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TRANSPORTATION OF DANGEROUS COMMODITIES:
THE MISSISSAUGA STORY

Abstract

The derailment at Mississauga, Ontario on November 10, 1979 of 24 cars of a freight train, including 19 cars loaded with dangerous commodities, is reviewed along with the Report of the Mississauga Railway Accident Inquiry, issued by The Honourable Mr. Justice Samuel G.M. Grange, Commissioner, December 1980; Show Cause Order issued to the railways by the Railway Transport Committee (RTC) of the Canadian Transport Commission, January 1981; RTC Panel Hearing, April 21-July 1, 1981 and the Show Cause Hearing Decision on Railway Safety, issued by the RTC Panel, September 30, 1981; and public reactions to the decision of the RTC Panel.

The anticipated effects of the decision of the RTC Panel on railway safety, costs and rates are assessed and proposed modifications to the decision are outlined.

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TRANSPORTATION OF DANGEROUS COMMODITIES:

THE MISSISSAUGA STORY

THE MISSISSAUGA DERAILMENT

On November 10, 1979, a CP Rail (CP) eastbound freight train moving dangerous and other commodities derailed at Mississauga, Ontario. Included among the 24 cars which derailed were a tank car loaded with chlorine and 19 tank cars loaded with other commodities which the Canadian Transport Commission (CTC) classifies as dangerous.

Three of the derailed tank cars loaded with propane gas exploded, resulting in considerable property damage, and the car loaded with chlorine was ruptured which, because of the threat to life of the escaping chlorine gas, required the evacuation of approximately 250,000 people for periods of up to six days.

THE MISSISSAUGA ACCIDENT INQUIRY

The Honourable Mr. Justice Samuel G.M. Grange of the Supreme Court of Ontario was commissioned to conduct an inquiry and report on the existing state of railway safety as it related to the handling and carriage of dangerous commodities with particular reference to, among other things:

1. the contributing factors and causes of the derailment at Mississauga; and
2. steps which can reasonably be taken to reduce the risk of recurrence of such an accident anywhere in Canada.

In the Report of the Mississauga Accident Inquiry, issued by Commissioner Grange in December 1980, the cause of the Mississauga derailment was attributed to a hot box on a tank car loaded with toluene and equipped with friction or plain type of bearings. Among 15 recommendations made by Commissioner Grange were the following three:

1. Subject to following recommendation number 3, trains transporting dangerous goods of any kind should be equipped as follows:
 - a. All cars whether dangerous goods cars or not should have roller bearings;
 - b. All tank cars should have double shelf couplers;
 - c. All CTC specification number 112 and 114 tank cars should have head shields and thermal protection;^{1/} and
 - d. All CTC specification number 111 and 114 tank cars which have bottom fittings should have bottom fitting protection.
2. Subject to following recommendation number 3, the routes of any trains carrying dangerous goods through built-up areas should be protected by hot box detectors. No point within the built-up area should be more than 20 miles from hot box detector protection.
3. If a dangerous goods train does not comply with recommendation number 1, it should not exceed 4,000 feet in length regardless of the hot box detector protection provided. If the dangerous goods train does

^{1/} CTC regulations require that particular dangerous commodities be transported only in tank cars designed and constructed in accordance with certain specifications.

not comply with recommendation number 1, or if the route of the dangerous goods train passing through a built-up area does not comply with recommendation number 2, the train in passing through the built-up area should not exceed 25 miles per hour (MPH).

SHOW CAUSE ORDER OF THE RAILWAY TRANSPORT COMMITTEE

On January 23 and 26, 1981, the Railway Transport Committee (RTC) of the CTC ordered various railways operating in Canada to show cause on or before February 9, 1981 why the RTC should not, effective February 12, 1981, order implementation of recommendations 1, 2 and 3 of Commissioner Grange and, additionally, order installation of dragging equipment detectors.

RTC PANEL HEARING AND DECISION

After receiving numerous responses to the Show Cause Order from the railways and non-railway intervenors in which evidence and arguments were presented against placing the order into effect on February 12, 1981, the RTC decided to hold an open hearing in which all parties in favor of and opposed to implementation of the order would be given an opportunity to present evidence and argue their case.

During the hearing, which commenced on April 21, 1981 and ended on July 1, 1981, 5,063 pages of testimony and argument were presented before an RTC Panel composed of Chairman John T. Gray, Q.C., and Commissioners John Hagee and J.F. Walter.

Decisions made by the RTC Panel in its Show Cause Hearing Decision on Railway Safety (RTC Panel Decision), issued on September 30, 1981, are summarized as follows:

1. All new cars acquired by Canadian railways to be equipped with roller bearings and 75 percent of their revenue car fleets to be roller bearing equipped by December 31, 1987.
2. Specification 105 tank cars carrying any regulated commodity after June 30, 1982 to be equipped with double shelf couplers.
3. Other CTC specification tank cars carrying any regulated commodity after February 28, 1985, to be equipped with double shelf couplers.
4. No CTC specification tank car built after the date of issuance of this decision will be accepted for transport unless equipped with double shelf couplers.
5. Only full head shields are to be used henceforth on new and retrofitted tank cars.
6. After December 31, 1981, new specification 105 tank cars constructed to a service pressure of less than 500 psi shall be equipped with a tank head puncture resistance system (head shields) equivalent to that now required for specification 112 and 114 tank cars.

7. Specification 112 and 114 tank cars carrying any dangerous commodity after December 31, 1982 to have thermal protection.
8. After December 31, 1981 new specification 105 tanks cars to have thermal protection equivalent to present requirements for specification 112 and 114 tank cars.
9. New CTC specification tank cars with bottom outlets built after December 31, 1981 shall have such outlets protected as set out in the AAR Specifications for Tank Cars or recessed into the tank shell.
10. The Dangerous Commodity Technical Review Committee shall prepare and submit to the Railway Transport Committee:
 - i. by February 1, 1982 a retrofit schedule for the protection of bottom discontinuities on all tank cars carrying special dangerous commodities;^{2/} and
 - ii. by June 1, 1982 a retrofit schedule for the protection of bottom discontinuities on all tank cars carrying other dangerous commodities.
11. Trains carrying any special dangerous commodity shall undergo a "gateway" inspection, at minimum consisting of a hot box and dragging equipment

^{2/} Special dangerous commodities encompass full carload lots of 174 commodities listed in Appendix 3 of the RTC Panel Decision which, in the opinion of the RTC staff, pose the greatest degree of danger to the public in event of release and of which 64 have been transported in carload lots in recent years.

detector or a mechanical inspection by railway employees, at a point between three and 20 miles before entering a densely populated area. A similar further inspection at no more than 20-mile intervals between the gateway points will be required unless the special dangerous commodity train operates below 15 MPH.

This requirement will be phased in starting with the largest cities and will be effective:

- a. immediately upon RTC approval of plans to be submitted by each railway within sixty (60) days hereof in census metropolitan areas (CMAs) with a population of over 100,000;^{3/}
 - b. October 1, 1984 for areas outside CMAs with population of 50,000 to 100,000; and
 - c. October 1, 1987 for areas outside CMAs with a population of 10,000 to 50,000.
12. Railways to report all hot boxes to the RTC.
 13. Recommend that the Technical Research Committee of Strategic Planning, Transport Canada, investigate the possibility of conducting tests on time for a malfunctioning roller bearing to go to failure.

^{3/} Includes 24 CMAs listed in Appendix 4 of RTC Panel Decision.

14. In areas not identified in item 11, railway priorities on hot box detector installations to be dictated by the levels of special and other dangerous commodities traffic.
15. No restrictions will be imposed on train length.
16. In CMAs with a population of 100,000 or more, trains carrying special dangerous commodities shall travel at no more than 35 MPH and in areas of population from 50,000 to 100,000 where provisions for protection as defined in item 11 have not been implemented, trains carrying special dangerous commodities shall travel at no more than 35 MPH. In areas of population from 10,000 to 50,000 not protected as defined in item 11, trains carrying special dangerous commodities shall travel at no more than 35 MPH after October 1, 1987.
17. Regulations will be drafted requiring a prescribed complete mechanical inspection by qualified personnel of all rail cars in a train, whether carrying dangerous commodities or not, at intervals to be specified by the Commission, and at interchange points before acceptance for forwarding from another railway.

Further regulations will be drafted such that cars loaded with dangerous commodities initially received by the railway from a shipper or manufacturer must receive a prescribed mechanical inspection to be performed by qualified railway personnel not farther than 25 miles from the shipper or manufacturer point of origin.

18. In the interim, section 74.596 of the Regulations for the Transportation of Dangerous Commodities by Rail (which requires inspection of tank cars carrying dangerous commodities before acceptance by a carrier) will be enlarged to include all cars carrying dangerous commodities (and not just tank cars).

PUBLIC REACTIONS TO THE RTC DECISION

As would be expected of any decision which the RTC Panel might have issued, public reactions to the RTC Panel Decision were mixed, as indicated by the following:^{4/}

- Mississauga Mayor Hazel McCallion, in an interview with the Toronto Star, said:

"It's just as I predicted - the railways snowed the CTC with volumes and volumes of cost figures and the CTC fell for it."

She described the commission report as "a compromise between economic expedience and public safety."

- Harold Morrison, chairman of the Metro Toronto Residents' Action Committee (M-TRAC) and a witness at the Mississauga probe, said he was pleased with the commission recommendations.

An editorial in the Vancouver Sun, October 5, said:

"They have been a long time coming, and it will be years before they are fully effective, but the new regulations promulgated by the Canadian Transport Commission for the shipment of dangerous goods by rail are a welcome improvement in safety precautions."

An editorial in the Toronto Star, October 1, said:

"The Canadian Transport Commission's long-awaited decision on measures to improve the country's rail safety have turned out to be a sharp disappointment. In citing the need for "practical compromise between safety and expenditure," the commission has all but shunted aside the sweeping changes proposed by Mr. Justice Samuel Grange after the 1979 Mississauga train crash."

^{4/} News Summary, Canadian Pacific, Volume 37, Number 40, October 9, 1981.

ANTICIPATED EFFECTS OF THE RTC DECISION
ON RAILWAY SAFETY, COSTS AND RATES

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Safety

An overall improvement in railway safety can undoubtedly be anticipated to flow from the decision of the RTC Panel. Although the extent of that improvement cannot be quantified with any significant degree of precision, some general assessments and qualitative observations can be made.

First, during the years 1973 through 1979 a total of 247 derailments were caused on Canadian railways by failures of friction (plain) bearings, 57 by roller bearing failures and 32 by bearing failures with the type of bearings unidentified.^{5/} Apportioning derailments caused by unidentified bearings to plain and roller bearings in the same proportion as known types of bearings, this indicates that roller bearings, while not fail-proof, are almost three times as safe as friction bearings. The RTC Panel Decision reported that in 1980 some 40 percent of the car fleets of Canadian railways were equipped with roller bearings.^{6/} Assuming that 60 percent of revenue freight cars are today equipped with plain bearings, the number of such cars would be in the range of 90,000. With 25 percent of the revenue freight car fleets of Canadian railways equipped with plain bearings and 75 percent with roller

^{5/} Grange, The Honourable Mr. Justice Samuel G.M., Report of the Mississauga Railway Accident Inquiry, December 1980.

^{6/} Op. cit., page 24.

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bearings and plain and roller bearing cars of private owners and U.S. railways operated in Canada remaining at the current level, derailments caused by plain bearing failures could be anticipated to decrease from approximately 39 to about 16 per year. Estimated derailments caused by failures of roller bearings would be expected to increase from 9 to 17 annually, resulting in a net decrease of approximately 15 derailments annually attributable to bearing failures.

The RTC Panel Decision related to tank car modifications is designed to decrease the probability of release of a dangerous commodity in the event of derailment. The installation of double shelf couplers reduces the incidence of cars coupled to tank cars becoming uncoupled during derailment as well as the couplers on such cars puncturing the heads of tank cars. In the event cars become uncoupled during derailment, head shields offer protection against puncture of the tank car heads. Thermal protection offers additional protection of dangerous commodities from fire, and bottom fitting protection assists in preventing rupture of exposed unloading fittings on the bottom of tank cars.

The worth of such tank car modifications is evidenced by similar U.S. regulations imposed after exhaustive investigations by the U.S. National Transportation Safety Board (NTSB), U.S. Federal Railroad Administration, Association of American Railroads and the Railway Progress Institute. During

a hearing held by the HTSB, all parties agreed that double shelf couplers and head shields used together would be the best technical safeguards against tank head punctures in over 85 percent of accident situations.^{7/}

The effectiveness of hot box and dragging equipment detectors in preventing derailments is evidenced by the use of such devices by Canadian and U.S. railways over the past several years as well as on-going programmes to install additional detectors.

In the event the railways opt to operate at restricted speed through some populated areas in lieu of performing inspections specified in item 11, the 15 MPH restriction is dangerously close to the range of 15 to 20 MPH in which resonant "rock and roll" occurs which can cause derailments. The rock and roll phenomenon is significant only on jointed rail (not on welded rail) and is less pronounced on adequately maintained track.

Trains operating at 15 MPH also increases the danger of highway crossing accidents, which is the more serious because highway crossings are most numerous in just those populated areas in which the speed restriction would apply. This increased danger arises from the nature of the timing of crossing warning devices (flashing lights and automatic gates), which are controlled by track circuits in the crossing approach. When a train enters the track circuit, gates are released and flashers are activated. The length of the

^{7/} National Transportation Safety Board, Safety Effectiveness Evaluation, Report Number NTSB-SEE-78-2, June 23, 1978.

track circuit is chosen to give adequate warning, about 30 seconds, for the fastest train. A track circuit long enough to provide 30 seconds warning of the approach of a passenger train at 75 MPH will give 2.5 minutes warning of the approach of a freight train at 15 MPH. Sad experience confirms that motorists becoming accustomed to long warning times will attempt to beat the train over the crossing-ignoring the flashing lights and going around the ends of the gates. Then when a passenger train or a normal-speed freight train approaches the crossing, an accident with loss of life is highly likely.

Regulations in item 17 related to car inspections will presumably prescribe inspections at somewhat shorter mileage intervals than the average at which inspections are currently performed. Safety will, of course, be enhanced to the extent that more rigorous inspections detect defects which, if left undetected over additional miles, might give rise to derailments. Regulations requiring car inspections at intervals of 500 miles and at interchange points (except on run-through and unit trains) have been in effect in the U.S. since 1973, although longer mileage intervals are now being considered.

Although a lessening of risks associated with dangerous commodities can be anticipated to flow from the RTC Panel Decision, the following conditions can exist in Canada after full implementation of the additional regulations:

- A. Cars equipped with plain bearings can be loaded with dangerous and even special dangerous commodities;

- B. Any number of cars in trains moving dangerous and even special dangerous commodities can be equipped with plain bearings;
- C. Less than full carloads of the most dangerous commodities can be moved in trains through densely populated areas at speeds restricted only by the railways;
- D. Full and less than full carloads of the most dangerous commodities can be moved through communities with population of less than 10,000 at speeds restricted only by the railways;
- E. Increased danger of derailments caused by resonant rock and roll; and
- F. Increased danger of accidents at highway grade crossings.

Costs

The RTC Panel estimated that the maximum number of plain bearing cars which will be required to be retrofitted with roller bearings would range from 4,500 to 6,000 cars annually over six years.^{8/} Based on 5,250 cars annually and estimated cost of \$6,800 per car, the total capital cost (in 1981 dollars) of retrofitting cars with roller bearings would amount to \$214.2 million over the six-year period which, at a rate of 20 percent, would cost approximately \$43 million annually.

^{8/} Op. cit., page 31.

Since practically all tank cars are privately owned, the costs of modifying tank cars will be borne by the owners and/or lessees and would not be reflected in the freight rates of the railways.

The RTC Panel estimated the total capital cost of additional hot box and dragging equipment detectors required to be an absolute maximum of \$20 million and operation and maintenance of \$1.6 million per year.^{9/} At a capital cost rate of 20 percent, the estimated total annual costs of additional detectors would amount to \$5.6 million.

Allowing for some increase in costs associated with train speed restrictions and additional car inspections, the additional railway costs resulting from the RTC Panel Decision can be expected to total somewhere in the range of \$60 million annually.

The railways should realize some benefits from the incurrence of the additional costs, such as reduced costs of the number and severity of accidents and inspection and maintenance of journal bearings. While any estimate of the anticipated benefits must, at best, be subjective, savings amounting to 50 percent of the costs would not appear unreasonable. At this level, the net costs to the railways of the RTC Panel Decision would amount to \$30 million annually.

^{9/} Op. cit., page 44.

For the year 1980, the Canadian National Railways (CN) reported revenues of \$170 million from the Red Book Commodities.^{10/} This would amount to 7.76 percent of \$2,189,472,448 total freight revenues reported by CN.^{11/} Assuming other Canadian Class I and Class II railways received revenues from dangerous commodities in the same proportion to total freight revenues as CN, the Canadian railways would have received revenues in the order of \$312 million from dangerous commodities in 1980. This implies that rate increases averaging almost 10 percent on dangerous commodities would be needed to recover \$30 million net costs of compliance with the RTC Panel Decision.

PROPOSED MODIFICATIONS TO THE RTC PANEL DECISION

Many derailments are, of course, attributed to causes other than hot boxes. Earlier this year, for instance, the derailment near Blue River in British Columbia of a train transporting ethylene dichloride was suspected to be caused by a broken rail, and the derailment near Orillia, Ontario, including a tank car loaded with hydrofluoric acid, was apparently caused by a broken wheel on a flat car.

^{10/} CN Rail Response to RTC Order No. R-31780,, February 6, 1981.

^{11/} Statistics Canada, Railway Transport, Part II, Financial Statistics, Catalogue 52-208 Annual, 1980.

Statistics in Appendix 5 of the report of Commissioner Grange show that, during years 1973 through 1979, 38.9 percent of derailments were caused by track conditions and 20 percent were caused by equipment components other than bearings.

The RTC Panel reported that an increase in the RTC staff assigned to safety by 31 person-years over a two year period had been approved, which will enable the RTC to institute a more comprehensive and complete safety program.^{12/}

It is understandable that the public outcry for investigation of railway safety which arose from the Mississauga accident demanded action from the RTC Panel--not more extensive study. Certainly, in the face of the high daily risks posed by the transport of large volumes of poisonous, explosive and combustible substances through centres of population, needless delay in taking measures to enhance needed safety cannot be tolerated. The RTC Panel deserves praise in assuming and discharging its responsibility to the public in a timely fashion.

In my opinion, however, certain of the measures adopted by the RTC Panel should be modified as follows:

^{12/} Op. cit., page 59.

- A. Special dangerous commodities should encompass only sufficient quantities of those lethal commodities which, if released, would require evacuation of the surrounding population. (In the derailment at Mississauga of 20 cars loaded with dangerous commodities, including three cars loaded with propane gas which exploded, evacuation of the surrounding area was dictated by the release of chlorine from one of the ruptured tank cars).
- B. All cars in trains moving any special dangerous commodity should be required to be equipped with roller bearings after a period of one year from the date of issuance of an order. (This would eliminate the necessity of retrofitting with roller bearings any plain bearing cars not planned for loading of special dangerous commodities and, additionally, would allow the railways the option of retrofitting additional plain bearing cars with roller bearings or moving such cars in trains other than those moving special dangerous commodities).
- C. Trains moving a special dangerous commodity should not be allowed to exceed 45 MPH on jointed rail and 55 MPH on welded rail at any time, and 35 MPH on jointed rail and 45 MPH on welded rail through populated areas. (This would afford some protection to the train crews as well as residents of small communities. Further, derailments are more likely to occur on jointed rail than on welded rail.)

These modifications to the measures adopted by the RTC Panel would be anticipated to decrease the economic burden and, more importantly, would afford the public needed and deserved additional protection from those commodities which could cause the loss of an untold number of lives.