The State of Rail Safety in Canada

Prepared for:

Railway Safety Act Review Advisory Panel

Prepared by:

CPCS Transcom Limited
# Table of Contents

Executive Summary............................................................................................................... i

1 **Introduction** .................................................................................................................. 1  
   1.1 Methodology and Related Issues .................................................................................... 1  
   1.2 Report Contents ........................................................................................................... 2  

2 **Overall Accident Trends 1989-2006** .............................................................................. 4  
   2.1 Total Accidents 1989-2006 ............................................................................................ 4  
   2.2 "Pure" Railway Accidents ............................................................................................... 6  
   2.3 Crossing and Trespasser Accidents ................................................................................. 7  

3 **Frequency and Severity of Railway Accidents** .............................................................. 9  
   3.1 Accidents per Train Mile ................................................................................................ 9  
   3.2 Fatalities and Serious Injuries ...................................................................................... 11  
      3.2.1 Crossing and Trespasser Accident Casualties..................................................... 11  
      3.2.2 Casualties From Pure Railway Accidents ........................................................... 12  
      3.2.3 Summary of Casualties by Type of Occurrence .................................................. 14  
   3.3 Cars Derailed per Accident ........................................................................................... 14  
      3.3.1 Distribution of Main Track Derailments by Number of Cars Derailed ....................15  
      3.3.2 Distribution of Non-Main Track Collisions by Number of Cars Derailed .................15  
      3.3.3 Distribution of Non-Main Track Derailments by Number of Cars Derailed .............16  

4 **Distribution of Accidents by Cause** ............................................................................. 17  
   4.1 Main Track Derailments by Assigned Factor .................................................................. 17  
   4.2 Non-Main Track Collisions by Assigned Factor ................................................................ 18  
   4.3 Non-Main Track Derailments by Assigned Factor ........................................................... 18  

5 **Passenger Train Accidents** .......................................................................................... 20  

6 **Accidents Involving Dangerous Goods** ........................................................................ 22  
   6.1 Rail Transport of Dangerous Goods.............................................................................. 22  
   6.2 TDG Reportable Rail Accidents ..................................................................................... 23  
   6.3 TSB Occurrences Involving Dangerous Goods ............................................................... 25  

7 **Comparison of Canadian and U.S. Reporting Criteria** .................................................. 27  
   7.1 Canadian Railway Reporting Criteria............................................................................. 27  
      7.1.1 Reportable Railway Accident ............................................................................ 27  
      7.1.2 Reportable Railway Incident ............................................................................ 27  
   7.2 U.S. Railway Reporting Criteria .................................................................................... 28  
      7.2.1 Train Accident ................................................................................................ 28  
      7.2.2 Train Incident ................................................................................................ 28  
      7.2.3 Non-Train Incident ......................................................................................... 28  
   7.3 Canadian and U.S. Reporting Criteria Differences .......................................................... 28  

8 **Comparison of Canada/U.S. Rail Safety Records** .............................................................. 30  

9 **Improving Reporting for Future Assessments** .............................................................. 32  
   9.1 Create Railway Occurrence Reporting Task Force .......................................................... 32  
   9.2 Improving Procedures for Normalizing Occurrences ....................................................... 34  
      9.2.1 Gross Ton Miles (GTMs) as the Principal Normalization Measure .........................34  
      9.2.2 Results of Normalizing Accidents Using GTMs ....................................................35  
      9.2.3 Normalizing Crossing, Trespasser and Passenger Train Accidents .......................37  
   9.3 Broaden Reporting Criteria for Derailments ................................................................. 37
10 Conclusion ........................................................................................................................................... 38
  10.1 Conclusions About the State of Rail Safety ................................................................................. 38
  10.2 Recommendations for Improving Future Reporting .......................................................... 39

Appendix A – International Benchmarking and Australia and New Zealand
  Reporting Criteria .......................................................................................................................... 41
  A.1 International Benchmarking .................................................................................................. 41
  A.2 Developments in Australian Reporting Criteria ........................................................................ 41
  A.3 Developments in New Zealand Reporting Criteria .............................................................. 42
Executive Summary

Purpose of Study

The purpose of this study is to examine and assess the state of rail safety in Canada as determined from the published statistics on rail accidents and incidents, supplemented by other readily available data as required. The purpose is also to consider the reliability and appropriateness of the various measures being used, and to make recommendations on how to improve the available information for purposes of future assessments.

Sources of Data

The information used in the study comes mainly from the accident and incident data published by the Transportation Safety Board (TSB), the federal agency responsible for investigating safety-related occurrences and identifying and making recommendations pertaining to safety-related deficiencies in transportation. As required for this study, the TSB data have been supplemented with other information, mostly from Transport Canada sources and some from other countries.

A major drawback of the TSB data for present purposes is that it pertains only to railway operations under federal regulation. This, of course, reflects the TSB’s mandate but means that the data does not give the whole picture. In addition, the TSB statistics do not take into account the changes that have occurred in the size of the rail network under federal jurisdiction. This includes the large reduction in the federally regulated network in the 1990s, enabled by passage of the Canada Transportation Act, and the increase in the federal network that occurred with the takeover by CN of BCR in 2004.

Another drawback of the TSB data is that it does not take into account the changes implemented in 1992 by the TSB in its reporting regulations. As a result of these changes, which took a few years to become fully effective, it is difficult to make meaningful comparisons of trends in rail occurrences before and after the mid-1990s.

Data Issues

Discussions were held with a number of organizations: the TSB, CN, CPR, various Transport Canada groups, and VIA Rail Canada. These highlighted several important matters. In particular, the TSB currently has new accident/incident reporting regulations under development that could become effective by the first part of 2008. These will immediately begin to affect reporting to the TSB, and therefore the ability to compare future data with the current data used in the preparation of this report.

Another important development is that some of the current data will be undergoing significant revision. The reason given by the TSB is clarification to the industry regarding TSB’s reporting regulations. Figures will be revised back five years to 2002, making comparison between the revised data and information prior to 2002 more difficult. These changes will begin to be reflected in the TSB regular monthly reports starting with the June 2007 report issued in July 2007.

It has also come to light that one of the key measures employed by the TSB is of questionable validity, yet it appears that no one using this data has been aware of this. The data in question is the published series on "Main Track Train Miles." This is important because the TSB uses this to “normalize” statistics on total main track accidents, main track derailments and crossing accidents. The problem with the data is that they are not actual numbers reported by the railways to Transport Canada under reporting requirements, but are estimates created by Transport Canada and provided to the TSB. It seems that no one can explain with certainty how these estimates are derived nor what they represent, e.g. how is “main track” defined and is it consistent with the TSB’s definition, and are the data applicable to railways under federal jurisdiction or to all railways?
The State of Rail Safety

The report examines the safety record of railways in Canada in terms of: the total numbers of accidents and the numbers by type of occurrence, i.e. main track, non-main track, crossing/trespassing accidents, and others; the frequency of accidents and the severity of accidents in terms of numbers of fatalities and serious injuries and numbers of cars derailed; the distribution of accidents by cause, i.e. environment, track, equipment and human actions; accidents involving passenger trains; and accidents involving dangerous goods. The report also considers the accident records of railways in Canada versus the United States.

In assessing these results, it is important to recognize that railway operations (like the other transport modes) are inherently risky and cannot be judged relative to a benchmark of zero occurrences. As stated before the Advisory Panel, “... a railway operation can most probably be classified to be ‘safe’ when the risk of occurrences causing damage to humans, property, and/or the environment is reasonable, prudent, and otherwise acceptable to those who would potentially bear the consequences.” (Gary M. McLaughlin, 2007 Review of the Railway Safety Act: A Submission to the Advisory Panel, 16 April 2007, p. 4.) However, measuring true safety, which is the result of both the occurrences or events and their consequences is complex and beyond the scope of this assignment.

With the above in mind, as well as the other caveats regarding the comparability and validity of the data noted in the report, certain observations may be made about railway safety trends, at least since the mid-1990s:

- All accidents should give rise to concerns and lead to more safety efforts. The system, however, does not appear to be more risky today than a decade ago based on the total numbers of accidents experienced. (Figure 2.1)
- Accidents consist of different types with varying causes and consequences. About half of rail accidents are non-main track collisions and derailments that are generally minor. Somewhat more than one-fourth of accidents occur at crossings or involve trespassers. About one-sixth of rail accidents are main track collisions and derailments. (Figure 2.2)
- Among all rail accidents, crossing and trespasser accidents remain the cause of almost all fatalities and serious injuries (Figure 3.9). In the totality of all railway accidents, casualty rates for employees have been low but should obviously be improved. (Figures 3.6-3.8)
- Due to the role of the public, achieving reductions in crossing and trespasser accidents has proven difficult. Also, interpreting the statistics is difficult because of the many factors that have influenced reported accidents. Over the past decade, it appears that Direction 2006 has helped limit crossing and trespasser accidents, and that some slow progress was made in reducing these types of accidents. (Figure 2.4)
- Because of their small role in the rail industry, passenger trains account for only about 6% of all trains involved in accidents. Passenger trains, however, account for a disproportionate number of rail crossing and trespasser accidents. More than 70% of passenger train accidents are crossing/trespasser accidents. (Figure 5.1)
- Two agencies track accidents involving dangerous goods, the Transport Canada Dangerous Goods Directorate (TDG), which is the regulator and primary source of this type of information, and the TSB. They have very different criteria for defining reportable occurrences involving dangerous goods. (Sections 6.2 and 6.3)
- Rail transport of dangerous goods has grown strongly over the past decade, by almost 60% since 1997 (CN and CPR combined, millions of revenue ton-miles or thousands of freight cars moved). (Figure 6.1) Data limitations prevent determining if this growth reflects similar growth in dangerous goods traffic overall, or a modal shift in favour of rail.
• TDG reportable accidents have varied considerably over the past decade but show no uptrend, and have fallen in the past few years. The total quantity of dangerous goods released in any year has also varied widely, being especially high in 1999 and 2003, but exhibits little correlation with the number of accidents. (Figure 6.2) As tracked by the TSB, accidents and incidents involving dangerous goods have tended to decline over the past decade. (Figure 6.4)

• The overall pattern in “pure” railway accidents (i.e. rail accidents excluding crossing and trespasser accidents) has been similar to that of total accidents. This includes recent sharp increases in 2002-2005 and a decrease in 2006, both driven by non-main track and main track derailments. (Figure 2.3)

• In terms of numbers of cars derailed per accident, there has been no increase in the severity of rail accidents over the past decade, including the 2002-2005 period when accidents were rising. (Figures 3.10-3.12)

• Focussing on the period 2002-2005, the increases in “pure” railway accidents, including the non-main track and main track derailments, are only partly ascribable to growth in railway activity (measured in gross ton miles). A substantial portion were not, suggesting a deterioration in safety in this period. (Section 9.2.2) The bulk of increases in derailments in 2002-2005 were associated with track conditions, as opposed to environment, equipment or human actions. The particular track-related factors suggest the causes were likely maintenance and inspection practices and capital replacement. (Sections 4.1 and 4.3)

• “Apples to apples” benchmarking of CN and CPR to that of their U.S. peers, based on the FRA definition of train accidents, indicates CN’s and CPR’s safety performance compares favourably. (Figures 8.1 and 8.2) These results reflect CN’s and CPR’s relatively low accident rates on their Canadian operations.

• International benchmarking has been found to be extremely difficult and generally unreliable due to differences in reporting criteria used in different countries. (Appendix A)

Improving Future Reporting

The report makes three recommendations for improving the statistical information available for future assessments:

• First, establish a (non-permanent) Railway Occurrence Reporting Task Force to address the many outstanding and emerging problems and issues with reporting to the TSB, the availability, reliability and use of data, and the publication of information. This would be comprised of TSB staff, industry stakeholders, independent experts and other relevant agencies. This would be not just a study group but a group to ensure that appropriate strategies are implemented, problems corrected and issues are addressed. Discussions with the TSB, various Transport Canada groups, and the railways have indicated long standing concerns with the reporting of occurrences to the TSB (e.g. issues of compliance, interpretation of the regulations), the reliability of the data, its use and manipulation by the TSB (normalization of accidents, categorization of accidents) and how the results are reported (manner of presentation and amount of explanation provided). Among the urgent matters are the problems that are about to arise over the comparability between the data that will be generated under the new reporting regulations, expected to become effective in the first part of 2008, and the existing data. The Task Force should also immediately resolve the problems identified with the “Main Track Train Miles” data now being used by the TSB to normalize accidents. There is a need for better coordination among agencies, such as in the reporting on accidents involving dangerous goods. There are also large amounts of untapped data that could be drawn upon, residing for example with TDG as well as the railways. Among other matters that could usefully be addressed by the Task Force are the development of additional or better measures of safety or risk than those currently being used, improvement in the procedures for normalizing occurrences, and the possible preparation of a guidance document.
Second, concerning the procedures for normalizing the rail accident/incident numbers, the present report makes specific recommendations. We recommend adopting gross ton miles or GTMs as the principal measure for normalizing total rail accidents, total rail accidents excluding crossing and trespasser accidents and other key categories including derailments and collisions. We would retain train miles as a supplementary measure since this is the international standard and will likely remain so. We also consider train miles to be the most appropriate indicator for normalizing crossing accidents as well as trespasser accidents, although the latter could also be normalized on the basis of length of track operated. Train miles should, in principle, also be the basis for normalizing accidents involving passenger trains, but the situation with respect to data availability on the commuter rail operations requires further examination.

With respect to reporting on derailments, we recommend redefining reportable railway accidents to include all derailments. This would address the apparent ambiguities in the current criteria that define reportable accidents, and that should be clarified or better guidance provided.

These issues are discussed at greater length in Section 9.
1 Introduction

This study on “The State of Rail Safety in Canada” has been undertaken for the Railway Safety Act (RSA) Review Advisory Panel as part of the Panel’s research program. As part of the review process, the Panel has commissioned independent study and analysis of several key subjects. These studies are intended to help in developing a picture of rail safety issues in Canada, and in identifying potential solutions where problems exist.

The purpose of this study is to examine and assess the safety record of railways in Canada as determined from the available statistical measures of accident and incident occurrences. The study is to consider the reliability and appropriateness of the various measures, and make a recommendation as to how the reporting of railway safety information might be improved for purposes of future assessments. Also important to understanding Canada’s state of rail safety is the possible comparison of Canada’s record with that of railways elsewhere, particularly the United States, including consideration of the differences in the regulatory criteria for reporting occurrences.

1.1 Methodology and Related Issues

This study develops a picture of the state of rail safety in Canada based largely on an examination of the railway accident and incident statistics published by the federal Transportation Safety Board (TSB). The TSB is the federal agency charged with investigating safety-related occurrences in the marine, pipeline, rail and air modes, and with identifying safety-related deficiencies, making recommendations to reduce or eliminate deficiencies, and reporting its findings. As required for purposes of this study, the TSB statistics have been supplemented by other available data and information.

Any rail accident or incident meeting the reporting criteria identified in the TSB regulations renders the occurrence reportable and requires the reporting of the occurrence to the TSB. Railway operators are required to report significant information about any such occurrences. The TSB further categorizes rail accidents or incidents according to type of occurrence (e.g. derailments, collisions), location (e.g. main track, non-main track) and third party involvement (crossings and trespassers) among others. Measures of safety that are typically cited using this data are the number of occurrences resulting in accidents and the number of serious injuries and fatalities. Accidents and incidents specifically involving dangerous goods are also highlighted by the TSB.

The accident and incident reports made to the TSB are the principal source of safety-related occurrence data in Canada. And while that is so, we should recognize that the regulations governing reporting to the TSB and the data collected have been developed by the TSB for its specific purposes. Any study such as the present one, where the purpose is different, is likely to encounter limitations with the data. For example, an important drawback of the TSB data is that it pertains only to federally regulated railways. It does not therefore give the whole picture and does not take into account the changes that have occurred over time in the size of the federally regulated rail network.

In addition to the desk research, discussions have been held with a number of organizations. These include the TSB, the main freight railways CN and CPR, Transport Canada’s Rail Safety Directorate, Dangerous Goods Directorate and Surface and Marine Statistics and Forecasts division, and VIA Rail Canada, the principal intercity passenger rail carrier. A number of important matters relevant to this study came up in these discussions. In particular, the TSB currently has new accident/incident reporting regulations under development. These are now in the hands of the Department of Justice.

---


2 Dangerous goods are an exception in that the primary source of information on safety-related occurrences involving dangerous goods is the Dangerous Goods Directorate of Transport Canada. See Section 6 of this report.
for review before being published in the Canada Gazette. Given the normal ninety-day period for responses to publication of new federal regulations, the regulations could become effective in the early months of 2008, and will affect future reporting and the ability to compare future data with that used in this report.

Another development with implications for the data used in this study is that some of the currently available data will be undergoing significant revision. This will coincide with the report for June 2007, to be released this month (July 2007). Figures will be revised back five years to 2002, making comparison with prior years more difficult. According to the TSB, the data are being revised as a result of clarifications to the rail industry of the TSB’s reporting requirements. The changes, however, will not be reflected in the TSB’s forthcoming annual analysis Statistical Summary Railway Occurrences 2006. Presumably, they will be incorporated into the annual analysis for 2007 that will be published next year.

Finally, it has come to light as a result of this project that one of the principal measures published and used by the TSB is of questionable validity, yet it appears that no one inside or outside of the TSB has been aware of this. The data in question is the series on “Main Track Train Miles,” which is provided to the TSB by Transport Canada and which the TSB uses to normalize the statistics on total main track accidents as well as main track derailments and crossing accidents. Transport Canada, in turn, takes the main track train miles information as published by the TSB and uses it in its own Annual Report. It is our understanding that Transport Canada will at some point to take up the matter of this data both internally and with the TSB. The problem with the data on Main Track Train Miles is that they are not actual numbers reported by the railways to Transport Canada as part of the railways’ normal reporting requirements, but are estimates created within Transport Canada and provided to the TSB. It seems that no one can explain with certainty how these estimates are developed nor what they actually represent, for example how is “main track” defined and is it consistent with the TSB’s definition, and whether the data are applicable to railways under federal jurisdiction or to all railways?

1.2 Report Contents

- Section 2 outlines overall rail accident trends since 1989, and identifies the basic types of rail accidents. Trends are highlighted in total accidents, total accidents excluding crossing and trespasser accidents and its components, and crossing and trespasser accidents.

- Section 3 examines trends in rail accident frequency and severity. Frequency is measured per million train miles, the most common standard in use. Severity is the numbers of fatalities and serious injuries, and the cars derailed per accident.

- Section 4 looks at the distribution of rail accidents by cause, i.e. environment, track, equipment and human actions.

- Section 5 examines trends in passenger train accidents.

- Section 6 examines trends in rail accidents involving dangerous goods.

- Section 7 outlines the differences in the regulatory criteria for determining reportable rail occurrences in Canada and the United States.

- Section 8 compares the safety records of Canada’s major railways with those of comparable U.S. railways.

- Section 9 considers how to improve the reporting of statistical information for future assessments and makes three recommendations.

• Section 10 highlights the main conclusions concerning the state of rail safety in Canada as suggested by the existing data, and briefly restates the recommendations for improvement.

• Appendix A highlights the challenges in comparing rail safety performance internationally, and outlines the reporting criteria used in Australia and New Zealand.
2 Overall Accident Trends 1989-2006

This section outlines overall trends in the numbers of railway accidents since 1989, when the Railway Safety Act came into force. Three key measures are examined: total railway accidents; total railway accidents excluding crossing and trespasser accidents, or “pure” railway accidents; and crossing and trespasser accidents.

Without meaning to downplay the significance of the raw numbers of accidents or of any occurrence, it is difficult to draw conclusions about the state of railway safety from these overall statistics. We note the following:

- Total accidents are comprised of many different types that have varying causes and consequences, which can also be the case even for accidents of the same type.
- The numbers of accidents vary over time, and any conclusions drawn will depend on the starting and ending years chosen for comparison.
- The numbers of accidents reported have been affected by changes implemented in the reporting regulations in 1992.
- The accident measures do not take into account the growth in railway traffic over time.
- The measures do not reflect the changes in the size of the rail network under federal jurisdiction. This included the large reduction in the federal network and proliferation of shortlines in the 1990s, facilitated by the Canada Transportation Act.\(^4\) In contrast, the takeover by CN in 2004 of BCR, not federally regulated, increased the federal network.

2.1 Total Accidents 1989-2006

Figure 2.1 shows the total number of reported railway accidents for each year since 1989. Since 1989, there have been two periods when the number has tended to rise, the periods 1992-1996 and 2002-2005. The increases in the first period are to a large extent attributable to changes implemented in 1992 in the regulations pertaining to accident reporting. This resulted in additional cases being reported as compared to prior years, and affected accident reporting for the next two years or so. However, according to the TSB, the additional reporting that came into effect in 1992 should not bear significantly on comparisons after 1994.\(^5\)

As regards the 2002-2005 period, the number of accidents went from 984 in 2002 to 1,248 in 2005. There has been much concern expressed over the increases in these years and the chart helps to put some perspective on this. It can be seen that despite the steady increases in 2003, 2004 and 2005, the total number of accidents in recent years has not exceeded the number that occurred in the mid-1990s. In 2006, moreover, the number decreased to 1,141, a decline of approximately 9%.

As a measure or indicator of the state of railway safety, the total number of accidents shown in Figure 2.1 is of limited help. As noted, the total is comprised of many different types of accidents with varying causes and consequences. For example, about half of all accidents today are non-main track (yard, spurs) related. As the TSB notes, these normally occur at slow speeds and are generally minor.\(^6\)

As categorized by the TSB, total accidents consist of main track collisions and derailments, non-main track collisions and derailments, collisions and derailments involving track units (such as maintenance of way equipment), employee/passenger accidents, crossing accidents, trespasser accidents, fires and explosions, and others. The percentage distribution of accidents for 2005 is shown in Figure 2.2.

2.2 “Pure” Railway Accidents

In examining railway accidents, it has been found useful to differentiate between those where third parties are involved – crossing and trespasser accidents – and others that may be considered “pure” railway accidents. This section focuses on the latter, i.e. railway accidents excluding crossing and trespasser accidents.

Pure railway accidents, i.e. accidents not involving third parties, are shown in Figure 2.3, where they are separated into main track collisions, main track derailments, non-main track collisions, non-main track derailments and other (i.e. collisions/derailments involving track units, employee/passenger accidents, fires/explosions and TSB other). Figure 2.3 also shows the total pure railway accidents. As with Figure 2.1, the numbers reflect the changes in 1992 in the accident reporting regulations, and which help to explain the sharp increase in reported accidents in the years immediately following 1992. Also similar to Figure 2.1, there is a sharp increase in the total accidents over the period 2002-2005. These are accounted for by large increases during these years in non-main track and main track derailments, the former increasing by 193 or 56% and the latter by 78 or 67%. Finally, in 2006, the data show a decline of about 11% in total pure railway accidents, mostly accounted for by declines of 60 or 11% in non-main track derailments and 61 or 31% in main track derailments.

One of the trends that stands out most sharply in Figure 2.3 is the increase over time that has occurred in the number of non-main track derailments. For example, comparing the average number of non-main track derailments in the two most recent years, 510 in 2005-2006, to the average of 390 for 1995-1996, the number of non-main track derailments has grown approximately 31% since the mid-1990s. In contrast, when the averages for 2005-2006 and 1995-1996 are compared for the remaining categories, the trends in all of these have been down.

7“Pure” is used here in the sense of unmixed, and was the term used by the Railway Safety Act Review Committee in its final report. See Railway Safety Act Review Committee, On Track: The Future of Railway Safety in Canada (Minister of Supply and Services Canada, 1994), p. 6.
8The 1995-1996 average is used as the basis of comparison here because, as noted earlier, the additional accident reporting that became effective in 1992 should not have much affect on comparisons after 1994.
2.3 Crossing and Trespasser Accidents

As noted, crossing and trespasser accidents should be considered as a separate category because they involve third parties, individuals who are not railway employees or passengers and who have usually played a causal role in the accidents. In addition, crossing and trespasser accidents are by far the largest source of fatalities and serious injuries in railway accidents. In 2006, for example, there were 164 serious injuries and fatalities as a result of railway accidents, based on preliminary data. Of these, 87% were the result of crossing and trespasser accidents. The Railway Safety Act Review Committee recognized the special problems associated with crossing and trespasser accidents and decided, on account of these, to devote a separate chapter to these accidents.9

There have been a number of initiatives aimed at reducing crossing and trespasser accidents. In 1996, the federal government, the railways and other partners launched the Direction 2006 program. The objective was to reduce crossing and trespassing incidents by 50% by 2006, largely through public education, communications, enforcement and other measures. With the program ending in 2007, Transport Canada is considering follow-up outreach initiatives. There is also the federal cost-share Grade Crossing Improvement Program, in which Transport Canada has invested more than $100 million in safety improvements over the past 15 years.10

Figure 2.4 shows the numbers of reported crossing and trespasser accidents since 1989. Crossing accidents show a downtrend from 469 in 1989, when crossing accidents accounted for half of all railway accidents, to 248 in 2006. Moreover, reported crossing accidents have declined despite the change in 1992 that made more crossing accidents reportable. However, there have been other factors affecting the numbers of reported crossing accidents. In the 1990s, there was the transfer of low density lines from CN and CPR to provincially regulated shortlines. This involved transferring a disproportionate number of unprotected crossings and contributed to reducing accidents at federal crossings, while the acquisition of BCR by CN resulted in the BCR crossings being added to federal crossings. Most recently, crossing accidents in 2006 were down by about 8% from 2005, and were 4% below the average for the previous five years 2001-2005.

Looking at the trespasser accidents, there is little evidence of any trend over the period since 1989 although trespasser accidents do appear to have peaked in 1996, coinciding with Direction 2006. Most recently, however, trespasser accidents were up 11% in 2006 from 2005, and were also 15% higher than the average for 2001-2005.

**Figure 2.4: Crossing and Trespasser Accidents – 1989-2006**

![Chart showing crossing and trespasser accidents from 1989 to 2006](chart.png)

Source: Transportation Safety Board

In brief, several factors have influenced crossing and trespasser accidents: changing reporting regulations, CN and CPR transfer of lines to provincial railways, Direction 2006 and the growth over time in road traffic. All of these make it difficult to interpret the statistics without further research. At the same time, the importance of crossing and trespasser accidents as the major source of serious injuries and fatalities in rail accidents is without question.

---

3 Frequency and Severity of Railway Accidents

The preceding section examined trends in the numbers of accidents. This section examines measures of the frequency and severity of railway accidents.\textsuperscript{12}

The most common measure of frequency that has been used in Canada and elsewhere is the accident rate per train mile, usually calculated as accidents per million train miles (MTM). The purpose is to adjust or “normalize” the number of accidents for the amount of railway activity, and thereby have a better basis for comparing the number of accidents over time or across railways of varying size. Train miles is, of course, not the only activity measure that can be used for this purpose, and whether it is the best measure is a matter that will be considered later in this report. However, because it is the most common measure, accident trends are examined here on this basis.

With regard to severity, the TSB provides data on two indicators: the numbers of human casualties measured by serious injuries and fatalities; and the numbers of rail cars derailed in accidents. These are reviewed below. However, because of the many consequences of rail accidents, many other indicators could be developed. These could include the extent of railway and other property damage, the legal claims paid in cases involving death, injury or property damage, or the impact on rail operations in terms of traffic delays and reduced profits. The impact on the environment constitutes another possibility for measuring severity. As described in Section 6 of this report, measures exist on the quantities of dangerous goods released, and other measures relating to the impact of dangerous goods releases are being explored. Important as this is, it should also be recognized that the environmental impact of rail accidents is not limited to accidents involving dangerous goods.

3.1 Accidents per Train Mile

In this section, we focus on three categories of accidents: total accidents; main track collisions and derailments; and crossing accidents. The focus on the latter two is justified by the fact that these are usually among the most serious types of railway accidents. As noted by the TSB, main track collisions and derailments are normally the most serious accidents in terms of financial loss and potential risk to the public.\textsuperscript{13} And as already noted, crossing accidents are one of the most serious types in terms of human casualties.\textsuperscript{14}

The results of normalizing accidents by train miles are shown in Figures 3.1, 3.2 and 3.3. Each of these shows both the absolute numbers of accidents and the accidents per million train miles since 1989. However, because train mile data for 2006 will be available only in the fall of this year, the normalized accident rates are shown only up to 2005.\textsuperscript{15} In terms of accidents per MTM, total rail accidents have averaged 14.3 since 1996. The corresponding average for main track collisions and derailments is 2.0, while for crossing accidents it is 3.6 per MTM. The relatively small rates for main track collisions and derailments and crossing accidents reflect their proportions in total railway

\textsuperscript{12}Strictly speaking, the accident numbers in the preceding section are frequencies in that they measure numbers of accidents per year.
\textsuperscript{13}Transportation Safety Board, "Statistical Summary Railway Occurrences 2005", op. cit., p. 5.
\textsuperscript{14}Ibid., p. 7.
\textsuperscript{15}The data on train miles used in this report has been provided directly by Surface and Marine Statistics and Forecasts, Transport Canada, and is not the same as the data published and used by the TSB to normalize accidents. As explained in the Introduction, there are some issues with the “Main Track Train Mile” series used by the TSB. First, as we understand it, the main track train miles used by the TSB are estimates developed by Transport Canada from monthly indicators and are not based on the actual train mile information which is only available to Transport Canada on an annual basis. Second, it is not clear whether “main track” actually has the same definition as that used by the TSB in accident reporting, and whether the main track train mile series relates only to federally regulated railways or to all railways. Third, the TSB switched in 2002 from using total train miles as its main indicator for normalizing accidents to using main track train miles and focusing on main track accidents, and does not have consistent data back to 1989. The train mile data used in this study is information that is reported to Transport Canada on an annual basis only. It is for total train miles, it relates specifically to federal railways only, and it includes freight, passenger and work trains.
accidents. As seen earlier, main track collisions and derailments and crossing accidents account, respectively, for 16.0% and 21.6% of all rail accidents (Figure 2.2).

Looking at Figure 3.1 and considering specifically the total accidents in the period since 2000, there were 12.6 accidents per MTM in 2002. This is not only the low since 2000 but also the low point of the past decade. After 2002, accidents per MTM increased steadily to a peak of 15.3 in 2005, a level 21% higher than in 2002, and 12% higher than the 2000-2004 average of 13.7. While the train mile data for 2006 is not yet available, it appears that the accident rate will fall in 2006 in line with the numbers of accidents.

**Figure 3.1: Total Rail Accidents and Rail Accidents per MTM**

![Figure 3.1](image1.png)

Source: Transportation Safety Board and Transport Canada

As regards main track collisions and derailments as shown in Figure 3.2, the pattern since 2000 mirrors that in total accidents. The low for main track collisions and derailments was 1.6 per MTM in 2002, the peak was 2.5 in 2005, while the average for 2000-2004 was 1.8 per MTM. Again, it appears that the rate should fall in 2006 in line with the decline in the numbers of accidents.

**Figure 3.2: Main Track Collisions and Derailments and Main Track Collisions and Derailments per MTM**

![Figure 3.2](image2.png)

Source: Transportation Safety Board and Transport Canada

With respect to crossings as shown in Figure 3.3, the trend since 2000 in accidents per MTM has been slightly downward. There was a recent low in 2004 of 3.1 accidents per MTM. In 2005, crossing accidents increased slightly to 3.3, but this was slightly less than the 2000-2004 average of 3.4.
What is strikingly evident in the Figures 3.1-3.3 is that the exercise of normalizing accidents by train miles provides almost no additional knowledge concerning railway accident trends over time. Whether looking at the trends in terms of the absolute numbers of accidents, or looking at the trends in terms of accidents per MTM, the resulting pictures are virtually identical. Thus, normalizing rail industry accidents on the basis of train miles turns out to be of little help in understanding the trends in aggregate rail accidents in Canada over time.

The explanation for this result lies in the behaviour of train miles. While the total industry train miles have shown some tendency to vary over time, this data displays no significant upward or downward trend and the degree of variation is rather small (this may be seen in Figure 9.1 later in this report). Hence, the procedure of normalizing the accidents by train miles is, mathematically speaking, practically the same as dividing the number of accidents by a constant. It therefore has no discernable affect on the trend observed over time.\textsuperscript{16}

\section*{3.2 Fatalities and Serious Injuries}

An obvious indicator of the severity of railway accidents is the number of human casualties, which is measured under the current regulations as fatalities and serious injuries. The reality is that railway fatalities and serious injuries are almost entirely attributable to crossing and trespasser accidents. “It appears that people will suffer injury or death at rail crossings in spite of every possible precaution taken by governments and railways.”\textsuperscript{17} Together, fatalities and serious injuries as a result of crossing and trespasser accidents have accounted for 91\% of all railway accident fatalities and serious injuries since 1996.

\subsection*{3.2.1 Crossing and Trespasser Accident Casualties}

Figures 3.4 and 3.5 show the trends since 1996 in the numbers of fatalities and serious injuries due to crossing and trespasser accidents. As shown in Figure 3.4, casualties due to crossing accidents fell sharply in 2006, dropping to 56 from 90 in 2005. Moreover, in line with the trend in the number of crossing accidents (Figure 2.4), the average number of casualties due to crossing accidents of 84 in 2001-2005 was lower than the average of 87 in the preceding five years 1996-2000.

\textsuperscript{16}Since 1989, the industry train miles series used here has ranged between a low of approximately 74.1 million in 1990 and a high of 87.5 million in 1994, with a mean over the period 1989-2005 of 79.3 million and a standard deviation of 3.8 million, which is only 4.8\% of the mean value.

Similar to the number of trespasser accidents, casualties from trespasser accidents were up in 2006, increasing to 86 from 81 in 2005. At the same time, the overall pattern in casualties from trespasser accidents has tended to mirror that in trespassing accidents (Figure 2.4), with the average number of casualties in 2001-2005 of 79 lower than the average of 92 in the preceding five years 1996-2000.

Comparison of Figures 3.4 and 3.5 shows that, in total, the numbers of serious injuries and fatalities from crossing accidents are about the same as the numbers from trespassing accidents. Since 1996, the former has averaged 83 per year while the latter has averaged 86. The split between fatalities and injuries is, however, quite different with fatalities constituting a much higher proportion of the total in the case of trespasser accidents (70%) than in the case of crossing accidents (43%).

3.2.2 Casualties From Pure Railway Accidents

Casualties from pure railway accidents, that is casualties from accidents other than crossing and trespasser accidents, are fatalities and serious injuries resulting from various collisions and derailments (main track, non-main track, collisions/derailments involving track units),
employee/passenger accidents, fires and other accidents. Nearly all of the casualties from these occurrences involve employees or passengers, although on occasion persons who are not employees or passengers are involved.

Figures 3.6 and 3.7 show the trends since 1996 in the employee and passenger casualties resulting from accidents other than crossing and trespasser accidents. As Figure 3.6 shows, the number of employee fatalities has ranged from a high of 7 in 1997 to zero in 1998 and 2002. At the same time, there were 2 passenger fatalities in 1997 and 3 in 2006. As Figure 3.7 shows, the number of employee serious injuries ranges from a high of 16 in 2001 to a low of 6 in 2005, while the number of passenger serious injuries ranges between 7 in 2001 and zero in 2002-2004.

As a final measure of casualties, employee serious injuries and fatalities have been examined on the basis of hours worked (the hours are service hours paid for and include regular and overtime). The results are displayed in Figure 3.8, and show casualties ranging between a maximum of 6.1 and a minimum of 1.9 for every 10 million hours worked.
3.2.3 Summary of Casualties by Type of Occurrence

Figure 3.9 presents a summary of all the rail accident casualties that have occurred since 1996 by type of occurrence. It has already been noted that railway casualties are almost entirely attributable to crossing and trespasser accidents. It has also been noted that, since 1996, there have been on average 83 fatalities and serious injuries per year at railway crossings and 86 fatalities and serious injuries per year as a result of trespassing. These numbers compare to a total of 15 fatalities and serious injuries per year for all other types of accidents combined. Among these other types of accidents, employee/passenger accidents are the main source of fatalities and serious injuries, accounting for a total of 8 per year since 1996. These are followed in importance by main track derailments with 3.5 casualties per year, and collisions/derailments involving track units with 1 casualty per year. The remaining types of occurrences, main track collisions, non-main track collisions and derailments, and fires and other have had fewer than 1 casualty per year.

### Figure 3.9: Total Rail Accident Casualties 1996-2006 by Type of Occurrence

<table>
<thead>
<tr>
<th>Type of Occurrence</th>
<th>Total Casualties 1996-2006</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fatalties</td>
</tr>
<tr>
<td></td>
<td>Number</td>
</tr>
<tr>
<td>Main Track Collisions</td>
<td>4</td>
</tr>
<tr>
<td>Main Track Derailments</td>
<td>14</td>
</tr>
<tr>
<td>Crossing Accidents</td>
<td>392</td>
</tr>
<tr>
<td>Non-Main Track Collisions</td>
<td>2</td>
</tr>
<tr>
<td>Non-Main Track Derailments</td>
<td>3</td>
</tr>
<tr>
<td>Collisions/Derailments Involving Track Units</td>
<td>2</td>
</tr>
<tr>
<td>Employee/Passenger Accidents</td>
<td>19</td>
</tr>
<tr>
<td>Trespasser Accidents</td>
<td>655</td>
</tr>
<tr>
<td>Fires/Other</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,091</strong></td>
</tr>
</tbody>
</table>

* -- = half percent or less. Sum may not equal total due to rounding.

Source: Transportation Safety Board
assessed on this basis. This is true even in the recent period since 2002 when the number of accidents has been on the rise. Figures 3.10-3.12 display the relevant data for the period 1996-2005.

### 3.3.1 Distribution of Main Track Derailments by Number of Cars Derailed

With regard to main track derailments, it is evident in Figure 3.10 that the largest group consists of accidents involving the derailment of a single car. Of the total main track derailments over 1996-2005, 41% have involved the derailment of only one car. Derailments involving 2-4 cars have accounted for 20% of all main track derailments, while derailments involving 5-10 cars have accounted for 19% of main track derailments. Derailments involving more than 10 cars have also accounted for 19% of main track derailments.

![Figure 3.10: Distribution of Main Track Derailments by Number of Cars Derailed per Accident](image)

Source: Transportation Safety Board

### 3.3.2 Distribution of Non-Main Track Collisions by Number of Cars Derailed

Regarding the non-main track collisions, approximately three-fourths of the total accidents over 1996-2005 have involved either no derailments or the derailment of only one car. The statistics are as follows: 52% have involved zero derailments, 22% have involved the derailment of one car, 21% have involved the derailment of 2-4 cars, 4% have involved the derailment of 5-10 cars, and 1% have involved the derailment of more than 10 cars.

![Figure 3.11: Distribution of Non-Main Track Collisions by Number of Cars Derailed per Accident](image)

Source: Transportation Safety Board
3.3.3 Distribution of Non-Main Track Derailments by Number of Cars Derailed

Regarding the non-main track derailments, the largest group here is also comprised of accidents involving the derailment of a single car. Of the total non-main track derailments over 1996-2005, 46% have involved the derailment of a single car. Derailments involving 2-4 cars have accounted for 20% of the derailments. Derailments involving 5-10 cars have accounted for 19% of the derailments, while derailments involving more than 10 cars have also accounted for 19% of the main track derailments.

Figure 3.12: Distribution of Non-Main Track Derailments by Number of Cars Derailed per Accident

Source: Transportation Safety Board
4 Distribution of Accidents by Cause

The TSB obtains data in accident reports that are indicative of the causal factors contributing to accidents. The TSB refers to these as “assigned factors” and groups them into environmental (e.g. weather), equipment-related (e.g. axle, brakes, truck, wheel), track-related (e.g. geometry, rail) and human actions (e.g. failure to use equipment properly, inadequate/inappropriate maintenance of equipment, operating at improper speed). The TSB reports this information for three categories of accidents: main track derailments, non-main track collisions and non-main track derailments.

There are several qualifications to make in respect of this data. First, accidents rarely have a single cause so that more than one contributing factor may be assigned to any given accident. (This also means that any attempt to classify accidents by cause is somewhat arbitrary). Second, the data on assigned factors come from information reported to the TSB, and do not necessarily represent TSB findings on the causes of accidents since the TSB actually investigates only a small fraction of occurrences. Third, not all accident reports filed contain the information on causal factors, so that the data are representative of a subset of the total accidents on which reports are filed. However, it is not possible to determine the size of the subset because of the fact that accidents usually result from a combination of factors.

Figures 4.1-4.3 below show, for the three accident categories, the distributions by major assigned factor – environment, equipment, track and human actions – and indicate the changes that have occurred in these distributions since 1996. As may be seen in the following charts, human actions are a considerable bigger factor in non-main track accidents as compared to main track accidents.

4.1 Main Track Derailments by Assigned Factor

Figure 4.1 shows that main track derailments as a group are for the most part associated with track and equipment-related factors. This is perhaps not surprising since it is when heavy trains are moving at high speeds, as is generally the situation on main track, that track and equipment are most subject to possible failure. In 2005, for example, it can be seen that track and equipment factors were assigned to 82% of the main track derailments, while human factors were assigned to about 12% and environmental factors to 6% of the derailments. In the case of these derailments, there has also been some tendency for human factors to decline in importance.

Considering the period since 2002, the data behind Figure 4.1 indicate that the most recent series of increases in main track derailments has been driven mainly by track-related factors, followed by
equipment factors. Between 2002-2005, 59% of the increase in main track derailments was associated with track-related factors, more specifically geometry and rail. For the most part, failure in these areas is normally indicative of inadequate maintenance or inspection or insufficient capital renewal.

### 4.2 Non-Main Track Collisions by Assigned Factor

Figure 4.2 shows that non-main track collisions are associated almost exclusively with human factors, as might be expected. In 2005, for example, it can be seen that 91% of the non-main track collisions were associated with human factors, while 4.5% were associated with track-related factors and another 4.5% with environmental factors. In the case of non-main track collisions, the chart shows that there has been very little change over time in the distribution of assigned factors.

*Figure 4.2: Distribution of Non-Main Track Collisions by Assigned Factor*

Source: Transportation Safety Board

### 4.3 Non-Main Track Derailments by Assigned Factor

As Figure 4.3 shows, non-main track derailments as a group are typically associated with both human actions and track-related factors. In 2005, for example, it can be seen that 46% of non-main track derailments were associated with human factors, while 41% were associated with track-related factors. This same pattern has characterized the series of large increases in non-main track derailments between 2002 and 2005.

*Figure 4.3: Distribution of Non-Main Track Derailments by Assigned Factor*

Source: Transportation Safety Board
Considering the period 2002-2005, the data behind Figure 4.3 indicate that 45% of the increase in non-main track derailments was associated with human factors while 42% of the increase was associated with track-related factors. The increase associated with human factors is almost entirely the result of failure to protect, and it may be that increased reporting compliance has played a role in the increase reported as due to human actions. The increase reported as due to track is, according to the data, related specifically to geometry, turnouts and switches. For the most part, failure in these areas is normally indicative of inadequate maintenance or inspection or to a lesser extent insufficient capital renewal.
5 Passenger Train Accidents

Passenger rail operations consist of regular intercity services, commuter services and a few seasonal and tourist operations. The intercity segment is dominated by VIA Rail, which accounts for 94% of total rail intercity passenger revenues. Commuter rail operations are dominated by three major rail commuter operators, GO Transit (Toronto), AMT (Montreal) and West Coast Express (Vancouver).

Measured by train miles, intercity rail activity accounted for 72% of the total of rail intercity and commuter activity in 2005, as intercity passenger train miles totalled 7.4 million while commuter train miles totalled 2.8 million. Measured by passenger miles, intercity rail activity accounted for 80% of the total of rail intercity and commuter activity in 2005, as rail intercity passenger miles totalled 919 million while rail commuter passenger miles totalled 225 million. At the same time, it should be recognized that commuter rail activity has been growing much more strongly than intercity rail activity. Since 1997, the numbers of rail commuters have grown 4.5% per year, compared to 0.7% per year for intercity passengers.

Passenger rail operations in total make up only a small part of railway operations in Canada. As a result, TSB data show that of all trains involved in accidents, only about 6% are passenger trains while about 80% are freight trains. Track units, single car/cut of cars and others account for the remainder. Figure 5.1 shows the numbers of passenger train accidents between 1996 and 2005, along with the breakdown by type of accident. These data include not only numbers for VIA Rail but also for GO Transit, AMT and West Coast Express as these operate mostly over federally regulated track. As seen in Figure 5.1, total accidents involving passenger trains varied between a high of 92 in 1996 and a low of 59 in 2003.

Given the nature of passenger rail operations, which involve relatively light trains moving at high speeds, the great majority of accidents involving passenger trains are crossing and trespasser accidents. Over the period shown, there were a total of 746 passenger train accidents, which included 285 crossing accidents and 249 trespasser accidents. Moreover, these crossing and trespasser accidents accounted for 10% and 29%, respectively, of the total of all rail crossing and trespasser accidents, freight and passenger included. It may also be seen in Figure 5.1 that since 2002, when there has been a trend up in total rail accidents, there has also been a trend up in passenger train accidents, with these increasing from 67 in 2002 to 85 in 2005. Most of this increase was accounted for by crossing accidents.

---

Figure 5.1: Passenger Train Accidents by Type

Source: Transportation Safety Board
6 Accidents Involving Dangerous Goods

This section reviews information on railway safety-related occurrences that involve dangerous goods. There are two sources of information for this, the TSB and the Dangerous Goods Directorate of Transport Canada (TDG). TDG is the federal regulator for the transport of dangerous goods and the principal source of data on occurrences involving dangerous goods, not only for rail but also for aviation, marine and roads. The TSB and TDG have very different criteria for the reporting by carriers of occurrences involving dangerous goods.

6.1 Rail Transport of Dangerous Goods

Before turning to the numbers of occurrences involving dangerous goods and some related data, it is of interest to look at the recent trends in rail dangerous goods traffic. This traffic has grown strongly over the past decade, as indicated by Figure 6.1. This shows rail transport of dangerous goods in Canada for CN and CPR combined, measured by millions of revenue ton miles (RTMs) and thousands of freight cars moved. Both series have grown by close to 60% since 1997, with RTMs rising from 24,592 million to 39,031 million, and numbers of cars moved rising from 781 thousand to 1,239 thousand.\textsuperscript{20}

Total tons carried is another measure of rail activity. Although not shown in the chart, total tons of dangerous goods carried by CN and CPR has increased by about one-third since 1997. The more rapid increase in RTMs as compared to tons carried implies an increase in the average length of haul of dangerous goods, and this has increased from approximately 750 miles in 1997 to approximately 850 miles in 2006. Another significant feature of rail dangerous goods traffic is that almost all dangerous goods transported by rail in Canada move in trains consisting of mixed freight. There are very few dangerous goods unit trains in Canada.

\textsuperscript{20}Due to lack of data, it has not been possible to determine whether the growth in rail dangerous goods traffic shown in Figure 6.1 reflects similar growth in dangerous goods traffic in total or a modal shift in dangerous goods traffic in favour of rail transportation. It would be possible to undertake some additional research along these lines using data that could be drawn from Statistics Canada's for-hire truck survey, but the information would still be incomplete for reasons that are well known, i.e. the for-hire truck survey does not cover private trucking, small operators and U.S. based operators.

TDG has recently attempted to estimate the amounts of dangerous goods transported by the different modes. Based on this work, TDG has estimated that about 46% of the tonnage of dangerous goods transported is moved by road while 39% is moved by rail. See Transport Canada, \textit{Transportation in Canada 2006 Annual Report}, op. cit., p. 31.
6.2 TDG Reportable Rail Accidents

Under the TDG regulations, the basis for determining whether an accident is reportable or not is the quantity of dangerous goods released. There are nine categories or classes of dangerous goods. If an accidental release occurs that exceeds the minimum quantity for any class specified in the regulations, an immediate report is required. Also, an immediate report is required in the event of an imminent accidental release, and such a report is considered an immediate report for any subsequent accidental release.\(^{21}\)

Figure 6.2 shows the number of TDG reportable rail accidents over the period 1997-2006, along with the total quantity of dangerous goods released in each year.\(^{22}\) While the number of accidents varies from a low of 45 in 1997 to a high of 100 in 2003, the data show no tendency for the number of accidents to have risen over the period. The quantity released also varies widely, with 1999 and 2003 having been especially bad years, but shows no uptrend over time. Figure 6.2 also appears to show little, if any, correlation between the number of accidents and the quantity of dangerous goods released. It is clear that the number of accidents, by itself, does not say much about the risk or consequences of occurrences.

---

\(^{21}\) Transport Canada, *TDG Regulations – Part 8* at <http://www.tc.gc.ca/tdg/clear/part8.htm>. The definitions of the nine classes of dangerous goods and other terms such as “imminent accidental release” may be found in Part 1 of the regulations. An imminent accidental release occurs when there has been an accident involving no release of product but where an imminent threat is present because the means of containment suffered damage.

\(^{22}\) The quantity released shown in Figure 6.2 is only an approximation. For some classes of dangerous goods the units are kilograms and in others they are litres. These have simply been added together to produce an estimate of the total quantity of dangerous goods released without taking onto account the specific gravity of the individual classes. On average over the period, about 30% of the quantities released were kilograms and 70% were litres.
It should also be noted that what constitutes a TDG reportable accident can occur while the dangerous goods are in transit, while they are being handled, or during temporary storage pending transport. Most accidents occur when the goods are not in transit. For example, the data behind Figure 6.2 shows that there were a total of 391 TDG reportable rail accidents over the past five years 2002-2006. Of these, 48 or 12% occurred while the dangerous goods were in transit. It is also true that the severity of accidents in terms of quantities released and the consequences do not necessarily correlate with whether the goods happened to be in transit or not.

For a number of years, TDG has tried to represent the severity of an accident through a summary measure based on a severity index called the ICI index. Under this methodology, the severity level of an accident ranges from 0-9 and is based on the answers to a series of yes/no questions about the accident. A point is assigned for each positive response to one of the questions. The information for determining the answers is derived from the accident reports. Figure 6.3 shows the results of applying the severity index to rail dangerous goods accidents over the period 1997-2006. To simplify the chart, the accidents have been grouped into three categories: minor (score of 0-3), moderate (score of 4-6) and major (score of 7-9).

---

24 Ibid.
Recognizing the drawbacks of the current index and others that it has examined, TDG has research ongoing relating to measuring accident severity. One possibility that is being considered is to apply the days of activation of an ERAP, or emergency response assistance plan, which would give some indication of the magnitude of an accident.

6.3 TSB Occurrences Involving Dangerous Goods

As outlined below in Section 7 of this report, the TSB has two criteria relating to the reporting by carriers of rail dangerous goods occurrences, one to “accidents” and one to “incidents.” Neither of these is comparable to the TDG reporting criteria.

Under the TSB regulations, the definition of “reportable railway accident” includes those accidents where the rolling stock is involved in a collision or derailment and is carrying dangerous goods, or is known to have last carried dangerous goods but where the residue was not purged from the rolling stock. Unlike the TDG reporting criteria, it is not necessary for there to have been any release of dangerous goods for the accident to be reportable as one involving dangerous goods, and there has to be a collision or derailment.

The TSB definition of “reportable railway incident” includes occurrences resulting directly from the operation of rolling stock where there has been no accident but where dangerous goods have nevertheless been released on board or from the rolling stock. The TSB refers to these as “dangerous goods leakers.” In this case, it is necessary for there to have been a release of dangerous goods but, unlike the TDG reporting criteria, there is no minimum quantity stipulated.


27 Emergency response assistance plan or ERAP means a plan that outlines what is to be done if there is an accident involving certain dangerous goods and that is in accordance with Part 7 of the TDG regulations. See <http://www.tc.gc.ca/tdg/clear/part7.htm>.
Figure 6.4 shows, for 1997-2006, the numbers of TSB reportable rail accidents involving dangerous goods and the TSB reportable rail incidents involving dangerous goods, or dangerous goods leakers. As can be seen, in both cases there is some tendency for the numbers to decline over the period. In the case of dangerous goods leakers, the drop is from 285 in 1997 to 86 in 2006, a drop of 70%. In the case of accidents involving dangerous goods, the decline is from 287 in 1997 to 182 in 2006, a drop of 37%.

The majority of TSB rail accidents involving dangerous goods are non-main track derailments. These accounted for 58% of the rail accidents involving dangerous goods between 1997 and 2006. This is followed by non-main track collisions, which accounted for 21% of these accidents during this period. The remainder was accounted for by main track derailments, crossing accidents and others.
7 Comparison of Canadian and U.S. Reporting Criteria

This section examines the differences between the regulatory criteria for determining railway reportable accidents and incidents in Canada versus those used in the United States.

7.1 Canadian Railway Reporting Criteria

7.1.1 Reportable Railway Accident

In Canada, the TSB regulations define what constitutes a “reportable railway accident.” This is an accident resulting directly from the operation of rolling stock, where

(a) a person sustains serious injury or is killed as a result of
   i) being on board or getting on or off the rolling stock, or
   ii) coming into contact with any part of the rolling stock or its contents, or
(b) the rolling stock
   i) is involved in a grade crossing collision,
   ii) is involved in a collision or derailment and is carrying passengers,
   iii) is involved in a collision or derailment and is carrying dangerous goods, or is known to have last carried dangerous goods the residue of which has not been purged from the rolling stock,
   iv) sustains damage that affects its safe operation, or
   v) causes or sustains a fire or explosion, or causes damage to the railway, that poses a threat to the safety of any person, property or the environment.28

These criteria require the reporting of accidents, and in particular derailments, but only with certain qualifications. Putting aside situations where casualties might be involved, derailments are reportable only if the rolling stock is carrying passengers, dangerous goods, dangerous goods residue, sustains damage that affects its safe operation, or causes damage that poses a threat to safety. Some of these qualifications would appear to be subject to interpretation, and the criteria have been the source of considerable controversy. This has raised the question as to whether all derailments that are supposed to be reported are being reported, and has led to the situation mentioned at the outset of this study where some of the current data published by the TSB will be undergoing revision beginning with the release of the occurrence data for June 2007.

7.1.2 Reportable Railway Incident

The TSB regulations also define a “reportable railway incident.” This is an incident resulting directly from the operation of rolling stock, where

(a) a risk of collision occurs,
(b) an unprotected main track switch is left in an abnormal position,
(c) a railway signal displays a less restrictive indication than that required for the intended movement of rolling stock,
(d) an unprotected overlap of operating authorities occurs,

(e) a movement of rolling stock exceeds the limits of its authority,

(f) there is runaway rolling stock,

(g) any crew member whose duties are directly related to the safe operation of the rolling stock is unable to perform the crew member's duties as a result of a physical incapacitation that poses a threat to any person, property or the environment, or

(h) any dangerous goods are released on board or from the rolling stock. 29

A reportable incident is thus a situation that presents a risk of an accident but where none has actually occurred. The exception is situation (h) where there is a dangerous goods leakage but no reportable accident.

7.2 U.S. Railway Reporting Criteria

In the U.S., “accident/incident” is a general term that is used in reference to the full list of reportable railway occurrences or events. As explained by the FRA these include: fatalities, injuries, and illnesses; collisions, derailments and similar accidents that involve the operation of on-track equipment and cause damage above an established threshold ($8,200 for 2007); and impacts at rail-highway grade crossings. Accidents/incidents are further categorized as train accidents, train incidents and non-train incidents.

Casualty is another key term. Casualties are reportable deaths, injuries or diagnosed occupational illnesses arising from the operation of a railroad. Casualties resulting from impacts at rail-highway crossings may also be categorized as train accidents, train incidents and non-train incidents.

Train accidents, train incidents and non-train incidents have the following definitions.

7.2.1 Train Accident

A train accident is any collision, derailment, fire explosion, act of God, or other event involving the operation of on-track equipment (standing or moving) that results in total damages to all railroads involved in the event that is greater than the current reporting threshold to railroad on-track equipment, signals, track, track structures, and roadbed.

7.2.2 Train Incident

A train incident is an event involving the movement of on-track equipment that results in a reportable casualty but does not cause reportable damage above the threshold established for train accidents.

7.2.3 Non-Train Incident

A non-train incident is an event that results in a reportable casualty but does not involve the movement of on-track equipment nor cause reportable damage above the threshold established for train accidents. 30

7.3 Canadian and U.S. Reporting Criteria Differences

It is evident that the definitions of what constitute railway reportable accidents and incidents in Canada are very different from those used in the U.S. In particular, the word “accident” in the context of railway safety regulation has a very different meaning in Canada than in the U.S. Thus,

---

29Ibid.

30All of the U.S. definitions are taken from U.S. Department of Transportation, Federal Railroad Administration, Office of Safety, FRA Guide for Preparing Accident/Incident Reports, DOT/FRA/RRS-22 (May 1, 2003), Chap. 2.
what are counted as “accidents” in the two countries are not the same and cannot be compared. In Canada, the definition of what constitutes a railway reportable accident is far more encompassing (notwithstanding the comments above in subsection 7.1.1 regarding the Canadian criteria). Perhaps most obvious, the U.S. definition of accident includes a monetary measure of severity, limiting reportable accidents to those causing damage above the established threshold. Also, the definition of accident in the U.S. does not include casualties (although casualties in the U.S. include all injuries and are not limited to counting serious injuries). Events categorized as “train incidents” and “non-train incidents” in the U.S. would count as accidents in Canada because of the casualties involved. In contrast, incidents in Canada are situations that in some way pose a threat but where no accident has occurred (except for dangerous goods leakages).

The TSB collects data on accidents in Canada that provide some indication of the significance of the differences in the Canadian and U.S. reporting criteria. Railways filing reports on accidents with the TSB are requested, but are not required, to indicate if the accident would also be reportable according to FRA criteria. The TSB has made the results for 2005 and 2006 available for purposes of this report, and these are shown in Figure 7.1 below. To the extent that the sample is an accurate representation, the implication is that if the U.S. definitions for accidents were to be adopted and used in Canada instead of the TSB definitions, the number of TSB reportable accidents would drop by 90% or more.

![Figure 7.1: Numbers of TSB Reportable Accidents and Accidents Indicated as FRA Reportable](image)

### Accident Type

<table>
<thead>
<tr>
<th>Accident Type</th>
<th>TSB Reportable Accidents</th>
<th>2005</th>
<th>Accidents Indicated as FRA Reportable</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Track Collisions</td>
<td>6</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Main Track Derailments</td>
<td>194</td>
<td>71</td>
<td>134</td>
<td>33</td>
</tr>
<tr>
<td>Crossing Accidents</td>
<td>269</td>
<td>3</td>
<td>248</td>
<td>5</td>
</tr>
<tr>
<td>Non-Main Track Collisions</td>
<td>93</td>
<td>6</td>
<td>108</td>
<td>7</td>
</tr>
<tr>
<td>Non-Main Track Derailments</td>
<td>540</td>
<td>44</td>
<td>481</td>
<td>17</td>
</tr>
<tr>
<td>Collisions/Derailments Involving Track Units</td>
<td>19</td>
<td>1</td>
<td>16</td>
<td>0</td>
</tr>
<tr>
<td>Employee/Passenger Accidents</td>
<td>8</td>
<td>0</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>Trespasser Accidents</td>
<td>83</td>
<td>0</td>
<td>92</td>
<td>3</td>
</tr>
<tr>
<td>Fires/Explosions/Other</td>
<td>36</td>
<td>0</td>
<td>46</td>
<td>0</td>
</tr>
<tr>
<td>R/S Damage without Derail./Coll.*</td>
<td>36</td>
<td>0</td>
<td>46</td>
<td>0</td>
</tr>
<tr>
<td>R/S Collision with Object *</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1247</strong></td>
<td><strong>126</strong></td>
<td><strong>1143</strong></td>
<td><strong>67</strong></td>
</tr>
</tbody>
</table>

* Insufficient information to assign to TSB reportable categories

Source: Transportation Safety Board

The Canadian railways have long been critical of the TSB definitions (and published statistics). Among other things, the railways argue, as has been suggested above, that the current TSB definition of reportable railway accident contains ambiguities, for example in phrases such as “affects its safe operation” [paragraph (b) (iv)] and “poses a threat to the safety of any person, property of the environment” [paragraph (b) (v)]. They have argued that the TSB weighs occurrences such as main track derailments equally, irrespective of their severity. In connection with this, the railways often point to the FRA criteria that do have a severity threshold in the form of the amount of property damages. On this latter point, however, the railways have not recognized the difficulties of using a monetary threshold, namely that damages from two accidents of roughly equal severity can vary widely depending on the age of the equipment and depreciation method used. This is an issue that has been studied in the U.S., but was been found difficult to resolve.\(^\text{31}\)

---

8 Comparison of Canada/U.S. Rail Safety Records

This section provides, to the extent possible, an “apples to apples” comparison of the rail safety performance of Canada’s major railways with those of comparable U.S. railways. The comparison uses the basic measure of accidents per million train miles, where accidents are defined in accordance with the FRA criteria. The results are shown in two charts, Figures 8.1 and 8.2. Figure 8.1 displays the basic data; Figure 8.2 displays the averages derived from the data in Figure 8.1. The results indicate that CN’s and CPR’s safety performance, based on their overall North American operations, compares favourably to that of their U.S. counterparts. This, however, reflects a better performance on the Canadian lines of CN and CPR.

In Figure 8.1, the data for the U.S. railways are official FRA statistics that are readily available from the website of the Office of Safety Analysis. The data for CN and CPR are statistics that CN and CPR are not legally obligated to provide, but calculate on their own on the basis of FRA definitions and make available to the public. They do this because they need to benchmark themselves to their main rail competitors, that happen to be the major U.S. railways, and they can only do this using FRA measures because that is how the U.S. railways report. It is important to recognize that the CN and CPR results in Figure 8.1 relate to their entire operations in Canada and the U.S., while the U.S. Class I average includes only the U.S. operations of CN and CPR along with the other U.S. railways (as explained in the next paragraph).

The U.S. railways generally considered comparable to CN and CPR are the U.S. Class I railways, and in particular, the four largest of these: Burlington Northern Santa Fe (BNSF), CSX Transportation (CSX), Norfolk Southern (NS) and Union Pacific (UP). Under U.S. federal regulations, railways are classified as Class I, II or III depending on the size of their annual operating revenue. Applying the regulatory definition, the Association of American Railroads (AAR) calculates that U.S. Class I railroads are those having 2005 operating revenue in excess of (U.S.) $319.3 million. The AAR further notes that CN and CPR are large enough that they would be U.S. Class I railroads if they were U.S. companies, and that CN and CPR both own railroads in the U.S. that, by themselves, qualify as Class I railroads. Currently, there are seven U.S. Class I railroads: BNSF, CSX, Grand Trunk Corporation (owned by CN), Kansas City Southern (KCS), NS, Soo Line Railroad (owned by CPR) and UP.\(^2\)

It is also interesting to note in Figure 8.1 that CPR’s performance since 1996-1997 has been consistently superior to its performance in the years 1996-1997. This reflects the massive corporate reorganization in connection with the move to Calgary in 1996, along with an extremely severe winter in 1996-1997. Similarly, CN’s performance since 1996 has been consistently better than its performance in 1996, its first year of operation following its privatisation in late 1995.

Figure 8.2 takes the data charted in Figure 8.1 and converts it into averages for the entire period 1996-2006. As seen in Figure 8.2, the CN and CPR accident rates per million train miles average 2.2 and 2.4, respectively. These figures are lower than the averages of each of the four largest U.S. railways, which range between 2.8 and 4.4. They are also lower than the overall U.S. Class 1 average of 3.9 per million train miles. As a further comparison, however, the CN and CPR averages for their U.S. operations alone as calculated from the data made available by the FRA work out to 5.4 and 4.1, respectively. Thus, on their U.S. operations alone CN’s accident rate is above the U.S. Class I average, while CPR’s accident rate is about the same as the U.S. Class I average.

Figure 8.1: Annual FRA Train Accident Ratios 1996-2006
North American Class 1 Railroads

Figure 8.2: Average FRA Train Accident Ratios 1996-2006
North American Class 1 Railroads

Source: CN, CPR, Federal Railroad Administration Office of Safety Analysis
9 Improving Reporting for Future Assessments

An important aim of this study is to consider how the reporting of statistical information on railway safety might be improved for purposes of future assessments. This section makes three recommendations. The first is to establish a (non-permanent) Railway Occurrence Reporting Task Force to address problems with reporting to the TSB, the reliability and use of the data, and the publication of information by the TSB. This is not intended to be solely a study group but a group to ensure that appropriate strategies are implemented and problems corrected. The second recommendation is a specific one and relates to how accidents should be normalized to improve comparability in the published statistics, an issue that could be further considered by the Task Force as part of its work. The third recommendation relates to apparent ambiguities in the current criteria that define reportable accidents, and that should be clarified or better guidance provided, especially with respect to derailments.

9.1 Create Railway Occurrence Reporting Task Force

Discussions with the TSB, the various groups within Transport Canada, and the railways have indicated that there have been concerns for some time with the reporting of occurrences to the TSB (e.g. issues of compliance, problems of interpretation of the regulations), the reliability of the data, its use and manipulation by the TSB (e.g. normalization of accidents, categorization of accidents) and how the results are reported (e.g. the manner of presentation and explanation provided).

The forthcoming changes in the regulations will presumably resolve some issues that both the TSB and the industry have had with railway occurrence reporting. Some of the concerns, however, have not been about the regulatory criteria per se but about procedures, data quality and reporting of results. For example, a major concern often stated by the industry is that the manner in which data on occurrences are reported to the public lacks sufficient contextual information. The industry argues that all accidents are treated as equal when in fact some are more severe than others, including accidents within the same category such as main track derailments. Crossing and trespassing accidents are another example cited by the industry. These are presented as though they were entirely the result of train traffic when the risk is also a function of factors such as the amount and type of road traffic. There is no question that improvements could be made along these lines. This report has also highlighted shortcomings, in particular with the “Main Track Train Miles” information used by the TSB for purposes of normalizing occurrences. There is a need for better coordination among agencies, such as in the reporting on accidents involving dangerous goods. There are also large amounts of untapped data, residing for example in the Dangerous Goods Directorate as well as the railways.

It is our view that a Railway Occurrence Reporting Task Force should be established to address and resolve these problems. This would be comprised of TSB staff, industry stakeholders, independent experts and other agencies. Its mandate would be to draw up a comprehensive list of the issues, and develop a plan to address the problems and implement needed changes in a timely manner; it is not intended that the Task Force would be permanent, nor would its job be to simply make recommendations. It would ensure that appropriate strategies are implemented and problems corrected. Among the urgent matters are the problems that are about to arise over the comparability between the data that will be generated under the new reporting regulations expected to become effective in 2008 and the existing data. It is important for future assessments that a consistent set of data linking the new data with the past is available, probably five years at a minimum. The Task Force would also without delay address the problem that has been identified in this report with the “Main Track Train Miles” data currently being used by the TSB.

Among other matters that could usefully be addressed by the Task Force is the preparation of a guidance document, perhaps similar to that produced by the FRA in the United States.\textsuperscript{33} The Task

\textsuperscript{33} U.S. Federal Railroad Administration, Office of Safety, \textit{FRA Guide for Preparing Accident/Incident Reports} (DOT/FRA/RRS-22, Effective May 1, 2003), op. cit.
Force could also consider the development of additional or better measures of safety or risk than simple accident/incident counts. These might include the development of leading indicators (see Box 9.1), or the development of more sophisticated measures of risk along the lines that have already been suggested to the Advisory Panel. The Task Force could also consider the possibility of better coordination among agencies that are collecting/publishing data, including the possibility of consolidating data gathering, generation and analysis of statistics within one group of either the TSB or Transport Canada.

Box 9.1: Developing Leading Indicators of Railway Safety

<table>
<thead>
<tr>
<th>Nature of Accident Cause</th>
<th>Leading Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Track</td>
<td>Capital spending on the track infrastructure</td>
</tr>
<tr>
<td>2 Track</td>
<td>Track inspections by Transport Canada safety inspectors/Compliance to Transport Canada’s railway track safety rules.</td>
</tr>
<tr>
<td>3 Track</td>
<td>Review of track inspection records by Transport Canada safety inspectors/completeness of records and follow up to noted deficiencies.</td>
</tr>
<tr>
<td>4 Train Handling</td>
<td>Quality and levels of training of running trades employees</td>
</tr>
<tr>
<td>5 Train Handling</td>
<td>Knowledge of rules</td>
</tr>
<tr>
<td>6 Train Handling</td>
<td>Observations of unsafe behaviours</td>
</tr>
<tr>
<td>7 Equipment</td>
<td>Equipment inspections by Transport Canada safety inspectors/Compliance to applicable Transport Canada rules pertaining to equipment.</td>
</tr>
<tr>
<td>8 Third Party</td>
<td>Adequacy of crossing sightlines at unprotected crossings</td>
</tr>
<tr>
<td>9 Third Party</td>
<td>Adequacy of signage and fencing to prevent trespassing</td>
</tr>
</tbody>
</table>

Of the above indicators, (1) is readily available, would require minimal data manipulation but may exhibit a relatively weak linkage. Some of the indicators are likely information currently gathered by safety inspectors (2,3,7) but not compiled for use as a leading indicator. Some of the information (4,5,6,8 and possibly 9) is likely collected by operators via safety audits conducted as part of their SMS and could be augmented by observations of Transport Canada safety inspectors. Two (5,6) would likely exhibit strong linkages, but it would be difficult to assure consistency in data collected across different operators and over time. For some indicators, measures should be readily available but may require a fair amount of analysis to be useful as leading indicators.

By conducting audits and measuring things such as unsafe behaviours and rules compliance, railways are generating performance measures that could be used as leading indicators. In addition, other performance measures or potential performance measures appear to exist that could be used as leading indicators. The question remains whether, given the quality and consistency of these over time and across operators, and the uncertainty regarding the strength of the linkages, whether the leading indicators would prove to be of real predictive value.

---

9.2 Improving Procedures for Normalizing Occurrences

A key question relevant to providing more reliable information for future assessments is whether train miles is the best possible measure of railway activity for normalizing accidents, even though it has become the standard for this purpose. To summarize our view on this, we would recommend the use of gross ton miles (GTMs) as the principal measure for normalizing total rail accidents, total rail accidents excluding crossing and trespasser accidents and other key categories of “pure” railway accidents including derailments and collisions. At the same time, we would argue to retain train miles as a supplementary measure since this is the international standard and will likely remain so.\(^{35}\) We would also argue that train miles is the most appropriate indicator to use for normalizing crossing accidents, and should be used for trespasser accidents but the latter could also be normalized on the basis of length of track operated. We would also favour train miles for normalizing accidents involving passenger trains, but there is currently a practical issue due to lack of historical data on commuter operations.

The reasoning and the results are as follows:

9.2.1 Gross Ton Miles (GTMs) as the Principal Normalization Measure

It has already been shown in Section 3.1 that, because of the behaviour of aggregate train miles over time in Canada, normalizing accidents by train miles yields no added information concerning the trend in the industry’s safety performance. If the intention of using train miles is to capture and normalize for the growth in rail activity, train miles is not adequate for the job, at least according to the Canadian data.

Train miles also has disadvantages for comparing safety records across railways. Other things equal, a railway operating with longer trains, and therefore with fewer trains and train miles, will appear to be less safe than others when compared on the basis of accidents per train mile. Similarly, if there is an industry-wide trend towards the increasing use of longer trains, this will tend to slow the growth in train miles and make the system appear less safe than otherwise. What this says is that the best measure for normalizing accidents is one that best filters out factors that unintentionally detract from normalization. This is in addition to the need for the measure to adequately represent the growth in rail activity.

There are other suitable measures of rail activity that can be used to normalize accidents instead of, or at least as a supplement to, train miles. These include GTMs and car miles. GTMs and car miles, of course, have their pros and cons. For example, GTMs puts much more emphasis on weight as a factor than car miles. A railway that has a mix of traffic less weighted towards heavy commodities and more weighted towards lighter traffic, or that carries a high percentage of empty traffic, will, other things equal, tend to produce fewer GTMs and appear less safe than other railways on the basis of accidents per GTM. Similarly, if there is an industry-wide trend towards an increasingly lighter mix of traffic, this will tend to slow the growth in GTMs and make the system appear less safe over time than otherwise. Significantly, there has not been much change in the overall balance of light and heavy rail traffic in Canada over the past decade.\(^{36}\)

All things considered, GTMs is probably the better measure to use. It is certainly the more common and familiar statistic, which is an important consideration. Furthermore, weight itself does play a role in...
in safety and should not be left out. Weight is a driver of the wear and tear of track infrastructure and of equipment components, and weight also makes the train harder to stop. That said, when it comes to derailments, some types are more prone with light or empty cars while others are more prone to loaded or heavy cars. On the other hand, it is generally true that a loaded car derailed will do more damage than an empty car, though this is not always the case. For example, an empty dangerous commodity residue car likely poses more threat derailed than many non-dangerous commodity loaded cars. Finally, when it comes to tracking the growth in aggregate rail traffic over time in Canada, an examination of GTMs and car miles shows that they behave similarly.

Having considered train miles, car miles and GTMs, the latter has been settled on as the preferred indicator. Figure 9.1 provides a comparison of the trend in GTMs to that of train miles.\(^{37}\)

![Figure 9.1: Billion Gross Ton Miles (BGTM) and Million Train Miles (MTM) (indexes 1989=100)](chart)

Source: Transport Canada

### 9.2.2 Results of Normalizing Accidents Using GTMs

Figures 9.2-9.4 show the results of normalizing accidents using GTMs (in billions) over the period since 1996. Three series are shown: total accidents excluding crossing and trespasser accidents; main track derailments; and non-main track derailments. It will be recalled that the latter two categories have been the drivers of the recent series of rail accident increases between 2002 and 2005 (see Figure 2.3).

---

\(^{37}\)The GTM series does not include passenger. Gross ton miles is not normally a measure that is used as an indicator of passenger rail activity. However, when it is required, it is usually estimated by assuming a standard weight per passenger car.
**Figure 9.2: Rail Accidents Excl. Crossing and Trespasser Accidents per Billion GTMs**

Source: Transportation Safety Board and Transport Canada

**Figure 9.3: Main Track Derailments per Billion GTMs**

Source: Transportation Safety Board and Transport Canada

**Figure 9.4: Non-Main Track Derailments per Billion GTMs**

Source: Transportation Safety Board and Transport Canada
Focusing on the recent 2002-2005 period, it can be seen that total accidents per billion GTM (Figure 9.2) have grown less rapidly than total accidents. While total accidents increased from 650 in 2002 to 896 in 2005, or 38%, accidents per billion GTM increased at roughly half that pace, from 1.7 to 2.0, or 18%. In other words, approximately half of the growth in accidents could be ascribed to the increase in traffic over the period (including the effect of the CN acquisition of BCR in 2004). In the case of main track derailments (Figure 9.3), these increased from 116 in 2002 to 194 in 2005, or 67%, while accidents per billion GTM increased 43%. In the case of non-main track derailments (Figure 9.4), these increased from 347 in 2002 to 540 in 2005, or 56%, while non-main track derailments per GTM increased 33%. Recalling the earlier discussion on the distribution of accidents by cause (Section 4), it can be said that a substantial number – though not all – of the main track and non-main track derailments that were behind the growth in rail accidents during 2002-2005 probably reflect inadequate maintenance or inspection and/or capital renewal.

9.2.3 Normalizing Crossing, Trespasser and Passenger Train Accidents

Although we consider GTMs to be a better choice than train miles for normalizing total rail accidents and other major categories such as "pure" rail accidents, there is a question as to whether GTMs is the best choice for normalizing crossing and trespasser accidents. Despite the potential problems with train miles outlined above as a result of the movement to longer freight trains, we do not think that GTMs is the best measure for normalizing crossing and trespasser accidents. Any measure of activity used for normalization should be representative of the activity that creates the risk. In the case of crossing accidents, we think the risk is better captured by train miles than GTMs. Hence, we would still argue for using train miles to normalize crossing accidents, at least when it comes to normalizing accidents in the aggregate. In the case of trespasser accidents, these should also be normalized using train miles, or they could logically be normalized using length of track operated.

As regards passenger train accidents, we would also continue using train miles as the measure for normalizing accidents. As we have seen, the great majority of accidents involving passenger trains are crossing and trespasser accidents. In addition, unlike freight, the weight of passengers carried is of little consequence (which means there is little variation in the weight per car) and operators’ train consists (numbers of cars) are also generally fixed. This means there should be little difference in the behaviour of train miles, passenger GTMs and passenger car miles. We should also note that there is a practical issue to deal with in normalizing passenger accidents, i.e. the unavailability of historical data prior to 2002 on commuter rail train miles.

9.3 Broaden Reporting Criteria for Derailments

In Section 7 it is noted that the definition of reportable railway accidents requires the reporting of accidents but only with certain qualifications. In particular, it is noted that a large number of derailments are likely not reportable or their reportability is subject to interpretation. This means that there is no reporting requirement where a derailment is minor (no casualty, did not occur at a crossing, no passenger present, no dangerous goods involved or residue present, no equipment damage or threat to safety) but where a rules violation occurs or there is a major track event. Information regarding such derailments is critical for monitoring the level of safety at the railways. It is therefore recommended that the reporting criteria for accidents be broadened to include all derailments. This would provide a fuller picture of the state of railway safety, and remove any issues relating to subjectivity that could be construed from the criteria. As evidence of the problem, we point to the reference made in the Introduction to this report concerning the data revisions that are being introduced this month on account of issues over the interpretation of the reporting requirements.
10 Conclusion

The mandate for this study has been to examine the state of rail safety in Canada as determined from readily available statistics, and to recommend how the information made available could be improved for purposes of future assessments. This section highlights what may be concluded about the state of rail safety over the past decade from the existing statistics, and briefly reiterates the recommendations for how to improve the information being used to judge rail safety.

10.1 Conclusions About the State of Rail Safety

Various sections of this report have examined the safety record of railways in Canada in terms of the absolute numbers of accidents and by type of occurrence, the frequency of accidents and the severity in terms of numbers of fatalities and serious injuries and numbers of cars derailed, the distribution of accidents by cause, and the record of accidents involving passenger trains and dangerous goods. In addition, the report considers the accident records of railways in Canada versus the United States.

In considering these results, it is important to recognize that railway operations (like the other transport modes) are inherently risky and cannot be judged relative to a benchmark of zero occurrences. As was stated before the Advisory Panel, “... a railway operation can most probably be classified to be 'safe' when the risk of occurrences causing damage to humans, property, and/or the environment is reasonable, prudent, and otherwise acceptable to those who would potentially bear the consequences.”38 However, measuring true safety, which is the result of both the occurrence and consequences of mishaps is complex and beyond the aim of this paper.

With that in mind, as well as other caveats noted in this report regarding the comparability and validity of the data, certain observations may be made about railway safety trends, at least since the mid-1990s:

- All accidents should give rise to concerns and lead to more safety efforts. The system, however, does not appear to be more risky today than a decade ago based on the total numbers of accidents experienced.

- Accidents consist of different types with varying causes and consequences. About half of rail accidents are non-main track collisions and derailments that are generally minor. Somewhat more than one-fourth of accidents take place at crossings or involve trespassers. About one-sixth of rail accidents are main track collisions and derailments.

- Among all rail accidents, crossing and trespasser accidents remain the cause of almost all fatalities and serious injuries. In the totality of all railway accidents, casualty rates for employees have been low but should obviously be improved.

- Due to the role of the public, achieving reductions in crossing and trespasser accidents is difficult. Also, interpreting the statistics is difficult because of the many factors that have influenced reported accidents. Over the past decade, it appears that Direction 2006 has helped limit crossing and trespasser accidents, and that some slow progress was made in reducing these accidents.

- Because of their small role in the rail industry, passenger trains account for only about 6% of all trains involved in accidents. Passenger trains, however, account for a disproportionate number of rail crossing and trespasser accidents. More than 70% of passenger train accidents are crossing/trespasser accidents.

Two agencies track accidents involving dangerous goods, the Transport Canada Dangerous Goods Directorate (TDG), which is the regulator and primary source of this information, and the TSB. They have very different criteria for defining reportable occurrences involving dangerous goods.

Rail transport of dangerous goods has grown strongly over the past decade, by almost 60% since 1997 (CN and CPR combined, millions of revenue ton-miles or thousands of freight cars moved). Data limitations prevent determining if this growth reflects similar growth in dangerous goods traffic overall, or a modal shift in favour of rail.

TDG reportable accidents have varied considerably over the past decade but show no uptrend, and have fallen in the past few years. The total quantity of dangerous goods released in any year has also varied widely, being especially high in 1999 and 2003, but exhibits little correlation with the number of accidents. As tracked by the TSB, accidents and incidents involving dangerous goods have tended to decline over the past decade.

The overall pattern in “pure” railway accidents (i.e. rail accidents excluding crossing and trespasser accidents) has been similar to that of total accidents. This includes recent sharp increases in 2002-2005 and a decrease in 2006, both driven by non-main track and main track derailments.

In terms of numbers of cars derailed per accident, there has been no increase in the severity of accidents over the past decade, including the 2002-2005 period when accidents were rising.

Focussing on the period 2002-2005, the increases in “pure” railway accidents, including the non-main track and main track derailments, are only partly ascribable to growth in railway activity (measured in GTMs). A substantial portion were not, suggesting a deterioration in safety in this period. The bulk of increases in derailments in 2002-2005 were associated with track conditions, as opposed to environment, equipment or human actions. Examining the specific track-related factors suggests the causes were maintenance and inspection practices and capital replacement.

“Apples to apples” benchmarking of CN and CPR to that of their U.S. peers, based on the FRA definition of train accidents, indicates CN’s and CPR’s safety performance compares favourably. These results reflect CN’s and CPR’s relatively low accident rates on their Canadian operations.

International benchmarking has been found to be extremely difficult and generally unreliable due to differences in reporting criteria used in different countries.

### 10.2 Recommendations for Improving Future Reporting

This report has made three recommendations for improving future reporting.

First, establish a (non-permanent) Railway Occurrence Reporting Task Force comprised of TSB staff, industry stakeholders, independent experts and other relevant agencies. The Task Force would address long-standing and emerging issues relating to reporting to the TSB, the reliability and use of the data, the publication of information by the TSB, and agency coordination. The Task Force would do more than recommend solutions; it would ensure that appropriate strategies are implemented and problems corrected. Among the urgent matters are the problems that are about to arise over the comparability of the data that will be generated under the new reporting regulations and the existing data. The Task Force should also immediately resolve the problem of the “Main Track Train Miles” data now being used by the TSB to normalize accidents. The Task Force should determine how to make use of the large amounts of untapped data, residing for example with TDG and the railways, and should explore the development of additional or better measures of safety or risk than those currently in use.

Second, change the basis on which accidents are normalized for purposes of monitoring and analysis of railway safety performance. Make GTMs the principal measure for normalizing total accidents,
“pure” railway accidents and key categories of “pure” railway accidents. Retain train miles as a supplementary measure because it will likely remain the international standard. Use train miles for normalizing crossing accidents, and train miles and/or length of track operated for normalizing trespasser accidents. Train miles should also be the basis for normalizing accidents involving passenger trains, but requires looking into the situation with respect to data on commuter rail operations.

Third, broaden the definition of reportable railway accident to include all derailments, eliminating the problems of subjectivity and data consistency created by the existing criteria.
Appendix A – International Benchmarking and Australia and New Zealand Reporting Criteria

This Appendix first notes the many difficulties that have been found to underlie the challenge in comparing or benchmarking rail safety performance internationally. The Appendix then outlines the recent developments with respect to the criteria being used in Australia and New Zealand for reporting railway safety occurrences.

Comparing the Australian and New Zealand criteria shown here to the Canadian and U.S. criteria in the main report makes obvious the difficulty of undertaking meaningful international comparisons. To take just one example, Australia does not count level crossing accidents separately. Instead, these are lumped together with “any other occurrence that compromises safety at a level crossing” to report level crossing occurrences.

A.1 International Benchmarking

Comparing Canada’s rail safety performance with that of other countries could be one means of assessing the state of rail safety in Canada. Such international benchmarking, however, is extremely difficult and has generally proven to be impractical. Indeed, an experiment to collect and collate occurrence data from various countries, led by New Zealand and begun in late 1999, lapsed about three years ago. In 2003, New Zealand identified the problems encountered in their experience as: the difficulty in getting common terminology amongst participants; the fact that railways around the world operate with different environments and technologies; and that statistical data is often not readily available.

Burrows enumerates in general the difficulties in attempting to conduct international benchmarking. First, the data to be compared need to be identically based. This means the definitions for the parameters to be compared need to be suitably comparable, and the data need to be collected in accordance with the definitions. The data then need to be appropriately normalized. In addition, issues arise if the operating environments are different. These can arise from circumstances or behaviours that are present in one country but do not exist in another. For example, a major factor in collisions in Australia has been collisions with wild animals. Finally, there is the matter of whether data from different countries is available. One of the most significant findings by Burrows is that, “One area where data comparison has proved nearly a waste of time has been in rates of death and serious injury.”

A.2 Developments in Australian Reporting Criteria

As of this year, Australia has begun publishing national rail safety statistics for the first time. These are published by the Australian Transport Safety Bureau (ATSB) in cooperation with the Australian state and territory safety regulators and the rail industry. The rail regulators provide the data to the

---


40 E-mail correspondence with Merv Harvey, Acting National Manager Rail Regulation, Land Transport New Zealand (received June 25, 2007).


42 Rob Burrows, Benchmarking Railway Safety Data in Australia and Internationally, op. cit., p. 15.

43 Ibid., p. 8.
ATSB for national publication. At this time, only data for 2005 and 2006 have been published although a more complete set of data is expected.\textsuperscript{44}

The database contains frequency counts for the following types of occurrences: derailment; collision; level crossing occurrence; signal passed at danger (SPAD); loading irregularity; and track and civil infrastructure irregularity. Normalising data is provided for train kilometers, freight-train kilometers, passenger-train kilometers and total track kilometers. In addition, frequency counts are provided for deaths and serious injuries. The definitions for the data are contained in Standard No. ON – S1: Occurrence Categories and Definitions,\textsuperscript{45} and have been developed by the rail safety regulators in collaboration with industry. In brief, the definitions are:

- **Fatality** – A person who dies, within 30 days of a railway occurrence, from injuries sustained in that occurrence.
- **Serious Personal Injury** – A person admitted to hospital as the result of injuries sustained in a railway occurrence.
- **Derailment** – Where one or more rolling stock wheels leave the rail or track during railway operations.
- **Running Line Derailment** – Any derailment occurring in the movement of a train on a running line.
- **Collision** – When a train or rolling stock strikes another train, rolling stock, obstruction, person or other object or is struck by another object.
- **Level Crossing Occurrence** – Any collision of a train or rolling stock with either a road vehicle, person, level crossing safety equipment or gate, or any other occurrence that compromises safety, at a level crossing.
- **Signal Passed at Danger** – Where a train passes without authority a signal displaying a stop indication or stop aspect.
- **Loading Irregularity** – Any danger to the load that affects or could affect the safe passage of trains or the safety of persons and/or property.
- **Track and Civil Infrastructure Irregularity** – Any irregularity in the track or supporting infrastructure that causes a danger to the safe passage of trains and or to people.

### A.3 Developments in New Zealand Reporting Criteria

The current New Zealand reporting criteria were passed as part of the *Railways Act 2005*. The definitions of accident and incident in the Act are very general:

- **Accident** – means an occurrence associated with the operation of a rail vehicle or the use of railway infrastructure or railway premises that causes: (a) death or serious injury to individuals, or (b) significant damage to property.

- **Incident** – means an occurrence, other than an accident, that is associated with the operation of a rail vehicle or the use of railway infrastructure or railway premises that placed or could have placed: (a) a person at risk of death or serious injury, or (b) property at risk of serious damage.\textsuperscript{46}

Concerning “serious injury,” there are no firm definitions in the Railway Act but officials would normally consider the serious harm definition in the *Health and Safety Employment Act* as applicable.

“Significant damage” would normally be dependent on the size of the organization involved and the type of occurrence, with some (nebulous) guidance provided in the LTNZ guidelines.\footnote{E-mail correspondence with Merv Harvey, Acting National Manager Rail Regulation, Land Transport New Zealand (received June 25, 2007), op. cit.}