



**PART II**  
**PREVENTION**

Report of Working Group 2

**A Review of Measures Taken by Industry and  
Government to Prevent Major Industrial Incidents in Canada**



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## SUMMARY

The objective of Working Group 2 was to assess the existing measures taken by industry and governments to prevent Bhopal-like incidents.

Legislation at the three levels of government can generally be described as:

- zoning and land-use planning (municipal/provincial);
- plant design approvals, safety and occupational health, environment (provincial/federal); and
- transportation (federal/provincial).

In designing and operating their production facilities, major industries have relied on their own standards to increase safety margins in addition to regulatory requirements. The Canadian Chemical Producers' Association's (CCPA) review of the practices of its member companies after Bhopal, indicates that most companies have established safety audit programs. The approach to these audits is variable and so CCPA has introduced a minimum standard safety audit procedure. The Working Group recommends that these procedures be implemented at plants which are outside of the CCPA membership but manufacture or use hazardous materials.

Effective safety management programs must start with the commitment of the senior officer of the company and be communicated through all levels of company personnel. Line supervisors and employees alike must be held accountable for safe operation. Again the Working Group believes that the safety philosophies and programs of the larger companies have to be incorporated into the operating practices of the medium and smaller operators.

Implementation of the Transport of Dangerous Goods Regulations accompanied by the improvements made in the rail system following the Mississauga derailment should reduce the number and size of transportation incidents. In the same way that Lodgepole affected the sour gas industry, Bhopal is causing considerable reaction in the chemical industry in the areas of improved safety practices and community awareness.

Even with all of these programs in place, there are still no guarantees that such accidents will be eliminated and emergency response plans must therefore be built into each program.



## 1 INTRODUCTION

This report provides an assessment of the measures taken in Canada by industry and government to prevent Bhopal-type incidents.

Working Group No. 2 was given the following terms of reference:

- 1) to undertake a review of existing legislation regarding zoning (or siting), design and construction of production facilities, process safety, in-plant storage and distribution/transportation of hazardous chemicals including petroleum products;
- 2) to identify the measures taken by industry and government to plan for and achieve safe handling of chemicals throughout the design and construction of manufacturing facilities, production, storage, distribution, transportation and use (especially major bulk users);
- 3) to examine initiatives taken by industry to encourage management responsibility for accident prevention such as regular internal safety audits; and
- 4) to make recommendations as appropriate.

The primary focus of this report is on major chemical accidents as defined by the Steering Committee and used by Working Groups 1 and 3.

Working Group 2 is made up of representatives of industry and a number of government departments. To obtain a wider information base:

- provincial input was sought through the Federal/Provincial Advisory Committee on Occupational and Environmental Health and the Federal/Provincial Committee on Occupational Health and Safety Canadian Association;
- direct input was sought also from groups such as the Industrial Accident Prevention Association of Ontario, and the Federation of Canadian Municipalities; and
- public input was provided through a number of public interest group organizations among them, "Friends of the Earth" and the "Canadian Environmental Law Association".

While accident prevention is the main theme of this report, its scope includes:

- 1) an examination of accident prevention legislation in Canada;
- 2) a review of industry and government accident prevention programs; and
- 3) a discussion of the importance of community and worker awareness.



## 2            **LEGISLATION FOR ACCIDENT PREVENTION**

In Canada, legislation relating to the life-cycle of chemical production from siting and zoning, through design, construction and operation, to transportation and distribution generally parallels the hierarchy of government levels from municipal through provincial to federal. The three levels of government have a shared responsibility for controlling major industrial incidents, each with different degrees of legislative authority. As a rule, municipal governments are involved in setting by-laws regarding the location of plants in order to provide adequate buffer zones between industrial complexes and residential areas. Plant design and construction approvals in regard to occupational health and safety and environmental concerns lie for the most part within provincial jurisdiction. At the federal level, emphasis is placed on the various modes of transport and consumer safety.

The following sections provide an overview of existing legislation affecting accident prevention and offering protection from major accidents.

### **2.1            Municipal**

As mentioned earlier the prevention of major industrial incidents such as Bhopal, is controlled to some degree by existing provincial and municipal statutes. At the municipal level this usually takes the form of zoning by-laws which are administered by local planning and development departments.

In Canada the municipalities are the creations of the provinces and their legislative authorities are granted under municipal acts and/or planning acts. Under such legislation the municipalities are given primary responsibility for local land-use planning. By insisting on adequate buffering distance between heavy industrial sites and residential areas the impacts of major environmental upsets can be mitigated.

The provincial agencies have developed land-use compatibility guidelines recommending separation distances and other control measures to protect citizens from unwanted emissions. The objective of such guidelines is to minimize the exposure of humans to adverse environmental impacts and nuisance factors. In addition, certain provinces have delegated responsibility for atmospheric emission controls to large metropolitan areas e.g., the Greater Vancouver Regional District (GVRD) and the Montreal Urban Community (MUC). Industry in these areas must conform to federal, provincial and community standards.

Community land-use planning helps to minimize the impact of major disasters involving industrial facilities. Where communities have grown up around industrial sites, buffering is generally minimal and emphasis must be placed on in-plant safety programs.

Such is the case in many areas of the country. In the upstream oil and gas sector, there have been applications to drill sour gas wells in relatively close proximity to urban areas. Of course, all safety requirements and emergency response plans are thoroughly reviewed to meet the requirements (including zoning) of the Alberta Energy Resources Conservation Board.

The Working Group is aware of several cases where residential housing has been constructed adjacent to oil refineries. Two examples are the Shellburn refinery in Burnaby, B.C. and the now closed Texaco refinery in Port Credit, Ontario. In the last few years, two new refineries have been constructed well away from any residential areas; the Texaco refinery at Nanticoke, Ontario and Shell Scotford refinery at Fort Saskatchewan, Alberta. Proper zoning and land use planning principles were applied in both cases.

The chemical and manufacturing sectors have also experienced the problems of having residential areas built close to the plant. This is particularly in the pulp and paper industry where many mills are located virtually in the centre of town. Such is the case at Fort Frances, Ontario where a chlorine leak in November, 1984 forced an evacuation and had the potential for impact on the local hospital.

There are also examples of many good practices which have been in place for quite a few years. Some include the Dupont and Nitrochem facilities located outside of Maitland, the Dow phenol plant (now Chatterton Chemical) at Tilbury Island outside of Vancouver and the Varennes area southeast of Montreal.

It is extremely difficult for municipalities to control residential encroachment into industrial basins. More senior governments can perhaps assist in this area by providing guidance and resources to local governments.

## **2.2 Provincial**

Safety in industrial plants is an important consideration when chemical, petroleum and natural gas plants and related storage facilities are being designed and built, and when process operations are being planned. The training of workers in proper work procedures is an important feature of safety programs.

Occupational safety legislation and regulations were first proclaimed by each of the provinces/territories and by the federal government in Canada. For a long time, each of these jurisdictions has had a regulatory agency for monitoring and, where

necessary, for enforcing its regulations. Occupational safety and health regulatory agencies have cooperated as members of the Canadian Association of Administrators of Labour Legislation (CAALL) since the early 1960's.

In Canada, industrial safety regulations are aimed at protecting the health and safety of workers. The prime responsibility of employers to manage their business effectively is recognized in addition to the rights and responsibilities of workers. Safety is perceived as everyone's business. Workers must report unsafe working conditions to their supervisors who in turn must respond to the workers' concern. Employers are required to inform their employees about potential hazards and workers have a right to know about the risks they face at work. Workers also have the right to refuse to work in conditions which are unsafe, and employers have a responsibility to correct unsafe conditions. Such measures may include engineering controls, safe work procedures or other measures to reduce the possibility of accidents. At a worksite, workers must follow plant safety rules which are enforced by their employers. In potentially hazardous establishments which have 20 or more workers joint health and safety committees are required. Such committees are expected to inspect for unsafe conditions, to consider the adequacy of worker training and to recommend improvements where needed or feasible. Safety and accident prevention are synonymous and largely a matter of attitude to be fostered by management, labour and government.

Preventive measures must be taken when potential hazards are identified during design and construction of industrial plants, during worksite safety audits, or as a result of the investigation of an accident in the workplace. Major accidents involving loss of life, serious injuries, or significant property loss or damage must be investigated to identify and correct causes of the accident. Consensus standards for preventive measures are frequently referenced in safety regulations. Such standards are amended from time to time as a result of experience gained from mishaps in Canada as well as in other countries.

Accident prevention programs in different chemical or petroleum manufacturing plants may be similar in concept but are usually different in detail. They are worksite specific and involve engineering controls, proper work procedures and worker training and education. While such programs are considered important in protecting the health and safety of workers, they are also important means of preventing fires, explosions and releases of toxic gases which threaten the health and safety of the public in nearby communities and may place the ecological environment at risk as well.

Both employers and workers in hazardous industries must be aware of possible risks and the importance of preventing accidents. Compliance with occupational safety and health regulations ensures a minimum standard of performance to control the possibility of injuries to workers. At the same time, it determines an acceptable level of safety attitude in a plant. Regulations complement performance standards which industries have evolved over time. It is generally accepted that effective plant operations over a long-term period can be achieved only when all risks are effectively controlled.

Some of the specific considerations covered by current occupational health and safety regulations include confined space entry, fire and explosion prevention, piping systems safety, approval of plans, drawings and specifications for new buildings or alterations to existing buildings including industrial plants, material handling, drilling and drill stem testing for petroleum and natural gas production plant operation. The following are examples of current safety legislation and regulations. The examples chosen deal with boilers and pressure vessels, piping and tank system safety, as regulated by federal, provincial and territorial jurisdictions.

1) Boilers and Pressure Vessels. A large number of statutes covering hazardous equipment and installations which are regulated in each jurisdiction with respect to concern for worker and public safety can be listed under the general heading of special legislative provisions relating to certain installations and industries in federal, provincial and territorial jurisdictions in Canada. Boilers and pressure vessels, gas and oil burning equipment, elevators and lifts and electrical installations are among these. The acts are administered by different departments depending on the jurisdiction. It is frequently a department or ministry of labour and manpower, a ministry of consumer affairs or some other, that is responsible for enforcement. In each instance, on site inspections are carried out periodically to ensure proper design, use, operation and maintenance of boilers and pressure vessels, etc.

2) Piping Systems. Piping systems and tanks are also included in the Canada Dangerous Substances Regulations. Employers are required to ensure that every piping system or tank is adequate for its intended purpose with regard to corrosiveness, pressure, temperature and any other hazardous properties of the materials they contain. Pipelines must be fitted with control devices to ensure safe operation, maintenance and repair. Each person who operates, maintains or repairs any part of a piping system must know the location and use of every valve in the system.

3) Tank Systems. Maintenance and repair of tanks are regulated under "working in confined spaces" of the Occupational Safety and Health regulations. Most jurisdictions in Canada deal with the hazards of confined spaces. These require that piping systems be blanked off during repairs and means of doing so must be available. For example, the Canada "Confined Spaces Regulations" requires that the flow of any substance to or from a confined space be prevented by means of a solid plate that completely blocks such material and that it is not dependent for its effectiveness on a valve or similar device. Alberta regulations contain similar requirements. Newfoundland, Saskatchewan, Ontario and New Brunswick each have general regulations for piping systems and tanks and have required blanking off under their Boiler and Pressure Vessel acts. British Columbia and the Northwest Territories require that pipelines be blanked off during repairs to piping systems. Tanks and pipelines must also be fitted with restraining devices and identified in accordance with the American National Standards Institute (ANSI) "Scheme for the Identification of Piping Systems" - A.13.1. Nova Scotia and Prince Edward Island have provided guidelines for pipelines in connection with the storage of hazardous liquids in tanks. A list of current Federal and Provincial Occupational Health, Safety and Related Environmental Legislation is outlined in Appendix II-1.

The use of the National Standards System of Canada in regulating occupational safety, provides additional means of preventing accidents involving hazardous chemical and petroleum products. These include standards produced by the Canadian Standards Association (CSA), the Bureau de normalisation du Québec (BNQ), Underwriters' Laboratories of Canada (ULC) and the Canadian Gas Association (CGA).

Provincial safety legislation sets base line standards in the workplace to prevent injuries and loss of life. Proper in-plant safety practices minimize the risk of large-scale community incidents and are an important part of the community safety program.

## 2.3 Federal

Federal legislation mainly covers the transport sector of the industrial accident problem. Of course, federal legislation in safety practices parallels provincial legislation pertaining to boiler and pressure vessels, confined entry, personal protective equipment, etc., for those activities related to its own jurisdiction.

As mentioned in Part I, Agriculture Canada legislates pesticides manufacture under the Pest Control Products Act. Specific requirements relate to safety and provision for a plant inspection program exists.

As shipment of goods is often transboundary, the federal government has always maintained the lead jurisdiction. As railway, roads and water systems were developed, relevant laws and regulations were implemented as necessary. Such legislation includes the Railways Act, Aeronautics Act, and the Canada Shipping Act which are administered by the Canadian Transport Commission and the Canadian Coast Guard. Under these acts, there are many regulations which apply to safety.

Starting around 1975, Transport Canada and other agencies began to look at the transport of hazardous materials in all four modes. On November 10, 1979 one of the worst Canadian derailment accidents took place in Mississauga, Ontario which resulted in the evacuation some 216 000 people. This event launched a public enquiry and led to the federal government accelerating the development of legislation pertaining to the transport of hazardous commodities.

In 1980 the federal government passed into legislation the Transportation of Dangerous Goods Act (TDGA). This act is intended to promote public safety in the transportation of dangerous commodities including chemicals. It applies with specific exceptions, to all handling, offering for transport and actual carrying of dangerous goods through Canada irrespective of their point of origin or destination or the means of conveyance.

In July 1985, the first regulations under TDGA came into force and applied to all modes of transportation. They respected the handling, offering for transport, and transport of dangerous goods as follows:

- Road** - Prior to these regulations, virtually no road regulations existed. The design specifications for tanks are identical with those of the United States Department of Transport as given in 49 CFR (Code of Federal Regulations Title 49).
- Rail** - The transportation of dangerous goods by rail has for many years been regulated under the Canadian Transport Commission's Regulations for the Transportation of Dangerous Commodities by Rail. As of July 1, 1985 these regulations must conform to the TDGR in respect of documentation, marking and placarding for packaged dangerous goods. CTC retains responsibility for bulk movements and operational matters such as speed, segregation and tank car specifications (the latter are essentially the same as United States Department of Transport specifications).

- Air** - Aeronautics Act/ICAO for international shipments by air (International Civil Aviation Organization).
- Sea** - Canada Shipping Act/IMDG Code for international shipments (International Maritime Dangerous Goods Code).
- Storage** - The Transportation of Dangerous Goods Act covers in-transit storage. The existing regulations do not specify requirements for in-transit storage of chemicals and are being reviewed.

Specific actions under TDG Regulations will improve safety and prevent accidents. These are:

- a) requiring adequate documentation of risk;
- b) requiring that packages be marked, labelled and placarded with an indication of risk;
- c) requiring minimum package specifications;
- d) requiring that dangerous goods be suitably segregated from each other and safely stowed;
- e) requiring that personnel involved with dangerous goods be appropriately trained; and
- f) requiring the appointment of regional inspectors of dangerous goods (eleven such inspectors are currently in place).

TDG Regulations will be implemented through provincial programs in departments such as Environment and public safety agencies. Some Canadian municipalities have required special routing for dangerous goods traffic (e.g., Edmonton). This is an issue that has been in the legislative force in many U.S. cities and will no doubt be picked up across Canada.

Vehicle inspection with respect to brakes, tires, load distribution and method of retention of load will help reduce the likelihood of an accident. Too much outage in tankers and tank containers can result in instability and turnover even at low speeds. Although the level of filling is not specifically addressed in the Regulations, it is something that must be considered and be subject to inspection.

Tunnels represent a very real danger when transporting dangerous goods as evidenced by some serious disasters. Bridges also present an additional risk. Rules for tunnels and bridges already exist in the United States and Europe. A general review of actions pertaining to tunnels and bridges in Canada is underway by Transport Canada.

The Mississauga accident would not have been prevented by any dangerous goods regulations as the cause was related to a malfunction in railway equipment. The

Working Group can only conclude that the regulatory side of the issue has been addressed. Nonetheless, there is still room for senior governments to assist municipalities in designating traffic routes for the dangerous commodities which pass through their boundaries. Transport regulations will help reduce the impact of such occurrences by:

- a) allowing the ready identification of the hazard;
- b) segregating incompatible substances;
- c) setting safety standards for packaging; and
- d) improving emergency response.



### 3 MANAGEMENT OF SAFETY AND LOSS PREVENTION

Industry has the main responsibility for health and safety of its operations. The safety programs of the major chemical and petroleum plants in Canada cover a wide spectrum of activities and all of these companies employ full time staff whose primary function is to maintain and improve safety.

#### 3.1 Corporate Commitment

In Canada, legislation clearly defines the responsibility of the employer for safety. Most company presidents in the Chemical and Petroleum Industry have taken this responsibility seriously and have communicated this commitment to safety throughout their organizations. Each safety program starts with a policy statement, which is usually signed by the Chief Executive Officer of the company, clearly stating that the objectives of the company must be the total elimination of accidents, injuries, or losses to the employees, the company, the public and the environment.

The Chief Executive Officer's commitment alone, will accomplish little unless it is converted into specific activities. The most effective way used to ensure that safety becomes part of the company's culture is by making safety a line responsibility and providing line management with safety professionals as resource persons. Merely stating that safety is a line manager's responsibility is not particularly effective. In many cases his performance in that area is appraised on a regular basis and his safety performance is directly related to promotion and pay. When operational safety is treated as a normal part of routine operations, losses can and will be minimized.

A typical policy statement used by a major manufacturer of chemicals in Canada is:

"Concern for the safety and health of our people is fundamental to the manner in which we conduct our business. Our objective in safety and loss prevention is the elimination of injuries and losses."

Management is responsible for:

- (1) Creating an awareness and understanding of our objectives.
- (2) Establishing the necessary training programs so that we understand how to do our business safely.
- (3) Monitoring our performance to ensure that we are making progress toward our objectives.

To fulfill our duties as employees, we must recognize that we share the responsibility for loss prevention, our own safety, and the safety of our co-workers." (Dow Chemical Canada Inc., 1983).

### **3.2 Responsible Care Programs**

The Canadian Chemical Producers' Association (CCPA), a voluntary trade association made up of some 65 member companies representing the major chemical manufacturers in Canada, has for some time recognized its social mandate with regard to health and safety and has developed a policy of "Responsible Care" that is now a condition of membership. "Responsible Care" involves encouraging the responsible development, introduction, manufacture, transportation, storage, handling, distribution, use and ultimate disposal of chemicals and products so as to minimize adverse effects on human health and the environment.

Principles incorporated into the policy and subscribed to by CCPA members are:

- to ensure that operations do not present an unacceptable level of risk to employees, customers, the public or the environment;
- to provide relevant information on the hazards of chemicals to customers, urging them to use and dispose of products in a safe manner; and make such information available to the public on request;
- to make responsible care an early and integral part of the planning process leading to new products, processes or plants;
- to increase the emphasis on the understanding of existing products and their uses and ensure that a high level of understanding of new products and their potential hazards is achieved prior to and throughout commercial development;
- to comply with all legal requirements which affect its operations and products;
- to be responsive and sensitive to legitimate community concerns; and
- to work actively with and assist governments and selected organizations to foster and encourage equitable and attainable standards.

### **3.3 Training**

It is management's responsibility to see that people are trained to do the job properly, paying attention to details in meeting their job objectives. In other words, a job done properly is done safely.

Senior line management at a plant location communicates down through the hierarchy to the first line supervisors who in turn train each and every employee on how

to carry out his/her function in a safe manner. The employee must not only understand the company safety policies, but he/she also must be trained how to detect hazards, to investigate accidents and to respond to emergency situations.

Safety professionals assist senior management by designing training programs that will not only inform but also motivate the workers to continually perform safely during their activities. Safe procedures for plant operations including start-up and shut-downs of units must be communicated in all the varied details to the plant personnel responsible for their execution.

In the chemical and petroleum industries employees are trained in mandatory Safety and Health standards relative to their functions. An inventory of critical skills/knowledge relative to the position is compiled. Initial training in those mandatory procedures is required before the employee is allowed on the job. Mandatory re-qualification is required after a certain time interval. Qualification of the procedure is achieved through written quizzes (not true or false) and field testing. An example of a training matrix is included in Appendix II-2.

In addition, accident reports and reports of near misses should be given wide company circulation and existing procedures evaluated in terms of the new experience. It is management's function to insure that the neverending cycle of evaluation, training and re-evaluation of plant practices is an on-going activity.

The objective of this type of training is to allow company personnel to be aware and identify hazards and reduce the risk of accidents.

A number of companies, notably the J.T. Baker Company have, for some time, organized seminars in various parts of Canada on aspects of safety in the workplace. The advertisement for the most recent series of two day seminars (August, 1985) covers the subjects "Hazardous Chemicals Safety", "Hazardous Spill Response" and "Management as a Safety Training Tool" (J.T. Baker Chemical Co., 1985).

Several community colleges offer safety courses. For example, the College of Cape Breton (Cape Breton, Nova Scotia) runs an annual safety course with the assistance of the department of Environmental Health and Safety, Industrial Hygiene, Harvard University. The Industrial Association for Prevention of Accidents (IAPA) in Ontario has initiated certain training programs in high schools. The general lack of safety programs and formal instruction in schools and universities, however, is of serious shortcoming.

Training programs in smaller companies are more likely to be served by safety organization such as IAPA (Ontario), labour organization and safety consultants. The adequacy of these programs for providing training to prevent Bhopal-type incidents was

not thoroughly investigated by the Working Group. There is a need in Canada for training institutions to provide adequate in-depth safety courses.

### **3.4 Auditing**

Safety auditing is viewed by many experts in the field as one of the most important features of a comprehensive safety and loss control program. It represents an independent evaluation of a company's or operating location's safety program. As such, it examines the adequacy of the program and how well it is followed. Properly planned and executed audits will identify program deficiencies and measure deviation from normative standards of performance.

Chemical and petroleum companies employ a variety of auditing options which include:

- 1) Internal Auditing - local management and the Health and Safety Committee, at the location may carry out periodic safety audits.
- 2) Company Audits of an Operating Location - usually conducted by Head Office specialists and personnel from other plant locations.
- 3) Insurance Company Audits - where insurance company trained risk assessors review the operating location for such factors as:
  - fire protection;
  - process safety;
  - pressure vessels integrity (both fired and unfired); and
  - electrical code compliance.
- 4) Government Inspection - Occupational Health and Safety or environmental agencies conduct periodic inplant compliance audits.
- 5) Industry Associations - Industry Associations such as the Canadian Chemical Producers' Association have developed safety assessment programs to assist member companies (Appendix II-3).
- 6) Safety Associations - Organizations such as the Industrial Accident Prevention Association of Ontario have made the "5 Star Safety Audit Program" available to interested parties (Appendix II-4).

Chemical and Petroleum facilities, in addition to frequent internal audits by location personnel, should also be subjected to periodic external audits. This audit should be conducted by people outside of the location or company, but familiar with the type of operation involved. Such an audit would last up to a week and involve a team approach.

Accountability for action to correct any deficiencies found in these audits is left to the line organization.

The Industrial Accident Prevention Association provided information to the study indicating that some one hundred firms in Ontario are involved with the "Five-Star" safety audit program and that twenty-four of these firms are from the petroleum and chemical sectors.