

Major Technological Risk

An Assessment of Industrial Disasters

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TORONTO

V. SATURDAY, NOVEMBER 10, 1979 : TORONTO

On Saturday, November 10, 1979, a little before midnight, a railway accident involving various dangerous products and mainly wagons of chlorine constrained the Canadian authorities to operate a large-scale evacuation in the suburbs of Toronto (Mississauga). More than 240 000 people were involved and an even larger movement of population was feared. The presence of a still more worrying product than chlorine, polychlorobiphenyl (PCB) was feared. Luckily this was not the case. Under the influence of the very strong heat created by the burning wagons of propane the PCB could have decomposed itself into a series of extremely toxic products.

1. THE ACCIDENT

The railway convoy that approached Toronto on that evening after a trip of 10 h 30 minutes consisted of three locomotives and one hundred and six wagons of which thirty eight carried goods classified as dangerous. Among those wagons twenty eight contained liquid hydrocarbons, five petroleum derivatives, five caustic soda, one of them 90 tonnes of chlorine. In the middle of the convoy one therefore found an assortment of twenty four wagons made up of one wagon of chlorine coupled to a wagon of propane on the one side and to a suite of wagons made up of one wagon of styrene, ten wagons of propane-butane, three of caustic soda and two of toluene on the other. During its trip the train had been inspected seven times by a qualified employee and more superficially checked five times.

Nevertheless, lubrication of one bearing (on the axle of one of the wagons) proved to be insufficient. It was an old-fashioned type of bearing : a simple grease box filled with oakum which had to be wetted with oil very frequently. At 23.53 h the axle heated up and cracked. A set of wheels careered off along the track. The train was passing an inhabited area. It stayed on the rails and approached an unoccupied area or rather one occupied by factories and warehouses which separated the first residential zone from the second. It was chance that the accident happened in this particular location.

At 23.56 h the first twenty seven wagons had cleared a level crossing; but, as two witnesses saw, two wagons detached themselves and a series of other wagons were piling on top of each other. There was a first explosion which was heard very far away. The mechanic's mate ran from the head of the train to shut a valve of compressed air which blocked the brakes of the convoy and detach the wagons at the level of the twenty-seventh, 400 metres from the locomotives. The whole front section of the train which included the largest number of wagons carrying propane and other dangerous products could thus be separated.

At 00.01 h a second explosion occurred. The mechanic's mate said that one wagon was blown vertically into the air. The front section of the train was stopped at 6 km distance and the company, Canadian Pacific (CP) which had been alerted by the mechanic at 00.00 h began to set up a rescue system (notifying the police, the fire brigade, the Federal Rescue Service etc.).

A police superintendent who arrived on the scene a little before midnight had for his first problem the removal of onlookers who had already gathered within a distance of 30 m from the train. The explosion and the clearly visible scene gave, themselves, general alert. The fire police were ready when the first call reached them. At 00.04 h two fire engines were already on the spot but the explosion at 00.01 h hit the rescuers who were setting up their equipment. The police were alerted by an ambulance which used its radio. The police network was alerted: serious risk of explosion, unidentified chemical products. Within the few minutes following the initial explosions the area was blocked by bottlenecks. The spectators came right up to the track to get a good view. The police tried to remove them. A third and fourth explosion carried more power of persuasion.

2. THE ORGANISATION OF RESCUE AND SAFETY FOR THE POPULATION

1st: The uncertainty about the content of the wagons

A command post was set up at a distance of 400 m from the accident. During the night 500 police and 100 firemen helped by 200 volunteers (who were used to control the traffic) were at work.

The first attempts by the firemen to approach the fire were hindered by a series of explosions. After one very strong explosion they received orders over the radio to turn back. The hosing had no effect on the wagons or on the nearby warehouse which had caught fire (and the roof of which soon fell in) .

The immediate problem of fire control was complicated by a very serious uncertainty: it was not known what was inside the piled-up wagons. The train driver brought a document which gave a list of the wagons and their content. This document gave no indication of the position of the wagons within the convoy. Still worse, it seems that the list stated erroneously, the presence of a wagon of PCB in the train. It took five hours to disprove this information. The firemen could not refer to the panels on the wagons which indicated the content: they had been burned. The officials from CP arrived at 01.30 h and it seems that they then confirmed that there was a wagon of chlorine in the accident train. An official of the region admitted: we needed quite a lot of time to identify the nature of the goods. The loading note supplied by CP was a listing for information which nobody could read or understand.

However, the wagons were piled upon each other and the tangle could only be sorted out on the afternoon of that Sunday by means of studies made from a helicopter: the wagon of chlorine rested upon three other wagons of which two contained propane which meant increased risk of explosion. The wagon with the chlorine had an 80 cm fissure.

2nd: The response in the face of danger: six successive evacuations

a) Sunday, 01.30 h: first evacuation – 8.000 people. Towards 01.30 h it was decided to evacuate 8.000 people from an area of a square mile located downwind (zone A, see map hereafter). The police and the ambulances patrolled the roads with sirens and loudspeakers advising evacuation because of "an immediate danger from chlorine". This was complemented by house-to-house control. Many people had anticipated this evacuation which was completed by 03.00 h.

Three rescue centres were set up (a shopping centre and two schools) but they had to be shut down subsequently when the evacuation zone was enlarged.

During this time experts had alerted, the industry got their chlorine rescue plan going. In addition, a general appeal to ambulances and their staff was launched in the Toronto area (2.15 h). At 02.45 h the increasing seriousness of the situation on the site made a general meeting of all the officials present necessary: it had to be decided in particular whether the army had to be called in, 150 men were on

alert but it would take them four hours to get there on foot. It was decided not to call on federal forces for the time being.

There was, nevertheless, still extreme worry about the chlorine. Because of its quality as an oxidising agent it could inflict serious burns and in gaseous form at a concentration of more than 3 ppm in the air it causes death. It was not known then, it was established only on Monday evening, whether 60-70 per cent of the wagon's content had been dispersed in the air in the first explosion (dispersion up to 1.200 m up and within a radius of 90 km). If the wagon broke up suddenly because of an explosion of one of the propane wagons the wind could blow concentrated chlorine over a vast area. There remained therefore two major problems once the first evacuation had been completed: controlling the fire, anticipating the action in case of an aggravation of the situation (break up of the wagon, change of wind direction).

While the experts were arriving (03.00 h) there was preoccupation about the establishment of relations with the media. An industrial outfit was transformed into a press centre. This outfit was near the accident site. The police actually have a policy of allowing them to stay in such proximity because this is indispensable for journalists, within the measure of safety requirements: the idea is that if this visual proximity is not offered the journalists begin to think that the truth is being hidden from them. Within an hour most of the TV networks were on the spot despite traffic problems. The representatives from the press could approach to within 30 m. They were warned that if the chlorine expanded they would have to take flight with the police, the press turning right and the police left to avoid collisions.

b) Sunday, 04.00 h: Second evacuation - 20,000 people. At 04.00 h a further series of explosions (from the wagons of propane) forced the launching of a further evacuation order (zone B in the diagram).

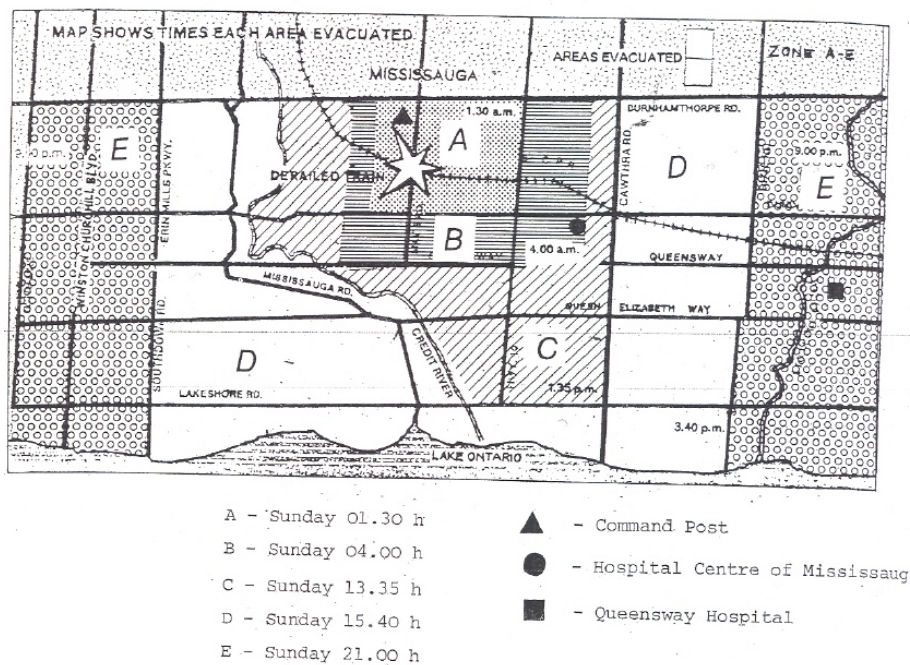


Fig. 17: Map of the successive evacuations.

This time the transport authority had mobilised sixty five buses. The initial explosion had affected the communication facilities of the authority the headquarters of which was in the accident zone. The bus drivers arrived spontaneously; private cars with C.B. radio were used to coordinate the dispersal efforts.

During this second phase 20.000 people were evacuated. The Red Cross took care of provisions and installed information offices. The Salvation Army helped in controlling the traffic and set up a kitchen for the firemen, policemen and other involved in the work. The Scouts and other organisations also helped in organising the evacuation. Volunteer radio operators were at work early on Sunday to deal with supply and information problems.

So, as a second line of defence a lot of organised groups took charge of the problems of organisation.

In the first line, thirty two respirators were procured by 06.00 h and technical assistance requested from the civil defence authorities to deal with the PCB. Higher officials had been alerted at 04.30 h and a first large meeting took place at 06.00 h.

c) *Sunday, 08.55 h: Decision to evacuate the hospitals of the area.* By 07.00 h the heat spread about by the burning propane wagons was so intense that the command post had to be moved back. It also seemed that the hospital centre of Mississauga would probably have to be evacuated.

At 08.45 h, considering that this evacuation would possibly take five to six hours, the decision was taken to proceed with the operation. Twenty five ambulances and a bus ambulance (with a capacity of twenty places) went to the scene; a general appeal was launched to obtain further means of transportation; by 09.30 h there were sixty ambulances and seven buses. The people capable of walking had been evacuated just before 09.40 h, the time when the evacuation of the one hundred and eighty nine bed-ridden patients began; the operation was completed by 13.05 h. Within the same period of time two nursing homes with two hundred and thirty seven and two hundred and two patients respectively were evacuated. Twenty sick people found themselves in hospitals which had to be evacuated subsequently and were therefore moved twice.

At 10.45 h the decision was taken to organise the possible evacuation of a further hospital in the area (Queensway Hospital).

d) *Sunday, 13.35 h: third evacuation – 42.000 people.* During Sunday morning the situation on the accident site had further deteriorated: at 09.55 h a further explosion had caused the spreading of a still larger quantity of gas; and the wind began to change direction, blowing westwards. The decision to evacuate one of the rest centres was taken, the operation was carried out between 12.00 and 14.00 h (there was some confusion: the bus drivers did not know their exact destinations) .

Wind speed increased from 2 to 13 km/h. At 13.55 .h general evacuation for a third zone (zone C) was announced. At that time a total of 70.000 people had been moved. Special meteorological instruments were installed ; the possible extension of a chlorine cloud was being studied.

e) *Sunday, 15.40 h: fourth evacuation.* At 15.40 h a further evacuation order was issued. Despite the extreme reticence of the people responsible at the Queensway Hospital (230 people seriously ill could only be moved with difficulty) the evacuation of the hospital centre was being prepared. The police had been alerted to the fact that in case of a further explosion there would be only fifteen to twenty minutes to evacuate. The operation was decided upon and set for completion by 19.00 h.

During the afternoon the evacuation of the residents proceeded calmly. The police adhered to the rule of issuing frequent bulletins of information. At 14.35 h the fast lanes were closed to traffic. The Red Cross, the Salvation Army and the other organisations which contributed were advised of the requirements of food and beds for at least one night. The army supplied 1.200 sleeping bags, 850 air mattresses, 6.300 blankets. Several organisations took part in the organisational effort.

Foreseeing further evacuations the authorities ordered the preparation of additional refuge centres at 17.05 h.

f) Sunday, 21.00: fifth evacuation; Monday 00.15 h: sixth evacuation. At 19.00 h the wind changed direction and forced a second-time evacuation of people who had already been evacuated. Between 19.00 and 21.00 h new refuge centres were set up.

At 21.00 h the evacuation zone was again enlarged ; traffic was diverted more extensively. At 22.45 h it was decided to evacuate a further hospital and a nursing home near it ; this was accomplished between 23.00 and 04.10 h: 300 patients transferred to other hospitals. At 00.15 h, for the 6th time the limits of the evacuation zone were extended.

3rd: The culmination point: 240.000 people already evacuated, West Toronto put on alert

At the end of a twenty four hour period 240.000 people had thus evacuated from Mississauga and its neighbourhood. A plan for the possible evacuation of the nearby airport of Malton had been drawn up.

At 01.30 h on Monday morning the police put the western part of Toronto and Hamilton on alert for a possible evacuation.

The area was closed, the roads blocked, trains rerouted. Police patrolled the streets and a helicopter kept watch to give warning of any looting. About 500 police were in action. Plainclothes policemen were dispatched to check the effectiveness of the roadblocks ; weak points were ironed out. Warning was given that anybody caught in the area would be arrested.

The strategy of the fire police was still to try control the burning propane. At dawn on Monday photographs were taken of the chlorine wagon with Special cameras to try and spot the fissures which need to be sealed.

During the day one gained the impression that it would be-necessary to prepare for a real siege: the operation would not be a fast one. That day therefore marked the beginning of a long wait for 240.000 evacuated people. Generally speaking, the information provided by the press was precise and guided by a sense of responsibility. Press conferences and visits to the phantom-town for the media were organised. ..There were alerts such as the case of a baby found to have scarlet fever in a refuge centre. The waiting was not always without worry. One rescue centre received an order forbidding the occupants to go outside because of the risk of a sudden explosion of chlorine. At 15.45 h on Monday the authorities confirmed that troops would not be called in but additional respirators were requested. They arrived from Halifax in Nova Scotia the following morning (85 apparatus, 65 in reserve) .

On Monday evening two more areas were put on alert.

During the day Canadian Pacific Rail announced that it would pay, and that purely- as a good-will gesture, only out-of-pocket expenses to evacuees. In Ottawa the federal minister of transport announced that he would introduce legislation on the control of transport of dangerous materials within ten days.

4th: Progressive Control of the situation: return in three phases

a) *Tuesday, 13.00 h first phase, 125.000 people authorised to return.* At 23.00 h on Monday the first attempt was made to seal the breaches in the chlorine wagon; but the fire delayed the operation until the next morning. The fire was put out at 09.00 h on Tuesday.

At 10.00 h a meeting was organised to study the possibility of a return of part of the population. The evacuated people had thought they were leaving for twenty four hours at the most, and they began to harass the police at the barriers. Another complication arose: the residents wanted to go home to feed their pets the number of which was estimated at 11.000. Passes were issued after 17.00 h; an animal protection organisation undertook part of the care. As the wind direction changed and the chlorine continued to escape (at the rate of 17 kg/h) it was difficult to reopen the evacuated zones.

At 13.00 h it was possible to decide to let about 125.000 people return to their dwellings. The police thought the return would be orderly but erroneous information led to traffic jams which lasted for seven hours; those who had been authorised to return mixed with those who mistakenly believed they too were authorised. The motorists lost their calm.

As the wagon still leaked the central area remained off limits.

On Wednesday morning the situation on the site had not improved. During the track clearing operations a chlorine cloud escaped. Masks had to be put back on and areas to the south of the accident site had to be reevacuated.

For the central area which had been infiltrated little by little by the evacuees the authorities let it be known that the police had the right to expel the people who had returned to their homes. On the fifth day, Thursday, the pressure exercised by the evacuees grew stronger. An appeal for cooperation had to be launched.

Nevertheless, at dawn on that Thursday the breaches in the wagon, which according to the experts still held between 10 and 20 tonnes of chlorine had been completely sealed. An attempt was made to transfer the gas into another tank, and half of this job was accomplished by midnight. In the evening a northerly breeze dispersed the pockets of chlorine which had presented a danger (eight rescuers had actually been hospitalised after having crossed through one of these pockets during the morning). By Friday morning 10 tonnes of chlorine had been tapped off and could be moved away. It was feared that there might again be escapes in the course of the transfer operation.

b) *Friday, November 16; 15.00 h: Second phase – 90.000 more people are to return.* After six days of absence another 90.000 people were to return to their homes; there remained still 30.000 evacuees.

c) *Friday, November 16, 19.42 h: Third phase - the whole area is reopened.* Over 16 hours 18 tonnes of chlorine had been taken out of the wagon. At 19.20 h while there were still between 15.000 and 20.000 litres of chlorine in the wagon there was unanimity that all evacuated people could go home. Authorisation was given at 19.42 h.

The authorities warned that the soil around the accident site would have to be removed because it had been contaminated. It was, however, hoped that the ice had prevented a deep penetration by styrene and toluene.

On Monday, November 19, Canadian Pacific Rail opened a claims office for out-of-pocket expenses. The claimants had to sign a document exonerating Canadian Pacific Rail from all later claims.

On November 20, the chlorine wagon, filled with water, was finally removed.

3. BALANCE SHEET

There had been an evacuation of 240.000 people. There had been no panic, no deaths, nobody seriously injured, few acts of vandalism.

The municipality of Mississauga estimated that the cost of the operation amounted to 25 million dollars per day, rescue measures not included i.e.:

- 1.5 million dollars of lost sales
- 6.0 million dollars loss of manufactured goods
- 12.0 million dollars loss of salaries
- 2.5 million dollars loss of services and various opportunities.

These figures must be regarded with caution. They represent only an estimate and give only a limited indication of the possible cost of a similar event.

4. CONCLUSION

Compared with what would have happened in case of a rupture of the chlorine wagon or of the wagon supposedly carrying PCB the problem experienced at Toronto from November 10 to 16, 1979 was only a very benign incident.

The event of Toronto was a magnificent alarm: an "exercise" which the Canadian authorities and all the organisations involved in the affair, in the first and the second line of defence, knew very well how to deal with. One event cannot hide the multiple possible ones which exist in this field. It is important here again not to file the affair away hastily under the usual and all too well known heading : "Nothing happened at Toronto".

References

- (1) P. TIMMERMAN, The Mississauga Train Derailment and Evacuation: November 10-17, 1979, Event reconstruction and organizational response. Institute for Environmental Studies, University of Toronto. Mississauga Report n° 1, May 1980 (40 pages).
- (2) A. WHYTE, D. LIVERMAN and J. WILSON, Preliminary report on survey of households evacuated during the Mississauga chlorine gaz emergency (November 10-16,1979). Institute for Environmental Studies, University of Toronto. Mississauga Report n° 2 (44 pages).

CONCLUSION : FIVE ACCIDENTS, 28 DEAD AND VERY SERIOUS QUESTIONS REMAIN

We have described five recent accidents. On the evidence each of them was very serious. Nevertheless, one might be astonished at the attention given to these events: did they not in the end cause rather a minimal total of victims? Twenty eight deaths, all of which occurred at Flixborough. If one sticks only to statistical considerations this figure appears rather small: what are twenty eight deaths by comparison to the hundreds of victims of railway and mine disasters? Or by comparison to the tens of death registered every week on the roads?

Yet, these accidents have caught the attention of areas, of whole countries, sometimes of the whole industrialised world as in the case of Seveso and Harrisburg. To understand this phenomenon one must not be satisfied with the simple explanation according to which the media were exclusively responsible for this echo: the question has aroused spirits including those of the most guarded among the experts and people in positions of responsibility.

What then underlies these events? Do they have something in common? Are they perhaps a sign of some change in our situation with regard to technological risk, a factor which, however, has never been negligible in history?

This group: Flixborough, Seveso, *Amoco-Cadiz*, TMI, Toronto : does it, in short, constitute a challenge to the industrial societies at the end of the twentieth century?

A broader examination of risk from technological and industrial origins, an analysis across history, permits the formulation of some observations in this respect. This will be the subject of Chapter 2 which will allow us to place the example presented here in a general context and in a structured perspective. They will then appear more clearly for what they really are: a series of grave warnings.