

4 SPECIAL CHEMICALS AND CONSIDERATIONS

As mentioned earlier in this report, Working Group 1 has concerned itself primarily with chemicals that may present an acute hazard of significant size. This implies the existence of a sufficient quantity of the dangerous chemical in order to pose such a potential level of risk. This will vary from chemical to chemical and is highly situation specific.

There are however, certain chemicals that although they do not fall within this category, have attracted such wide media attention that the Working Group agreed to provide comment. The following is a brief description of the reasons why pesticides, polychlorinated biphenyls and dioxin have been given special consideration.

(i) Pesticides

As a class of chemical agents pesticides are by definition poisonous to a large variety of organisms. They are used to control insects, fungi, weeds and pests. As with any poison they pose a threat to human health or the environment if they are misused. Every year there are reports of spills and poisonings involving pesticides that are usually the result of transport accidents or product misuse.

A review of the Canadian situation showed that primary manufacturing of the active ingredients in pesticides is carried out at only one or two locations. There are a number of formulating plants in Canada, however where imported active ingredients are combined with other chemicals to form the pesticide product. Since it was impossible to characterize the hazard posed by these chemical mixtures or to establish the critical quantities required to pose a public threat, the Working Group concluded that pesticides would have to be evaluated on a case-by-case basis. The only potential for Bhopal-type disasters likely to occur from these chemicals would be in transport accidents or storage fires where plumes of toxic gases could potentially be dispersed over a wide area.

(ii) Polychlorinated Biphenyls (PCBs)

Polychlorinated biphenyls have been widely publicized as environmental and human health contaminants. As of 1980 the use of PCBs in Canada was severely restricted under the Environmental Contaminants Act. In 1985, Transport Canada passed regulations concerning the transport of PCBs. The phasing out of PCBs in electrical and heat transfer equipment, however, may continue for several years. In all

probability PCB spills or fires would be highly localized and would not be expected to lead to acute human effects. Therefore this class of chemicals was not included on the Bhopal-type chemicals list.

(iii) **Dioxin (2,3,7,8-tetrachlorodibenzo-p-dioxin)**

In the early 1980's a great deal of publicity was given to a dangerous chemical by-product that goes by the diminutive name of dioxin. In reality there are 75 compounds that belong to a group of chemicals that collectively are called dioxins. Of these 2,3,7,8-tetrachlorodibenzo-p-dioxin is reputed to be the most toxic man-made chemical of all time. It is produced inadvertently in trace quantities in the combustion of certain organic materials and is a by-product of the manufacture of the pesticide 2,4,5, trichlorophenol.

Since this substance is not manufactured in Canada and since the emissions of dioxin from organic waste incineration are in trace quantities usually below the acute hazard level, dioxin is unlikely to cause a major chemical accident in Canada.

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APPENDIX I-1

**TRANSPORTATION OF DANGEROUS GOODS ACT HAZARDOUS
CHEMICALS WITH DISPERSIVE AND EXPLOSIVE POTENTIAL**

APPENDIX I-1 TRANSPORTATION OF DANGEROUS GOODS ACT HAZARDOUS CHEMICALS WITH DISPERSIVE AND EXPLOSIVE POTENTIAL

In the Federal Transportation of Dangerous Goods Act (TDGA), dangerous commodities are categorized into nine classes depending on the type of hazard they present. The classes are further subdivided into divisions and each division separates out the hazard characteristics. A numerical coding is used with the classes numbered 1 to 9 followed by a decimal point and then a division numeral.

The nine classes, their divisions where applicable and a brief description of their characteristics are:

Class 1 - Explosives -

- 1.1 - A substance or article with a mass explosion hazard.
- 1.2 - A substance or article with a fragment projection hazard, but not a mass explosion hazard.
- 1.3 - A substance or article which has a fire hazard along with either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard.
- 1.4 - A substance or article which presents no significant hazard - explosion effects are largely confined to the package and no projection or fragments or appreciable size or range are to be expected.
- 1.5 - A very insensitive substance which nevertheless has a mass explosion hazard like those substances in 1.1.

Class 2 - Gases

- 2.1 - A flammable gas.
- 2.2 - A non-flammable, non-toxic, non-corrosive gas.
- 2.3 - A poisonous gas.
- 2.4 - A corrosive gas.

Class 3 - Flammable Liquids

- 3.1 - A liquid with a closed-cup flash point of less than -18°C.
- 3.2 - A liquid with a closed-cup flash point greater than -18°C but less than 23°C.
- 3.3 - A liquid with a closed-cup flash point greater than 23°C but less than 37.8°C (for international air transport, the flash point is greater than 23°C but less than 60.5°C) (for international marine transport, the flash point is greater than 23°C but less than 61°C).

Class 4 - Flammable Solids, Substances Liable to Spontaneous Combustion, and Substances that on Contact with Water Emit Flammable Gases

- 4.1 - A solid which under normal conditions of transport is readily ignitable and burns vigorously and persistently or which causes or contributes to fire through friction or from heat retained from manufacturing or processing.
- 4.2 - A substance liable to spontaneous combustion under normal conditions of transport, or when in contact with air, liable to spontaneous heating to the point where it ignites.
- 4.3 - A substance that, on contact with water, emits dangerous quantities of flammable gases or becomes spontaneously combustible on contact with water or water vapour.

Class 5 - Oxidizing Substances and Organic Peroxides

- 5.1 - A substance which causes or contributes to the combustion of other material by yielding oxygen or other oxidizing substances whether or not the substance itself is combustible.
- 5.2 - An organic compound that contains the bivalent "-O-O-" structure which is strong oxidizing decomposition or is sensitive to heat, shock or friction.

Class 6 - Poisonous Substances and Infectious Substances

- 6.1 - A solid or liquid that is poisonous through inhalation of its vapours, by skin contact or by ingestion.
- 6.2 - Organisms that are infectious or that are reasonably believed to be infectious to humans or to animals and the toxins of such organisms.

Class 7 - Radioactive Materials

- Radioactive materials within the meaning of the Atomic Energy Control Act with activity greater than 74 kBq/kg.

Class 8 - Corrosive Substances

- A substance that causes visible necrosis of skin or corrodes steel or non-clad aluminum.

Class 9 - Miscellaneous Dangerous Goods

- 9.1 - A substance or product presenting dangers sufficient to warrant regulation in transport but which cannot be ascribed to any other class.
- 9.2 - An environmentally hazardous substance.
- 9.3 - A dangerous waste.

SCHEDULE XII - PART I - EXPLOSIVES

Ammonium Nitrate
 Ammonium Nitrate Fertilizer*
 Ammonium Perchlorate
 Ammonium Picrate
 Diazodinitrophenol, Wetted
 Diethylene Glycol Dinitrate, Desensitized
 Dinitrophenol
 Dinitroreorcinol
 Dipicryl Sulphide
 Guanyl Nitrosaminoguanilydene Hydrazine, Wetted
 Guanyl Nitrosaminoguanilyltetrazene, Wetted or Tetrazene, Wetted
 Hexanitrodiphenylamine or Dipicrylamine or Hexyl
 Hexanitrostilbene
 Hexatonal, Cast
 Hexolite
 Lead Azide, Wetted
 Lead Nitroresorcinate, Wetted
 Lead Styphnate, Wetted
 Mannitol Hexanitate, Wetted or Nitromannite, Wetted
 Mercury Fulminate, Wetted
 5-Nitrobenzotriazol
 Nitrocellulose
 Nitroglycerin, Desensitized
 Nitroglycerin, Spirit of
 Nitroguanidine or Picrite
 Nitrosoguanidine, Wetted
 Nitrostarch
 Nitro Urea
 Octolite or Octol
 Pentaerythrite Tetranitrate, Wetted or Desensitized Pentaerythrit
 Pentaerythrite Tetranitrate or Petn
 Pentolite
 Tetranitroaniline
 Trinitroaniline or Picramide
 Trinitroanisole
 Trinitrobenzene
 Trinitrobenzenesulphonic Acid
 Trinitrobenzoic Acid
 Trinitrochlorobenzene or Picryl Chloride
 Trinitro-*m*-Cresol
 Trinitrofluorenone
 Trinitronaphthalene
 Trinitrophenetole
 Trinitrophenol or Picric Acid

* Regulatory requirements under review by Transport Canada and the Canadian Fertilizer Institute.

SCHEDULE XII - PART I - EXPLOSIVES (Cont'd)

Trinitrophenylmethynitramine or Tetryl
Trinitroresorcinol or Styphnic Acid
Trinitroresorcinol, Wetted or Styphnic Acid, Wetted
Trinitrotoluene or TNT
Trinitrotoluene and Trinitrobenzene Mixtures or TNT and Trinitrobenzene
Trinitrotoluene Mixtures Containing Trinitrobenzene and Hexanitro
Tritonal
Urea Nitrate
Ethylene Glycol Mononitrate Solution
Methylamine Nitrate Solution

SCHEDULE XII - PART II

Dangerous goods listed under Part II Schedule XII of the TDGA regulations. (Part II deals with the Application of the Act and identifies under what circumstances the Act does not apply) are those that if there is a spill or emission to the environment the chemicals could potentially migrate outside the transportation corridor's right-of-way.

This list is shown on the accompanying tables. The chemicals on this list were arrived at through a consensus process between senior scientists of both industry and government. This comprehensive list of some 300 chemicals was used by Working Group 1 as a starting point for developing the acutely hazardous list of chemicals having a Bhopal-type potential.

SCHEDULE XII - PART II - CLASS 2.1 - GASES IGNITABLE AT NORMAL ATMOSPHERE
WHEN IN A MIXTURE OF LESS THAN 13% (VOL.) WITH AIR OR HAVE A
FLAMMABILITY RANGE OF AT LEAST 12

Hydrogen Sulphide, Liquefied or Hydrogen Sulphide
Methane, Refrigerated Liquid or Natural Gas, Refrigerated Liquid
Propane
Butane or Butanes Mixtures
Ethylene, Compressed or Ethylene
Ethylene, Refrigerated Liquid
Hydrogen, Compressed or Hydrogen
Hydrogen, Refrigerated Liquid or Hydrogen, Liquefied
Propylene
Vinyl Chloride, Inhibited
Butylenes
Ethylene Oxide
Butadiene, Inhibited
Acetylene, Dissolved or Acetylene
Ethyl Chloride
Aerosols
Carbon Dioxide and Ethylene Oxide Mixtures
Carbon Monoxide and Hydrogen Mixture
Carbon Monoxide
Chlorodifluoroethanes or Difluorochloroethanes
Coal Gas
Compressed or Liquefied Gases, Flammable, N.O.S.*
Compressed or Liquefied Gases, Flammable, Toxic, N.O.S.*
Cyclopropane, Liquefied or Cyclopropane
Deuterium
Diborane or Diborane Mixtures
Dimethyl Ether
Dimethylamine, Anhydrous
Ethane, Compressed or Ethane
Ethane, Refrigerated Liquid
Ethylamine or Monoethylamine
Hydrocarbon Gases, Compressed, or Non-Liquefied N.O.S.* or Hydrocarbon Gases
Hydrogen Gases, Liquefied, N.O.S.* or Hydrocarbon Gases Mixtures, Liquefied
Hydrogen and Methane Mixtures, Compressed
Isobutane or Isobutane Mixtures
Isobutylene
Methyl Acetylene and Propadiene Mixtures, Stabilized
Methyl Chloride and Methylene Chloride Mixture
Methyl Chloride
Methyl Fluoride
Methyl Mercaptan
Methylamine, Anhydrous
Oil, Gas

* N.O.S.: Not otherwise specified.

SCHEDULE XII - PART II - CLASS 2.1 - GASES IGNITABLE AT NORMAL ATMOSPHERE WHEN IN A MIXTURE OF LESS THAN 13% (VOL.) WITH AIR OR HAVE A FLAMMABILITY RANGE OF AT LEAST 12 (Cont'd)

Petroleum Gases, Liquefied, N.O.S. or Liquefied Petroleum Gas
 Propadiene, Inhibited
 Tetrafluoroethylene, Inhibited
 Trifluorochloroethylene, Inhibited
 Trifluoroethane, Compressed
 Trimethylamine, Anhydrous
 Vinyl Bromide, Inhibited
 Vinyl Fluoride, Inhibited
 Vinyl Methyl Ether, Inhibited
 1, 1-Difluoroethylene
 2, 2-Dimethyl Propane

SCHEDULE XII - PART II - CLASS 2.2 - GASES HAVING A LC₅₀ OF LESS THAN 5000 mL/m³ AT NORMAL ATMOSPHERE BY REASON OF TOXICITY

Arsine
 Sulphur Dioxide, Liquefied or Sulphur Dioxide
 Boron Trichloride
 Boron Trifluoride
 Bromine Chloride
 Carbonyl Fluoride
 Chlorine Trifluoride
 Chloropicrin and Methyl Chloride Mixtures
 Chloropicrin and Non-Flammable, Non-Liquefied, Compressed Gas Mixture
 Chloropicrine and Methyl Bromide Mixtures
 Cyanogen Chloride
 Cyanogen, Liquefied or Cyanogen, Gas
 Dichlorosilane
 Fluorine, Compressed or Fluorine
 Germane
 Hexaethyl Tetraphosphate and Compressed Gas Mixtures
 Hexafluoroacetone
 Hydrogen Selenide, Anhydrous
 Insecticide Gases, Toxic, N.O.S.
 Methyl Bromide
 Methylchloroarsine
 Nitric Oxide and Nitrogen Tetroxide, Mixtures
 Nitric Oxide
 Nitrogen Dioxide, Liquefied or Nitrogen Dioxide, Liquid
 Nitrogen Oxides, N.O.S.
 Nitrogen Trifluoride
 Nitrogen Trioxide
 Oxygen Difluoride

SCHEDULE XII - PART II - CLASS 2.2 - GASES HAVING A LC_{50} OF LESS THAN 5000 mL/m³ AT NORMAL ATMOSPHERE BY REASON OF TOXICITY (Cont'd)

Phosgene
Phosphine
Phosphorus Pentafluoride
Selenium Hexafluoride
Silane
Silicon Tetrafluoride
Stibine
Sulphur Tetrafluoride
Sulphuryl Fluoride
Tellurium Hexafluoride
Tetraethyl Dithiopyrophosphate and Gases, in Solution or Tetraethyl Ditiopyr
Tetraethyl Pyrophosphate and Compressed Gas Mixtures

SCHEDULE XII - PART II - CLASS 2.3 - GASES HAVING A LC_{50} OF LESS THAN 5000 mL/m³ AT NORMAL ATMOSPHERE BY REASON OF CORROSION EFFECTS

Ammonia, Anhydrous, Liquefied or Ammonia Solutions
Chlorine
Hydrogen Bromide, Anhydrous
Hydrogen Chloride, Anhydrous
Hydrogen Chloride, Refrigerated Liquid
Hydrogen Fluoride, Anhydrous
Hydrogen Iodide, Anhydrous
Nitrosyl Chloride

SCHEDULE XII - PART II - CLASS 3.1 - FLAMMABLE LIQUIDS WITH A FLASH POINT OF LESS THAN -18°C

Propylene
Carbon Disulphide or Carbon Bisulphide
Acetaldehyde
Acrolein, Inhibited
Chlordane, Liquid
Flammable Liquids, Corrosive, N.O.S.*
Flammable Liquids, Poisonous, N.O.S.*
Mercaptans, Liquid, N.O.S. or Mercaptan Mixtures, Liquid, N.O.S.

SCHEDULE XII - PART II - CLASS 3.2 - FLAMMABLE LIQUIDS WITH A FLASH POINT OF BETWEEN 23°C AND -18°C

Acetyl Chloride
 Acrylonitrile, Inhibited
 Arsenical Pesticides, Liquid, Flammable, Toxic, N.O.S.
 Bipyridilium Pesticides, Liquid, Flammable, Toxic, N.O.S.
 Carbamate Pesticides, Liquid, Flammable, Toxic, N.O.S.
 Copper Based Pesticides, Liquid, Flammable, Toxic, N.O.S.
 Dimethylhydrazine, Symmetrical or 1,2-Dimethylhydrazine
 Dimethyldichlorosilane
 Dimethylhydrazine, Unsymmetrical or 1,1-Dimethylhydrazine
 Dithiocarbamate Pesticides, Liquid, Flammable, Toxic, N.O.S.
 Mercaptans, Liquid, N.O.S. or Mercaptan Mixtures, Liquid, N.O.S.
 Mercury Based Pesticides, Liquid, Flammable, Toxic, N.O.S.
 Methacrylaldehyde
 Methyl Cyanide/Acetonitrile
 Methyldichlorosilane
 Organochlorine Pesticides, Liquid, Flammable, Toxic, N.O.S.
 Organosphorus Pesticides, Liquid, Flammable, Toxic
 Organotin Pesticides, Liquid, Flammable, Toxic, N.O.S.
 Pesticides, Liquid, Flammable, Toxic, N.O.S.
 Phenoxy Pesticides, Liquid, Flammable, Toxic, N.O.S.
 Phenyl Urea Pesticides, Liquid, Flammable, Toxic, N.O.S.
 Triazine Pesticides, Liquid, Flammable, Toxic, N.O.S.

SCHEDULE XII - PART II - CLASS 4.2 - SOLIDS LIABLE TO SPONTANEOUS COMBUSTION

Phosphorus White, Molten
 Phosphorus, White or Yellow, Dry or Underwater
 or in Solution
 Aluminum Alkyl Halides
 Dimethylzinc
 Ethyl Phosphonous Dichloride, Anhydrous
 Fuel, Pyrophoric, N.O.S.
 Magnesium Diphenyl
 Methyl Magnesium Bromide in Ethyl Ether
 Sodium Hydrosulphide, Solid

SCHEDULE XII - PART II - CLASS 4.3 - SUBSTANCES THAT ON CONTACT WITH WATER EMIT FLAMMABLE GASES

Calcium Carbide
 Aluminum Carbide
 Aluminum Phosphide - Pesticide
 Calcium Phosphide
 Ethyldichlorosilane
 Magnesium Aluminum Phosphide
 Magnesium Phosphide
 Methyl Chlorosilane
 Potassium Phosphide
 Sodium Phosphide
 Stannic Phosphides
 Strontium Phosphide
 Trichlorosilane
 Zinc Phosphide

SCHEDULE XII - PART II - CLASS 5.1 - OXIDIZING SUBSTANCES

Hydrogen Peroxide, Aqueous Solutions
 Hydrogen Peroxide, Stabilized
 Bromine Pentafluoride
 Bromine Trifluoride
 Iodine Pentafluoride
 Perchloric Acid
 Tetranitromethane

SCHEDULE XII - PART II - CLASS 5.2 - ORGANIC COMPOUNDS THAT CONTAIN THE BIVALENT "-O-O-" STRUCTURE

Acetyl Cyclohexanesulphonyl Peroxide
 Cyclohexanone Peroxide(s)
 Dibenzoyl Peroxide, or Benzoyl Peroxide
 Dicyclohexyl Peroxydicarbonate, Technically Pure
 Diisopropyl Peroxydicarbonate, or Isopropyl Peroxydicarbonate
 Disuccinic Acid Peroxide, or Succinic Acid Peroxide
 Di-n-Propyl Peroxydicarbonate
 Di-(Sec-Butyl) Peroxydicarbonate
 Di-(Tert-Butylperoxy) Phthalate
 Di-(2-Methylbenzoyl) Peroxide
 Ethyl-3, 3-Di-(Tert-Butylperoxy) Butyrate
 Methyl Ethyl Ketone Peroxide(s)
 Tert-Butyl Peroxy-2-Ethylhexanoate

SCHEDULE XII - PART II - CLASS 5.2 - ORGANIC COMPOUNDS THAT CONTAIN THE
BIVALENT "-O-O-" STRUCTURE (Cont'd)

Tert-Butyl Peroxydiethylacetate
 Tert-Butyl Peroxyisobutyrate
 Tert-Butyl Peroxyisopropyl Carbonate
 Tert-Butyl Peroxypivalate
 Tert-Butyl Monoperoxymaleate
 1,1-Di-(Tert-Butylperoxy) Cyclohexane
 2,2-Dihydroperoxy Propane
 2,5-Dimethyl-2,5-Dihydroperoxy Hexane
 2,5-Dimethyl-2,5-DI-(Benzoylperoxy) Hexane
 2,5-Dimethyl-2,5-DI-(Benzoylperoxy) Hexane
 2,5-Dimethyl-2,5-DI-(Tert-Butylperoxy) Hexyne-3
 3,3,6,6,9,9-Hexamethyl-1,2,4,5-Tetraoxocyclononane
 3-chloroperoxybenzoic Acid

SCHEDULE XII - PART II - CLASS 6 - POISONOUS/TOXIC SUBSTANCES WITH LD₅₀
 (ORAL) 5 mg/kg, LD₅₀ (DERMAL) 40 mg/kg, LD₅₀ (INHALATION) 500 mg/kg

Sodium Cyanide
 Acetone Cyanohydrin
 Aerosols
 Azinphos-Methyl Mixture, Liquid
 Beryllium, Metal Power
 Bromobenzyl Cyanides
 Calcium Cyanide
 Chloropicrin Mixtures, N.O.S.
 Copper Cyanide
 Dichlorodimethyl Ether, Symmetrical
 Dichlorophenyl Isocyanates
 Dinitrobenzenes
 Diphenylamine Chloroarsine
 Diphenyl chloroarsine
 Disinfectants, N.O.S.
 Ethyldichloroarsine
 Ethyleneimine, Inhibited
 Hydrocyanic Acid, Aqueous Solutions
 Hydrogen Cyanide, Anhydrous, Stabilized
 Medicines, N.O.S.
 Mercuric Potassium Cyanide
 Mercury Cyanide or Mercuric Cyanide
 Methyl Bromide and Ethylene Dibromide Mixtures, Liquid
 Motor Fuel Antiknock Mixtures
 Nickel Carbonyl
 Organophosphorus Pesticides, Liquid, Toxic Flammable
 Phenol, Molten

SCHEDULE XII - PART II - CLASS 6 - POISONOUS/TOXIC SUBSTANCES WITH LD₅₀
(ORAL) 5 mg/kg, LD₅₀ (DERMAL) 40 mg/kg, LD₅₀ (INHALATION) 500 mg/kg (Cont'd)

Phenol, Solid or Phenol
Poisonous Liquids, Corrosive, N.O.S.
Poisonous Liquids, Flammable, N.O.S.
Poisonous Solids, Flammable, N.O.S.
Potassium Cyanide
Strychnine
Tear Gas Substances, N.O.S., Liquid
Thiphosgene
Xylol Bromide

SCHEDULE XII - PART II - CLASS 8 - CORROSIVE SUBSTANCES

Antimony Pentafluoride
Bromine
Chlorosulphonic Acid
Corrosive Liquids, Poisonous, N.O.S.
Dichloroacetyl Chloride
Etching Acid, Liquid, N.O.S.
Fumaryl Chloride
Hydrochloric Acid Solution or Hydrochloric Acid
Hydrofluoric Acid and Sulphuric Acid Mixtures
Nitrating Acid Mixtures, Spent
Nitric Acid, Fuming
Nitric Acid
Nitrohydrochloric Acid
Nitrosylsulphuric Acid
Sulphur Trioxide, Inhibited
Sulphuric Acid, Fuming or Oleum
Sulphuric Acid

APPENDIX I-2

**NATIONAL ANALYSIS OF TRENDS IN EMERGENCIES SYSTEM
150 MOST FREQUENTLY SPILLED SUBSTANCES**

APPENDIX I-2 150 MOST FREQUENTLY SPILLED SUBSTANCES

Acetic Acid	Ethylbenzene
Acetic Anhydride	Ethylene
Acetone	Ethylene Dibromide
Acetylene	Ethylene Dichloride (1,2-Dichloroethane)
Acrylonitrile	Ethylene Glycol
Adipic Acid	Ethylene Oxide
Aluminum Chloride	Fenitrothion
Aluminum Hydroxide	Ferric Chloride
Aluminum Sulphate	Fluorochloromethanes
Aminocarb Pesticide (Matacil)	Formaldehyde
Ammonia	Formic Acid
Ammonium Chloride	Hydrazine
Ammonium Nitrate	Hydrogen Chloride/Acid
Ammonium Phosphates	Hydrogen Fluoride/Acid
Ammonium Sulphate	Hydrogen Peroxide
Arsine	Hydrogen Sulphide
Barium Sulphate	Hydrogen
Benzene	Isopropanol
Benzoic Acid	Isopropylbenzene
Borax	Latex
Boric Acid	Lead Chromate
Butanols	Lead Oxides
Butylene	Magnesium Hydroxide
Butyraldehydes	Malathion
Calcium Carbide	MCPA
Calcium Carbonate	Mercury
Calcium Chloride	Methanol
Calcium Hypochlorite	Methyl Ethyl Ketone
Calcium Oxide/Hydroxide	Methyl Isobutyl Ketone
Calcium Phosphate	Methyl Methacrylate
Caprolactam	Methylamines
Carbaryl	Methylene Chloride
Carbofuran Pesticides	Morpholine
Carbon Dioxide	Naphta
Carbon Disulphide	Natural Gas
Carbon Tetrachloride	Nitric Acid
Chloradane	Nitrilotriacetic Acid
Chloride	Nitroglycerine
Chloroform	Nonyl Phenol
Copper Sulphate	n-Hexane
Cresols	PCBs
Cyclohexane	Pentachlorophenol
Dicamba	Pentaerythritol
Dichlorobenzene	Perchloroethylene
Dimethyl Ether	Phenol
Dimethyl Terephthalate	Phosphoric Acid
Dinoseb	Phosphorous
Diphenylmethene-4,4'-Diisocyanate	Phthalic Anhydride
Ethanolamine	Potash (Potassium Chloride)
Ethanol	Potassium Hydroxide

APPENDIX I-2 150 MOST FREQUENTLY SPILLED SUBSTANCES (CONT'D)

Potassium Sulphate	Sulphuryl Chloride
Propylene	Tall Oil
Propylene Glycols	Terephthalic Acid
Propylene Oxide	Terphenyls
Sodium Aluminate	Tetraethyl Lead
Sodium Arsenite	Titanium Dioxide
Sodium Borohydride	Toluene
Sodium Carbonate	Triallate Pesticides
Sodium Chlorate	Trichlorfon Pesticides
Sodium Chloride	Trifluralin Pesticides
Sodium Cyanide	Trinitrotoluene
Sodium Dichloroisocyanurate	Turpentine
Sodium Dichromate	Urea
Sodium Hydrosulphite (Dithionite)	Vinyl Acetate
Sodium Hydroxide	Vinyl Chloride
Sodium Hypochlorite	Xylenes
Sodium Phosphates	Yellow Cake
Sodium Silicates	Zinc Chloride
Sodium Sulphate	Zinc Oxide
Sodium Sulfite	Zinc Sulphate
Styrene (Monomer)	1,1,1-Trichloroethylene
Sulphur	1,3-Butadiene
Sulphur Dioxide	2,4-D (2,4-Dichlorophenoxyacetic Acid)
Sulphuric Acid (and Oleum)	2,4-Toluene Diisocyanate

APPENDIX I-3

**CHEMICALS WITH HIGH PROBABILITY OF RELEASE
BASED ON HISTORICAL SPILL DATA**

APPENDIX I-3 CHEMICALS WITH HIGH PROBABILITY OF RELEASE BASED ON HISTORICAL SPILL DATA

2.1 Gases ignitable at normal atmosphere when in a mixture of less than 13% (vol.) with air or have a flammability range of at least 12, e.g.:

Hydrogen Sulphide, Liquefied or Hydrogen Sulphide
 Methane, Refrigerated Liquid or Natural Gas, Refrigerated Liquid
 Propane
 Butane or Butanes mixtures
 Ethylene, Compressed or Ethylene
 Ethylene, Refrigerated liquid
 Hydrogen, Compressed or Hydrogen
 Hydrogen, Refrigerated Liquid or Hydrogen, Liquefied
 Propylene
 Vinyl Chloride, Inhibited
 Butylenes
 Ethylene Oxide
 Butadiene, Inhibited
 Acetylene, Dissolved or Acetylene
 Ethyl Chloride

2.3 Gases have a LC₅₀ of less than 5000 mL/m³ at normal atmosphere by reason of toxicity, e.g.:

Arsine
 Sulphur Dioxide, Liquefied or Sulphur Dioxide

2.4 Gases have a LC₅₀ of less than 5000 mL/m³ at normal atmosphere by reason of corrosion effects, e.g.:

Ammonia, Anhydrous, Liquefied
 Chlorine
 Hydrogen Chloride, Anhydrous
 Hydrogen Chloride, Refrigerated Liquid
 Hydrogen Fluoride, Anhydrous

3.1 Flammable liquids with a flash point of less than -18°C, e.g.:

Propylene Oxide
 Carbon Disulphide or Carbon Bisulphide

4.2 Solids liable to spontaneous combustion, e.g.:

Phosphorus White, Molten
 Phosphorus, White or Yellow, Dry or Under Water or In Solution

4.3 Substances that on contact with water emit flammable gases, e.g.:

Calcium Carbide

**APPENDIX I-3 CHEMICALS WITH HIGH PROBABILITY OF RELEASE BASED ON
HISTORICAL SPILL DATA (CONT'D)****5.1 Oxidizing substances, e.g.:**

Hydrogen Peroxide, Aqueous Solutions
Hydrogen Peroxide, Stabilized

6.1 Poisonous/Toxic Substances with

LD₅₀ (oral) < 5 mg/kg, or

LD₅₀ (dermal) < 40 mg/kg, or

LD₅₀ (inhalation) < 500 mg/kg

e.g, Sodium Cyanide

APPENDIX I-4

**SUMMARY OF TECHNICAL INFORMATION
FOR SELECTED CHEMICALS**

Name of Chemical	Physical State	Production	Uses	Transport	Hazards	Remarks
Ammonia	Colourless gas.	Produced at 12 plants (7 in Alberta, 3 in Ontario and 1 each in B.C. and Manitoba); total annual production 2.5×10^6 t (1982).	Used widely across Canada for fertilizer manufacture or directly as fertilizer and in the production of certain chemicals, e.g., nitric acid, nylon, ammonium compounds; also used in the mining, pulp & paper and refining industries.	Shipped in tank cars as anhydrous ammonia (liquidified gas) or solution by rail or trucks.	Toxic by inhalation (TLV: 25 ppm), rapidly disperse in air and water; harmful to aquatic life in very low concentrations.	High production volume (top 3), spilled frequently (top 10), widely used, universally transport and toxic.
Ammonium nitrate	White to light gray solid granules.	Produced at 11 plants in Alberta, Ontario, Quebec and Manitoba; total annual production 1.2×10^6 t (1982).	Used as fertilizer and explosives across Canada.	Shipped across Canada by trucks and by train (box cars).	High explosion potential.	High production volume (top 5), transport universally with explosion potential.

APPENDIX I-4 SUMMARY OF TECHNICAL INFORMATION FOR SELECTED CHEMICALS (CONT'D)

Name of Chemical	Physical State	Production	Uses	Transport	Hazards	Remarks
Chlorine	Greenish yellow gas	Produced at 13 plants across Canada (all provinces except Manitoba, PEI and New-foundland); total annual production 1.4 x 10 ⁶ t (1984).	Used widely across Canada mainly by pulp & paper, mining & smelting and water treatment industries as well as starting material for the manufacture of certain chemicals.	Shipped in tank cars as liquidified compressed gas by rail or trucks.	Highly toxic (based on its corrosive properties) to human via all routes (TLV: 1 ppm) as well as to all form of aquatic life (TL _m 96 less than 1 mg/L), plants and animals; highly reactive, reacted with water to form HCl gas which is also toxic (TLV: 5 ppm).	High production volume (Top 9), spilled frequently (Top 10), widely used, universally transported and highly toxic.
Ethylene	Colourless gas.	Produced at 5 plants in Ontario (Sarnia), Alberta (Joffre) and Quebec (Montreal); total annual production 1.01 x 10 ⁶ t (1982).	Used in the manufacture of polyethylene, ethylene oxide, ethylene dichloride and ethylbenzene located near the production sites.	Shipped primarily via pipeline directly to users; some product in Sarnia is shipped in tank trucks to the U.S.	Extremely flammable with explosion potential; harmful to sensitive plants at concentration in excess of 0.1 ppm.	High products volume (Top 5), spilled frequently (Top 50) and extremely flammable.

APPENDIX I-4 SUMMARY OF TECHNICAL INFORMATION FOR SELECTED CHEMICALS (CONT'D)

Name of Chemical	Physical State	Production	Uses	Transport	Hazards	Remarks
Hydrogen chloride	Colourless gas; aqueous phase is anhydrous hydrochloric acid (pale yellow liquid).	Produced at 13 plants across Canada (all provinces except PEI, Manitoba and Newfoundland); total annual production 135 kt (1982).	Used widely across Canada mainly in the electronic, petroleum, steel and metal working industries; also used for brine purification in mining, metallurgical, and pharmaceutical industries as well as raw material for manufacture of certain chemicals.	Shipped in tank cars as aqueous hydrochloric acid by rail or trucks.	Toxic by all routes (TLV: 25 ppm); highly corrosive to living tissues. Harmful to aquatic life in low concentration (due to its acidity).	Widely used, transport universally, spilled frequently (top 50) and highly corrosive.
Hydrogen fluoride	Colourless gas; aqueous phase is anhydrous hydrofluoric acid (water-white liquid).	Produced in Quebec and Ontario; total annual production 79 kt (1982).	Used mainly in Ontario and Quebec in the production of certain chemicals, i.e., aluminum fluoride, uranium hexfluoride, and motor gasoline alkylate; a small amount is transported to B.C. and Alberta.	Shipped as a liquidified gas in tank car primarily by rail.	Highly toxic by inhalation, ingestion and skin absorption (TLV: 3 ppm) Harmful to aquatic life in very low concentration.	Spilled frequently (Top 50) and highly toxic.

Name of Chemical	Physical State	Production	Uses	Transport	Hazards	Remarks
Hydrogen sulphide	Colourless gas with rotten egg odour.	Produced at 4 plants in Alberta, Ontario and Quebec; total annual production 11.9 kt (1980).	Used mainly in the manufacture of heavy water, elemental sulphur and certain chemicals e.g., soda ash, sodium hydrosulphide, mercaptans, nylon, ethylene, etc.	Shipped in railway tank cars and cylinders to areas across Canada.	Highly toxic by inhalation and contact (TLV: 10 ppm); toxic to aquatic life at very low concentrations; flammable.	Transport universally, spilled frequently (top 50) and highly toxic.
Natural gas	Colourless and odourless gas; consumer gas has an odourant added.	Produced over 3500 wells, most of them in Alberta (86%), the others are in B.C. (12%), Saskatchewan, Ontario and NWT; total Canadian production 480 x 10 ⁶ cm ³ /d (1983).	Used widely across Canada for heating and in the manufacture of petrochemicals.	Transported by pipeline across and throughout Canada.	Highly flammable with explosion potential.	High production volume, widely used, transported across Canada, Spilled frequently (top 5) and flammable with explosion potential.

Name of Chemical	Physical State	Production	Uses	Transport	Hazards	Remarks
Phosphorus	Colourless or white to pale yellow solid.	Produced at 2 plants in Newfoundland and Quebec; total annual production 55 kt (65% of the total production was exported).	Used mainly to produce phosphoric acid; a few percent was used to produce chemicals, such as red phosphorus, phosphine and sesquisulphide.	Shipped in liquid state under a water cover in railway tank cars or tank trucks in Quebec and Ontario.	Highly toxic by all routes (TLV: 0.1 mg/m ³); toxic to aquatic life in very low concentrations; ignites spontaneously to produce highly toxic gases.	Highly toxic with potential to ignite spontaneously and produce highly toxic gases.
Sulphur	Yellow powder granules, lumps or prills; in molten form is yellow to orange-red.	Produced across Canada (in all provinces except PEI); total annual production 6.67 x 10 ⁶ t (Alberta accounts for 90%).	Used widely across Canada mainly to produce sulphuric acid (3/4 of the total production) and by the pulp and paper industry.	Shipped in either solid or molten form all over Canada.	Combustible to produce toxic sulphur dioxide gas; reacts violently in contact with oxidizing agents; molten sulphur may evolve toxic hydrogen sulphide gas.	High production volume, used widely, transport universally and may react with others to produce toxic gas or with explosion potential.