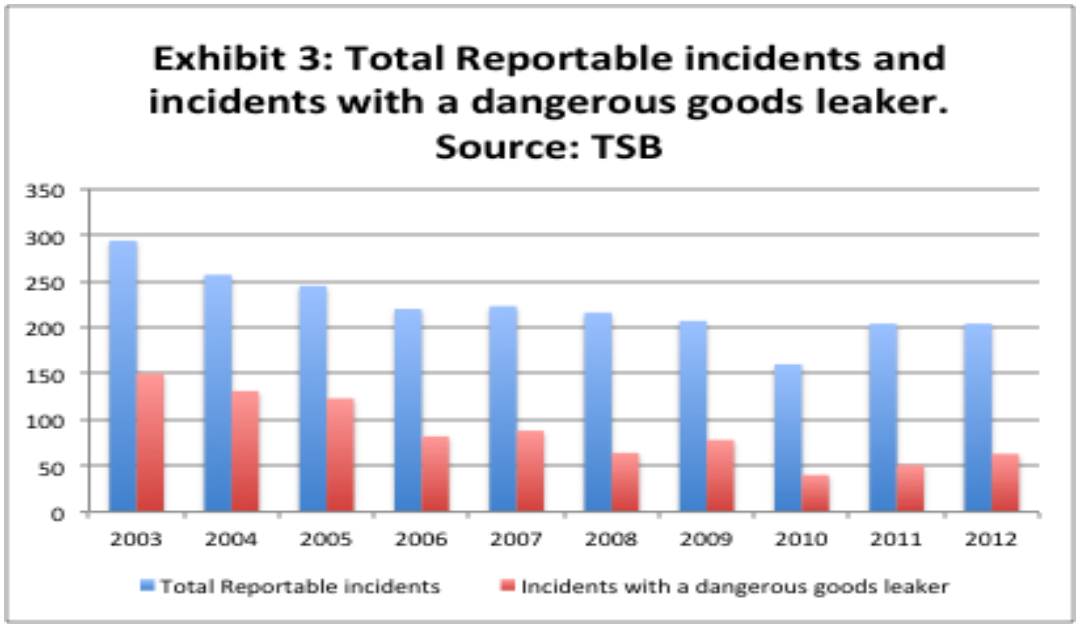
[1] The provincial regulatory frameworks vary by province.



In Exhibit 2 is presented the number of main-track derailments involving dangerous goods, and the total number of accidents with a dangerous goods release between 2003 and 2012. The number of main-track derailments involving dangerous goods has declined significantly over the period, and the number of releases is few and declining.



In addition to accidents, the TSB requires the railways to report on incidents that involve the potential for an accident, including specific rules violations. In Exhibit 3 is presented the total number of reportable incidents and the number of dangerous goods leakers between 2003 and



2012. As indicated by the TSB, *"A dangerous goods leaker incident is the unintentional release of a hazardous material while in transit and does not involve an accident. The vast majority of these incidents involve small quantities of products."* Once again the trends in these incidents are declining. Overall, the declining trends for the absolute numbers of accidents, incidents and casualties over the past decade has occurred while rail freight traffic has been on the increase.

THE LAC-MÉGANTIC ACCIDENT

This accident has received wide coverage in the media and will only be summarized briefly here.

A unit train of crude oil from the Bakken shale formation was en route between New Town, North Dakota and Saint John, New Brunswick. The rail movement began on the Canadian Pacific (CP) railway and was passed off to the Montreal, Maine and Atlantic (MMA) shortline in Montreal for furtherance. The train was subsequently parked on the MMA mainline outside Lac-Mégantic, Quebec for the night by the sole engineer, and, under circumstances that are still under investigation by the TSB, early on July 6, 2013, the train consisting of five locomotives, one baggage car, and 72 tank cars – some or all of which were class DOT-111 – became a runaway train. The train descended the grade to the town of Lac-Mégantic, reached speeds in excess of 100 kilometres per hour, and all the cars derailed in the centre of town, 63 of the 72 tank cars were breached, some of the crude oil exploded, and 47 people were killed. This accident was the worst rail accident in North America in some 100 years, and the extraordinary extent of this tragedy can be seen when contrasted with figures above.

While there was some surprise expressed that crude oil exploded, the TSB has subsequently confirmed that the crude involved was mislabelled as a dangerous good Class 3 Flammable

Liquid Packing Group III, instead of Packing Group II with a lower flash point[2]. Combined with the enormous energy from the fast moving cars that needed to be dissipated upon derailment, this could be the reason for the explosions, but the definitive answer must await the TSB findings.

While the structure of the tank cars do not appear to be a factor in the cause of the runaway, the fact of their being breached will be of concern to the TSB. It should however be noted that some commentators have suggested that the speed of the cars at derailment make it unlikely that all the tank cars would have remained intact no matter what their class and design.

Government agencies in Canada and the US have already tightened rules. On July 23, 2013 Transport Canada announced an emergency directive under section 33 of the RSA, and in the US the Federal Railroad Administration issued an emergency order on August 3, 2013. These emergency orders relate to tightening operating rules to prevent runaways of trains handling dangerous goods. On October 17, 2013 Transport Canada also announced Protective Direction 31 under the Transportation of Dangerous Goods Act requiring any person who imports or offers for transport crude oil to conduct classification tests on crude oil. Until such testing is completed, when shipping by rail all such crude oil shall be identified as Class 3 Flammable Liquid Packing Group I – the designation with the lowest flash point.

The balance of this policy paper will outline further possible changes to the regulatory framework associated with rail safety, and the rail transportation of dangerous goods in particular, and these changes will be addressed under four headings:

I The need for enhanced standards for DOT-111 tank cars;

II Strengthening railway third-party liability insurance regulations;

III Examining operations, while balancing the legitimate concerns of communities, to identify concrete actions that can be taken to further reduce safety risks; and

IV Revisiting relevant TSB recommendations not yet fully implemented.

I THE NEED FOR ENHANCED STANDARDS FOR DOT-111 TANK CARS

The tank cars involved in the Lac-Mégantic accident were a type designated as DOT-111 that handle liquids – dangerous goods and non-dangerous goods – and are non-pressurized. At times during 2013, some 70% of the tank cars operating on the rail property of CP and CN were of the DOT-111 type. The principal commodities handled were crude oil, canola oil, LPG and fuel.

Both the TSB and the National Transportation Safety Board (NTSB) in the US have expressed concerns about the DOT-111 tank cars as a result of their vulnerability to rupture during

[2] Flash point means the lowest temperature at which the application of an ignition source causes the vapours of a liquid to ignite near the surface of the liquid or within a test vessel.

accidents. Both safety agencies have recommended enhancing the safety standards for new such tank cars, and the NTSB has further recommended that enhanced standards be applied to existing cars. The enhanced standards require end-of-tank protection in the form of an additional outer layer of steel called a head shield, for thicker and more impact-resistant tank steel, for higher-capacity pressure relief valves, and for top fittings protection. While these enhanced regulatory standards have not yet been legislated, they were implemented in AAR Circular Letter CPC-1232 dated August 2011, effective for new cars ordered after October 1, 2011. Note that these enhanced standards do not apply to the existing tank car fleet.

At this juncture it should be noted that tank car standards need to be harmonized for the whole of the North American tank car fleet, as the rail industry is integrated and cars cross the Canada-US border on a daily basis. The balance of this Section will therefore address the issue on a continental basis.

In 2013 the total number of tank cars in North America is some 320.000. Some 75% of this tank car fleet is owned by 8 car leasing companies or their affiliates, of which Procor is the largest in Canada. Some 700 tank cars, or significantly less than one percent of the total, are owned by the six Class 1 freight railways. The balance of the fleet is owned by a wide range of shippers involved in the energy and chemical industries, and others including some shortline and regional railways.

Of the total 320,000 tank cars, excluding the pressurized tank cars leaves some 265,000 DOT-111 cars, of which some 160,000 handle dangerous goods. Of these 160,000:

- Some 30,000 handle crude oil, another 30,000 handle ethanol, and another 25,000 handle the remaining commodities classed as Flammable Liquids, such as gasoline;
- The balance of 75,000 cars handle dangerous commodities in other classes;
- 70% were built after 1990, but only 10% were built after 2011.

Railway tank cars are principally built by five manufacturers all based in the US. These manufacturers are estimated to be currently producing some 20,000 to 25,000 new cars annually, and with an estimated backlog of a year, suggests the current demand for new tank cars is in excess of 40,000.

On September 6, 2013, the US Pipeline and Hazardous Materials Safety Administration (PHMSA) announced it is seeking public comment within 60 days on its Advance Notice of Proposed Rulemaking (ANPRM) that is intended to further enhance the safe transportation of hazardous materials by rail tank cars[3]. One of the five proposed amendments would *"impose additional requirements that would enhance the standards for DOT Specification 111 tank cars used to transport Packing Group (PG) I and II hazardous materials"*. While this is a US initiative, it will have direct consequences in Canada through likely harmonization.

[3] Federal Register, Vol 78, No 173, September 6, 2013, Proposed Rules.

The proposed amendment is specifically concerned with

- Enhanced tank head and shell puncture resistant systems, and top fitting protection;
- Enhanced bottom outlet valves; and
- Revised centre sill or draft sill designs.

The four Petitions associated with this amendment[4] differ on three principal issues:

- The revised tank car standards: AAR Petition standards proposed on March 9, 2011 or the enhanced standards subsequently proposed by an AAR T87.6 Task Force on March 1, 2012;
- The Packing Groups I and II hazmat commodities involved: All, or restricted to ethanol and crude oil;
- The range of tank cars involved: New cars only, or new cars and a retrofit of existing cars.

The US railroad industry has expressed support for the higher of the two standards for new cars – keeping in mind the railroads own almost no tank cars. Associations representing the Chemical and Petroleum industries would like to see the standards applied only to new cars handling crude oil and ethanol. Representatives of communities in proximity to rail lines would like to see the standards applied to both new and existing cars.

While the primary concern is rail safety, a first economic issue is the additional cost of new cars with enhanced safety standards. Secondly, the Railway Supply Institute (RSI) has estimated that the number of older tank cars handling crude oil and ethanol is some 45,000 cars. What would be the loss in value if these cars are phased-out and repurposed to other commodities, where possible, or sold to other jurisdictions? Thirdly, if a retrofit were the regulatory outcome, the RSI has estimated the cost of such a retrofit to those cars in excess of $1 billion.

By comparison, derailment costs in the US involving packing Group I and II materials totalled some $64 million over the five year period 2004-2008, including equipment, lading, response, and environmental remediation costs.

There are two additional concerns that have been expressed. Communities are concerned that, without phasing-out or retrofitting existing cars, the mixing of new enhanced tank cars with existing tank cars in a train consist will not achieve the intended increase in rail safety. In contrast, RSI has identified a number of concerns regarding a retrofit of existing cars, associated with the additional weight and the impact on shipper loading and unloading facilities.

[4] The earliest Petition was from the AAR in 2011, followed by two Petitions from the chemical and petroleum industries, and one Petition from community interests in Illinois.

II RAILWAY THIRD-PARTY LIABILITY INSURANCE

As described by the Agency[5], the Canada Transportation Act (CTA) prescribes that: "No person shall construct or operate a railway without a certificate of fitness". Sections 90 to 94 of the CTA require a person proposing to construct or operate a freight or passenger railway under federal jurisdiction to apply to the Agency for a certificate of fitness. The Agency issues such certificates if it is satisfied that there will be adequate third party liability insurance coverage for the proposed construction or operation.

Railway operations can vary a great deal in terms of the volume of traffic, commodity mix, scope of operations, whether in rural or urban areas, number of crossings etc. Because of this, the Railway Third-Party Liability Insurance Coverage Regulations do not set definite amounts, neither minimum nor maximum.

On a case-by-case basis, the Agency determines whether the third party liability insurance is adequate by confirming that the:

- Risks have been fully disclosed by the railway company to the insurance broker and the amounts and nature of the coverage have been specified, based on the Agency's application form;
- Financial capability of the railway company to sustain its self-insurance portion;
- Financial strength of the insurance company to pay its contractual coverage; and
- Proposed coverage is not out of line with similar railway operations.

Legislation places the onus on the railway to notify the Agency in writing, without delay, whenever it cancels or alters its third party liability insurance coverage, or whenever a change in construction or operation may mean that its coverage is no longer adequate. The Agency may suspend or cancel a certificate of fitness if it determines that the railway's insurance coverage is no longer adequate for its operations.

A review of railway third-party liability insurance coverage has become necessary because MMA – the shortline involved in the Lac-Mégantic accident – had only $25 million in third party liability insurance and the environmental clean-up costs alone are expected to cost more than $200 million. MMA has subsequently declared bankruptcy.

The Agency has begun such a review of how to determine minimum insurance amounts with consultations in late 2013. Both CP and CN have in excess of $1 billion in liability insurance and do not want more. Instead, they would prefer to see dangerous goods shippers assume more responsibility for the risks posed by their products. A key issue will likely be, that if shortlines

[5] See https://www.otc-cta.gc.ca/eng/backgrounder-certificate-fitness

were required to carry sufficient insurance to cover such extraordinary events as the Lac-Mégantic accident, then they would likely not be able to remain in business. Moreover railways

are subject to common carrier obligations which requires that they handle traffic that is offered, so they cannot simply refuse to handle particular dangerous goods with potentially high risk.

Faced with this situation in other contexts, US railroads have suggested that potential losses from a catastrophic rail accident be capped and that governments assume the balance of risk – this is the approach that has been adopted in the Canadian Nuclear and Marine Liability Acts – but governments are naturally wary of such an approach.

III THE SAFETY OF RAIL OPERATIONS AND COMMUNITIES

On October 22, 2013, the Minister of Transport asked the Advisory Council on Railway Safety – with members including railway companies, Transport Canada, the Railway Association of Canada, provinces, shippers, suppliers and municipalities – to examine operations, while balancing the legitimate concerns of communities, to identify concrete actions that can be taken to further reduce safety risks[6]. This followed on from a meeting on September 30, 2013 between the Minister and the Federation of Canadian Municipalities (FCM) to discuss safe rail transport.

FCM's National Municipal Rail Safety Working Group has called for action on the following priorities to address rail safety issues[7]:

1. Equip and support municipal first responders to rail emergencies:

    - Municipalities need to know what dangerous goods are being transported through their communities so local services can plan and respond effectively to emergencies;

    - Railways and federal agencies cannot plan for emergencies alone. Local governments and authorities must be involved as partners in emergency planning.

2. Ensure federal and industry policies and regulations address the rail safety concerns of municipalities:

    - At the local level, rail incidents can have significant impacts on public safety, the economy and the environment;

    - Municipal concerns must be included in federal government risk assessment and policy development on rail safety.

A third priority has been addressed in Section II above.

It has been noted by other commentators that such actions should also involve the provinces, not just municipalities.

[6] See http://www.tc.gc.ca/eng/mediaroom/releases-2013-h140e-7389.html
[7] See http://www.fcm.ca/home/issues/more-issues/rail-safety.htm

A key issue is the scope and timeliness of information on the goods onboard trains, particularly dangerous goods, that is provided to municipalities and first responders. Real-time information supplied electronically might be preferred, but freight railways are not presently set up to provide train consist information in that format. Furthermore, providing real-time information (even if it was possible) could in fact be more problematic than beneficial for a number of reasons including:

- The risk of a train consist changing (e.g. need to set off en route) from the real-time info provided so that the car contents and sequencing is not what was provided to first responders;

- The risk of first responders taking it upon themselves to respond to the wrong commodity;

- Information overload to first responders – some fire chiefs have indicated that they could not handle this amount of information even when a mayor has asked for it.

Moreover there are hundreds of municipalities across Canada with rail lines, and providing them information would involve maybe thousands of people, which would pose a potential security threat if such sensitive information fell into the wrong hands.

Information is currently provide to first responders to allow them to develop emergency plans to respond to incidents involving the specific dangerous goods that may be involved in a specific incident. Perhaps the scope and timeliness needs to be reviewed to ensure they have what they need. Additional training for first responders on the handling of rail dangerous goods might also be required.

IV REVISITING TSB RECOMMENDATIONS

Following an accident investigation, the TSB frequently makes recommendations to enhance rail safety. While many of these recommendations have been addressed to their full satisfaction, some remain on their watchlist – where the TSB has found that actions taken to date are inadequate, and that industry and regulators need to take additional concrete measures to eliminate the risks. What follows are two issues relating specifically to freight railways as described by the TSB.

On-board locomotive video and voice recorders[8]

There is no requirement for on-board video and voice recorders on locomotives. Objective data is invaluable to investigators in helping them understand the sequence of events leading up to an accident and for identifying operational issues and human factors, including crew performance. Video and voice recordings would allow the TSB investigators to confirm the nature of crew communications and the dynamics of crew actions and interactions. Moreover, such information

[8] See http://www.bst-tsb.gc.ca/eng/surveillance-watchlist/rail/2012/rail_3.asp

would allow accident investigators to eliminate extraneous factors that did not play a role in the accident. Technology abounds in the area of recorded information and, indeed, the aviation

industry has had voice recordings for at least three decades, and some sectors of the marine industry are considering adding video recordings to supplement their voice recordings.

A number of rail accident investigations in North America have led to findings, recommendations and other safety communications where human factors were identified as an underlying condition or an unsafe act. Many of these investigations would have benefitted from a recording of crew communications immediately prior to the accident. In Canada, early indications from investigations such as the VIA Rail derailment in Burlington, Ontario, and findings in Saint-Charles-de-Bellechasse, Quebec, determined that recordings of crew interactions would have been useful. In the United States, accident investigations conducted by the National

Transportation Safety Board, such as Silver Spring, Maryland, Anding, Mississippi, and Chatsworth, California, called for the installation of voice, video and forward-facing video recorders on locomotives.

Some Canadian railway companies have already installed forward-facing video recorders on their locomotives, but progress toward broader use of voice and video recorders in locomotive cabs has not been made.

On June 7, 2013 a final report from the Advisory Council on Rail Safety[9] was made public by the Minister of Transport. This comprehensive report identified the key issues including the differences between the positions of the railway unions and the railway companies:

"Unions are concerned and oppose locomotive voice/video recorders, if used for compliance monitoring and disciplinary action by the railways. In addition, unions question why rail would be required to have video when no other mode is required to have this device.

Railway companies, on the other hand, support the installation of cab recording devices and firmly believe that a safety benefit can be derived from their use, but only if the information is to be used for safety performance monitoring as well as post-accident investigation. Railway companies cannot agree to shoulder the cost to install voice and video recorders if the sole use is for TSB post-accident investigation, as this approach would not result in improved safety. Railway companies also stress that installing voice recording devices without video recording capability would be ineffective to their safety programs."

To date, the Minister has indicated acceptance of the recommended voluntary approach, while strongly encouraging the freight railways to follow VIA Rail's commitment to voluntarily installing voice recorders on all their trains.

[9] See http://www.tc.gc.ca/eng/mediaroom/releases-2013-h074e-7210.html

Following signal indications[10]

There is a risk of a serious train collision or derailment if rail signals are not consistently recognized and followed. Since 2002, there has been an average of 11 occurrences per year in which a signal indication was misidentified, misinterpreted or not immediately recognized. When this type of occurrence results in a train collision or derailment, there can be significant risk to the public and the environment.

Since 1911, the railway industry in Canada has relied on centralized traffic control (CTC), a system of visual signals, to control traffic on a significant portion of its network—currently more than 44,000 kilometres of track. The CTC system provides train crews with a series of signal indications requiring actions relative to the signal displayed. The signal indications convey information such as operating speed and the operating limits within which the train is permitted to travel. Train crews must be familiar with the signal indications and must control their trains accordingly.

If signal indications are not followed, the CTC system cannot ensure that trains on the same line are separated appropriately. CTC does not provide any warning that a train may be passing beyond a restricted location, nor does it provide automatic means to slow or stop a train before it passes a stop signal or other points of restriction.

To augment CTC safety measures, railways have adopted various other defence mechanisms to help prevent accidents, such as two-man crews, Canadian Rail Operating Rules, and general operating instructions. However, these defences are inadequate in situations where the train crew misinterprets or misperceives a signal indication or does not apply, or misapplies, an operating rule. The TSB has recommended that Transport Canada and the railway industry implement additional backup safety defences to help ensure that signal indications of operating speed or operating limits are consistently recognized and followed.

It has also been noted that such safety enhancements might also be appropriate for operations on non-CTC track.

In their investigation reports the TSB refers to Positive Train Control (PTC). PTC is a developing train control system whose core functions are designed to prevent train–to–train collisions, over-speed derailments, incursions into established work zone limits, and the movement of trains through improperly positioned switches. This is achieved by continuously monitoring and positively enforcing points of restriction. PTC systems vary widely in complexity and sophistication based on the level of automation and functionality, system architecture, the wayside systems upon which they are based (that is, non–signalled, block signal, cab signal) and the degree of train control they are capable of assuming.

[10] See http://www.bst-tsb.gc.ca/eng/surveillance-watchlist/rail/2012/rail_2.asp

On September 12, 2008, a collision occurred between a Metrolink passenger train and a Union Pacific freight train in California resulting in 25 fatalities and more than 135 serious injuries. This accident prompted the passage of the US Rail Safety Improvement Act (RSIA) in 2008, which

mandated that PTC be installed on all rail main lines in the US by 2015. Specifically, the RSIA required *"the installation and operation of PTC systems on all rail main lines, meaning all intercity and commuter lines — with limited exceptions entrusted to the Federal Railroad Administration (FRA) — and on freight–only rail lines when they are part of a Class I railroad system, carrying at least 5 million gross tons of freight annually, and carrying any amount of poison – or toxic–by–inhalation (PIH or TIH) materials."*

On December 8, 2009, the FRA issued its Regulatory Impact Analysis that concluded that the 20-year costs and benefits of PTC discounted at a 7% discount rate were $9.5 billion and $440 million respectively: the costs will be 22 times the benefits. This is an example of moving in haste to respond to the anguish associated with a rare and tragic event can result in poor or uneconomic policy making

The TSB has as its mandate, in part, *"identifying safety deficiencies, as evidenced by transportation occurrences, and making recommendations designed to eliminate or reduce any such safety deficiencies"*. It does not have to be concerned with the economic consequences of its recommendations. It is perhaps for this reason, in part, that Transport Canada has not moved to implement PTC in Canada at this time.

While the precise circumstances of the Lac-Mégantic accident are still under investigation: MMA is not a Class 1 railway; it may not carry any PIH or TIH materials – crude oil is not such a material; and it is very unclear, anyway, whether PTC could have prevented the runaway train when the locomotives were shut down and unmanned.

As recognized by the TSB, there have also been challenges and delays with implementing PTC in the US and that is why, when considering solutions, *"TC and railways should not limit the design options to PTC alone. Any one of the physical fail-safe train controls used internationally, such as automatic train control (ATC), Amtrak's Advanced Civil Speed Enforcement System (ACSES), and interoperable electronic train management system (I-ETMS), or other forms of PTC, will prevent accidents of this type. These should not be discounted, nor should other emerging technologies with the potential to provide similar protection."*

On September 3, 2013, Transport Canada has proposed that the Advisory Council on Rail Safety establish a working group with representatives from the railways, the unions and Transport Canada to study the issue of fail-safe train control systems for Canada's railways, with a special focus on the high-speed rail corridors and to provide Transport Canada with options and recommendations as to how to address this issue in a written report by April 30, 2014.