MISSISSAUGA AND OTHER
MAJOR CANADIAN TRANSPORTATION
ACCIDENTS INVOLVING CHEMICALS

A paper presented by

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Mississauga and Other Major Canadian Transportation Accidents Involving Chemicals

It is a pleasure to be at this seminar to discuss technological accidents involving chemicals and I want to thank the organizers for providing me the opportunity to do so. I have never attended a meeting such as this, where I have not had the occasion to learn something about the topic, to see the problem from a different perspective and hence to find for later consideration the possibility of alternative solutions and remedies for application within Canada.

My objectives here today are to describe a number of transportation accidents we have experienced in Canada, to analyze them for the lesson's we learned and to describe to you the main features of the organizational and legislative responses of the Canadian governmental agencies and our industries to the fact of these types of occurrences.

Chemicals are so diffused in our economy, being used for agriculture, forestry, mining, food processing, manufacturing, service industries and indeed, even in our own homes, that you can be sure that accidents involving chemicals will occur everywhere, at anytime (although weekends, and especially long weekends seem to be a frequent choice) and will involve both large and small quantities and all modes of transport.

M.V. Wien - Halifax Nova Scotia

A very typical marine accident will involve a "container" ship that, due to a rough weather voyage will suffer damage to the containers and will consequently arrive in port with damaged cargo. The M.V. Wien entered Halifax harbour with one compartment filled with loose and the damaged freight containers. From one container, 40 drums of phosphorous pentoxide (\(P_2O_5\)) had come loose and the damaged drums had spilled their corrosive powderous contents on the floor of the hold. From another container of bottled wines, over 1000 litres of liquid had mixed with the \(P_2O_5\) with consequent release of hydrogen gas.

The removal of the damaged cargo containers, and the clean up of the spilt products presented a number of problems:

1. the cargo hold had to be kept dry since the product, \(P_2O_5\), reacts with water;
2. the cargo hold had to be kept ventilated to clear the air of released hydrogen gas; and
3. the spilt and unreacted corrosives had to be neutralized and then cleaned up.

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This necessitated the acquisition and use of special equipment; protective clothing and respirators for the work crews; non-sparking lighting; neutralizing chemicals; and "recovery" and other drums into which the damaged drums or the uncontaminated or neutralized products could be packed. The undamaged drums and the re-packed uncontaminated cargo were then reconsigned to the destination and the contaminated and neutralized product was sent for disposal at a waste disposal site. In addition, the vessel had to be docked at a wharf with appropriate crane and lifting equipment and where there was a cargo shed with proper lighting and weather protection for work, and where there was shower equipment to wash off any of the workers who might come into direct contact with the product.

A post-accident analysis identified a number of problems and hence lessons for effective response:

1. there was a delay in reporting the spillage which could have been avoided and which would have resulted in earlier response,

2. there were too many agencies that became involved, whose actions were not well coordinated and between whom, communication channels were bad,

3. the media were not given good information and population fears were raised, and

4. the Port's emergency response plan was out-of-date and had not been tested.

Truck Accident - Smiths Falls, Ontario

A tank trailer carrying liquified hydrogen (in a deeply refrigerated state) rolled over on a bridge over a river dividing a small town. There was initially, a suspicion of leakage of hydrogen liquid or gas with a nearby residential area being potentially at risk. The bridge was effectively blocked by the tractor trailer.

Based upon advice received as to how to proceed, the Fire Service found that there was no leakage of gas that had ignited. They therefore, decided there was no need to evacuate adjacent residents so long as all possible ignition sources were eliminated. This was done by blocking all traffic in the vicinity. Experts were called in to check for leaks and to check the integrity of the trailer's cargo insulation system.
There were no leaks found and the insulation system had not been breached. There was therefore up to 72 hours available to discharge the load, to upright the trailer and to remove the vehicle from the bridge before any danger of venting gases would occur.

The requisite equipment was requested - air bags to push the trailer up from below, a crane to lift the trailer, tow trucks to stabilize the trailer during the lift, and a replacement tractor trailer and pumping equipment and personnel to transfer the cargo. About 8 hours were needed to get the equipment to the site during which time the bridge remained closed to all traffic. Proper information was communicated to the media and no public fear was felt and public annoyance at the bridge closure was reduced.

Due to the design of the trailer, it had to be upright before the load could be removed easily, and since the trailer was not leaking, uprighting the trailer in its loaded condition was considered feasible if heavy duty equipment were available - which it was. The trailer was uprighted and with a different tractor to pull it, was towed to a nearby airport property for the load transfer operation.

The lesson learned from this accident was that if you have no immediate safety reason to act, suffer the inconvenience to the public and await the arrival of the proper equipment.

**Rail accident - Mississauga, Ontario**

The derailment of a major freight train within the urban area of Mississauga, Ontario, catalysed the general public's concern for safety in the transportation of chemicals. Thirty-seven freight and tank cars were derailed into a jumbled pile of wreckage involving 100 tonne loads of propane, styrene monomer and chlorine gas. Within several minutes of the derailment occurring, three propane tank cars had exploded into fire balls with hot metal shards and sheets being projected through the air - one pierced the chlorine tank car and started the release of gas which ultimately led to over 90 tonnes escaping.
Fire fighting and police were at the scene within minutes and due to the availability train "consist" documentation, the involvement of the chemicals was identified early on. The detection of leaking chlorine was also made within hours and appropriate evacuation (downwind areas only) was commenced.

The response problems focussed on three issues: the need to evacuate population at risk from the chlorine leak; the need to extinguish the fire at the derailment site; and the need to seal the chlorine tank car. Recuperation of the site following the resolution of these issues was considered not to present problems. Evacuating the population at risk (which increased as the disaster continued and the wind direction changed) involved:

1. police services from all adjacent municipalities (to guide the residents out of the area and to prevent persons from returning to it - for either lawful or unlawful purposes);

2. ambulance and public transit services to evacuate hospitals and senior citizens residences; and

3. Red Cross and other non-governmental groups to accommodate and feed evacuees.

The size of the conflagration eliminated any possibility of an early extinguishment of the fires and efforts were made to control the perimeter of the fires, working in towards the principal sources of burning chemicals and other cars. After nearly two days, the fires were out and the wreckage had cooled to the point that the technical crews could identify the location, size and shape of the hole in the chlorine car - it turned out to be 1 meter in diameter on the end of the tank's cylinder but also extending over the edge into the tank's head - thus the hole had compound curves and presented a most difficult problem. Over 2 more days, 5 different attempts were made to patch the hole before success was achieved. Once the hole was patched, pressure could be applied to the tank to remove the remaining chlorine into tank trucks positioned alongside. Only once the unloading of the damaged tank car was achieved, were the final residents allowed to return.

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The lessons learned from the Mississauga accident were:

1. never underestimate the time and resources needed to respond: the chlorine tank car repair crews were called out at the beginning of the accident and remained on duty until exhausted, time was lost to organize replacement crews;

2. the need to improve the identification of rail cars in accident situations;

3. the need to coordinate better the interests of the agencies involved; and

4. the need to prepare emergency response crews to handle large-scale accidents.

It was coincidentally learned that the chlorine that had leaked was either largely consumed in the propane fire or lifted by the fierce updraft caused by the inferno to an altitude of 10,000 metres where its disposition into the atmosphere did not cause a problem.

Rail Transport - Medonte Ontario

Another railway derailment involving a toxic gas, hydrogen fluoride (HF), occurred in a rural area near Medonte, Ontario. Like most derailments involving overturned railway cars, there was an ensuing fire which presented the initial problem. In this case the accident was remote from highways which caused access problems and occurred in mid-winter which created water supply and icing problems. The train's documentation indicated that the HF car was in the derailment but it could not be located as it was buried under several layers of boxcars at the bottom of the railway line's embankment. Initial expectations that a leak was likely to have occurred led to precautionary evacuations within a fire kilometer radius which covered some farms and a skiing resort.

The fire services managed to extinguish the fires and testing of the car's valves and the area indicated there were no leaks, the recuperation response therefore became difficult but not complex. The HF car had to be emptied of its product by pumping its contents up to a replacement car on the rail line - a task that took more than a day. Then the car had to be lifted to the rail line and transported away for purging and repair.
During the course of this response, the participating agencies (health, fire services and environmental monitors) all worked closely.

The lesson learned in this accident again centered around the need to improve the ability to locate a chemical carrier and to determine as soon as possible if it is ruptured or leaking. Neither of these problems has been adequately resolved.

**Truck Transport - Salmon Arm British Columbia**

In this incident a tank truck of propane was involved in a vehicle accident and left the highway. It rolled down the highway embankment coming to rest on its side some 10 meters below the road next to a railway track running parallel to the highway but between the highway and a lake. The accident was observed by a number of motorists who stopped to assist and to observe the tank truck at the bottom of the embankment. The driver of the tank truck, almost uninjured, climbed back up to the road and another motorist called for the police to attend the accident.

The truck's valving and piping systems had been damaged and a pool of propane vapours gathered around it. Almost within minutes of the accident, a train hauling 100 tonne cars of coal passed the tank truck and provided an ignition point. The flames from the fire engulfed the tank and moments later the truck's cargo tank exploded in a fireball. The explosion derailed 14 of the heavy railway hopper cars, destroyed the truck, projected the cargo tank 50 meters and sent a blast of heat up and over the embankment and highway. Over 20 people suffered burns of all types, some so seriously burned that weeks and months of hospitalization were needed. Included in the injured was the highway patrol police officer who had just arrived and was looking at the truck which was on fire but had not yet exploded.

The problem faced here was that despite there having been several minutes where the truck was engulfed in flames, the police officer had not been trained to recognize the danger and to pull back the spectators to a safe distance. The other problem was the train's engineer who, seeing the truck from some distance away decided not to halt the train and investigate whether or not it would be safe to proceed but who calmly proceeded. Again the lessons seem to be in recognizing a danger and removing those at risk.

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Truck Transport - Calgary, Alberta

Perhaps the most common accident involving "chemicals" is the gasoline tank truck accident. In all likelihood, this will be an urban accident as was the one in Calgary, Alberta. A tank truck carrying 12 000 litres of gasoline overturned after having made too fast a turn. The cargo leaked out through the loading hatch and ignited from some source of ignition. Burning gasoline spread across the roadway and in this case poured over the edge of the overpass out the roadway below. The smoke and flames quickly alerted motorists to stop - so no other vehicles became involved. No explosion took place because the leaking fuel melted the aluminum cargo tank. The Fire Services was on the site within minutes.

The problem, quickly identified was the need for "foam" fire extinguishers and through pre-planning, the Fire Services were able to call on the assistance of the foam equipment of the Airport's Fire Service. The fire was controlled and eventually extinguished, but not without damage to both roadway surfaces and the complete destruction of the truck and trailer.

Here the product was quickly identified, as was the need for specialized response equipment which was obtained. The lesson, not needed in this case, was to obtain the right resources to deal with the emergency.

Government-Industry Response - to Chemical Accidents

The continuing occurrence of accidents such as these have led government and industry in Canada to consider ways of better responding to chemical accidents. Planning and preparing for accidents has become a recognized necessity and is now being practiced.

It is clearly understood from both moral and legal grounds that the responsibility to make these preparations is a joint responsibility. It has also been recognized that no effective response to accidents can be made in the absence of properly developed plans and that to undertake planning, a broad range of factual data is needed.

The first element of planning is to identify the products that are being imported, manufactured, used, transported and stored; to identify the locations and routes for these activities; and the sites at which contaminated and waste products might be sent for disposal.
A number of sources are recognized for this data - first from already submitted reports - customs data, industry statistics reports etc; or from industry directly; from trade and commerce newspapers and journals; and also from commercial documents typically accompanying consignments in transport. All of which taken together should be able to provide at least a sketch or a reasonable picture of the broad locations and movements of products.

Product specific data is also required on the product properties (chemical and physical), on health considerations and for environmental impacts. Information on how to respond to spills, fires, reactions with other products all are needed. Sources for this information should be available from the industry producing the product - very often there are Material Safety Data Sheets for each commercial product. If not, some government agencies, other governments, and international agencies have collections of this data, all of whom will share their data with accredited institutions. Certainly whatever information we have in Canada will be made freely available to other governments and their institutions. Finally the academic and the scientific communities have a wealth of detailed information on thousands of chemicals.

Effective response also requires the training of the responders, the immediate reporting of an accident (including the relevant information) to the organization responsible for responding and, the conduct of a number of support operations. These must take place, like planning exercises, on the basis that an accident can happen anywhere and therefore that planning for response and response must take place at the local level.

Canada's socio-legal system assumes planning and response at the local level (i.e. bottom-up) and assistance coming from more senior levels of government as required (i.e. top-down). Typically, senior level governments must establish the legal framework setting out responsibilities and obligations, within which local governments and industry are expected to work. The preparation and delivery of training program to local government employees (and perhaps in some cases industry) is also another function. Finally, the collation of data and the establishment of a first class hazard and response information data bank, accessible 24 hours a day and the ability to communicate that data in verbal, electronic and hard copy form is essential.
In Canada, the following hierarchy of response is the scheme. First, the persons at the site of a spill (the producer/user or the carrier/storer of the product) has an immediate moral and legal responsibility to respond to remedy the situation. Should the spill require outside assistance then this is to be reported immediately to the local (municipal) authority whose public safety forces (fire, police, health, etc.) have an obligation to respond, calling upon other local public agencies and local industry groups for assistance. Should the incident require greater response resources as necessary than the local authority has, then the local authority can declare the incident to be an emergency and the Provincial (State) government is expected to contribute its own resources or to requisition province-wide industry resources to respond. At this point "on-site" command responsibility can shift to the higher level of government. Finally, in Canada, should the Province not be able to adequately respond, a formal call for assistance to the federal level can and is made. The federal government can direct any of its resources to assist or requisition industry resources anywhere in the country for response purposes.

Again though, it is clear that all parties in this hierarchy must:

- plan for response
- train and equip themselves for response, and
- respond when called to do so.

The various parties are:

1. the producer/user in relation to on-site spills or to assist the carrier for transport spills;

2. the carrier/warehouse for reporting of spills and immediate appropriate response;

3. local authorities for fire fighting, spill control, evacuation of the public, hospitalization or treatment of injured persons, and for the protection of local services (electricity, water, sewage systems etc); and

4. senior governments for the legal framework, for training programs and for data and communication services.
Transport Canada's Particular Role

Transport Canada is responsible for regulating the transportation of dangerous goods under the Transportation of Dangerous Goods Act and its Regulations. This is considered to be the primary way of promoting public safety in respect to the handling and transporting of chemicals. This is the preventative part of the risk management equation where risk management = risk prevention + risk response.

Because risk response is not, under the Canadian Constitution a federal responsibility but that of the provinces and by them, the responsibility of local authorities, the federal government has a limited role in risk response. Consistent with the discussion just described, Transport Canada has established the socio-legal framework (the Transportation of Dangerous Goods Act and Regulations) and provides a number of supporting activities.

While the legislation has provided for risk prevention in the conventional manner of regulating the dangerous goods as to classification (into hazard classes), identification (by safety marks such as labels, and documentation with specified product names), packaging standards, and operating rules (segregation of cargos etc); the legislation has also broached topics of social responsibility. The legislation sets out the specific needs for:

- training employees in their legal obligations, the hazards they face in handling and transporting dangerous goods, and in remedial response;

- reporting accidents to designated (provincial or local) public response agencies; and

- the preparation by shippers of dangerous goods of plans to provide assistance to public agencies in the event of a emergency involving their product.

This comprehensive approach has established a clear socio-legal framework within all parties must and do act.
Probably the most prominent of the support programs conducted by Transport Canada is the operation of the Canadian Transportation Emergency Centre (CANUTEC) which has a major data bank of chemical hazard and response data, a list of industry and government resources across the country that can be contacted and called upon for specialist advice or assistance and which operates on a 24 hour a day basis. CANUTEC will receive emergency calls on the telephone number (613) 996-6666 and will accept the telephone charges for such calls even from other countries or it will, on the information lines (613) 992-4624, respond to general calls for chemical information.

In addition to this, CANUTEC produces an Initial Emergency Response Guide listing the 3000 or so chemicals or groups of chemicals known to be in transportation and cross referring the reader to a series of guide pages providing basic response warnings and instructions and advice for initial response. Copies of this Guide have been distributed to every fire and police station in the country for ready reference until CANUTEC or some other public agency can start the flow of more detailed response information and actions. Copies of this Guide in either English or French can be obtained without cost, by writing to CANUTEC, Transport Canada, Ottawa, Ontario, Canada, K1A 0N5.

Finally the Department, along with federal and provincial Emergency Preparedness Agencies are conducting response planning and site commander training courses and are now preparing technical training courses and videos for "hands-on" response.

Conclusion

Canadian experience with transportation accidents involving chemicals has created the realization of the need to act comprehensively in order to manage the risks inherent in the activity. The risk prevention activities include legislative requirements intended to reduce the probability of the accidents and to reduce the consequences of those accidents that do occur. The risk response activities have seen the encouragement of response planning by industry and by the other levels of government, the encouragement of coordination of efforts, and the provision of key supporting programs of training, of chemical data acquisition and of information flow. Accidents however will continue to happen and the response to these must be to monitor continuously our capability of preventing their occurrence and of responding effectively and quickly.