

**Proposed Amendments for Environmental Emergency
Regulations Under Section 200 of the Canadian Environmental Protection Act
(CEPA) 1999**

Kimberly Hradecky, Robert Reiss, Kerry Ketcheson and John Shrives
Environmental Emergencies Division
Environmental Protection Operations Directorate
Environmental Stewardship Branch
Environment Canada
Gatineau, Québec
Kimberly.Hradecky@ec.gc.ca

Abstract

On November 18, 2003 the Environmental Emergency (E2) Regulations came into force (Government of Canada, 2003) under the authorities of section 200 of the *Canadian Environmental Protection Act (CEPA), 1999* (Government of Canada, 1999). These regulations require the development and implementation of environmental emergency plans for 174 substances with associated thresholds that, if released to the environment as a result of an environmental emergency, may harm human health or environmental quality. Companies in Canada storing these substances, with the conditions stipulated in section 200, will need to have their E2 plans implemented within one year of the regulations coming into force.

This presentation will review the proposed amendments to the regulations on Canadians. Presently, a total of thirty-four new substances are being recommended for addition to the regulations based on the analysis of the substances listed in the Toxic Substances List (http://www.ec.gc.ca/cepregistry/subs_list/Toxicupdate.cfm) (Environment Canada, 2002). Thresholds will be explained and their associated concentrations.

1 Introduction

CEPA, 1999 provides the Government of Canada instruments including regulations to protect the environment and human health. CEPA 1999 Part 3, Section 44, authorizes the Minister of the Environment to collect and publish data on environmental quality in Canada, conduct research and studies on pollution control and environmental contamination, and on the quality and state of the Canadian Environment. As a result of this authority under CEPA 1999, Environment Canada has compiled a list of substances that have been found to be contaminants within Canada's ecosystems, and have been known to cause harm to the environment and/or humans. In this manner, these substances are referred to as "toxic" under CEPA 1999 are recommended for addition to the List of Toxic Substances (Schedule 1) of the Act.

The preparation of environmental emergency plans can be required for substances that have been assessed to be "toxic" under CEPA 1999 and are on the List of Toxic Substances or are recommended for addition to that List. CEPA clearly outlines this authority, as is illustrated below from Part 8, Section 199.

199. (1) The Minister may at any time publish in the Canada Gazette, and in any other manner that the Minister considers appropriate, a notice

requiring any person or class of persons described in the notice to prepare and implement an environmental emergency plan respecting the prevention of, preparedness for, response to or recovery from an environmental emergency in respect of

(a) a substance or group of substances on the List of Toxic Substances in Schedule 1; (CEPA, 1999).

This list can be located on the web, under the title, "Toxic Substances List" (http://www.ec.gc.ca/ceparegistry/subs_list/Toxicupdate.cfm). This Toxic Substances List currently has some 79 substances as of November 30, 2005. For the entire listing of the substances that were studied see (Ketcheson and Shrives, 2004).

It is important to understand that the origin of these substances were the result of extensive examination of their respective concentrations in the environment, whether they were located in water, land or air. Once the quantity of substance was detected in a certain media, it was then a matter of determining if the concentration of that substance could theoretically cause a toxic effect to an organism. This determination was undertaken by comparing the measured in situ concentration to a known in vivo experiment. If the substance was found to cross a certain toxicity threshold then the substance was referred to as a "CEPA-toxic", and was subsequently added to Schedule 1.

The substances listed in Schedule 1 were assembled so as to highlight those substances that would require a mechanism to minimise, or virtually eliminate, their exposure to the environment. Typically the majority of the substances fall under the umbrella of E2 plans or pollution prevention (P2) plans. E2 plans cover those substances that could enter the environment via a catastrophic spill, whereas P2 plans address those substances that are released via emissions, effluents, or chronic releases.

This method of protecting Canadians is useful, but there are some situations where the devised system has not been effective. Phenol for example is a substance that was examined and was not recommended to be placed on Schedule 1. Phenol was not listed in Schedule 1 because the substance degrades in the environment and thus, it was not found in sufficient quantities to cause a harmful effect on the environment. However from an emergency perspective, there have been cases where a man had phenol spilled on his back, and he died 10 minutes later (HSDB, 2005). Fortunately, Section 200 of CEPA allows substances to be added to the E2 regulations if they are found to be hazardous and do not require to be labelled as a "CEPA-toxic".

On the other hand, road salts have been found to be toxic to the environment. If one were to spill road salts, there would be virtually no emergency pathway for this substance. One only requires shovelling the substance back into the container, with essentially no concern of toxic effects. Thus, no emergency plan would be required for road salts. But road salts was found to persist in the environment and are causing toxic effects to organisms and/or plants. Hence by this method of analysis, special provisions have been created for road salts by calling for a code of practice for the dispersing of this substance on the roads. Here P2 plans were applicable instead of E2 plans.

These set of amendments have addressed the question of which of the substances on Schedule 1 require environmental emergency plans. Although

Schedule 1 substances are continually being added, these set of amendments have brought to closure many of the substances that had been on Schedule 1 since the 1990's.

Because the current regulations did not take into account possible effects to the environment, this first set of amendments addressing only substances on Schedule 1, has included environmental thresholds. The current regulations will be re-assessed for their potential to cause damage to the environment at a later time.

Some of the substances are not found on Schedule 1 but they belong to classes of substances. For example, sulphur hexafluoride is within the class of substances called, "Inorganic Fluorides". The cadmium compounds are under the heading, "Inorganic Cadmium Compounds". Naphthalene can be located in the class called, "Polycyclic Aromatic Hydrocarbons". Nickels are found in, "Oxidic, Sulphidic and Soluble Inorganic Nickel Compounds", and chromium substances are in, "Hexavalent Chromium Compounds". Of the 65 substances originally listed on Schedule 1, there are actually 97 reports because the classes of substances can have many compounds included.

Three of the substances, namely styrene, acetic acid and ammonium nitrate, were never on Schedule 1 but industry requested them to be added to this set of amendments because they were chemicals of concern. This illustrates that industry is aware of the potential hazards of catastrophic spills of certain substances and is demonstrating a proactive approach to protecting their employees and the population at large.

Of the 65 substances and classes of substances listed, some were rejected because they were regulated under another Act of parliament. Others were not accepted for E2 plans due to the fact that they were by-products or contaminants and were not stored. A few did not require E2 plans because they were being phased out and were no longer allowed to be manufactured. Others, P2 plans were more applicable than E2 plans. The remaining substances a total of 34, with one being deferred due to lack of scientific data, were assigned threshold quantities and are being proposed for addition.

2 The Current List of Regulated Substances

The E2 regulations currently have 174 substances and their associated thresholds in the Canada Gazette II notice registered 20 August, 2003 (Government of Canada, 2003). These substances have been divided into two categories, Part 1 (flammable substances) and Part 2 (other hazardous substances). In order to know how their respective thresholds were calculated see (Ketcheson and Shrives, 2005).

3 The Proposed List of Substances

This list of substances was first mentioned in (Ketcheson and Shrives, 2004), since then there have been 97 reports written on these substances or classes of substances that are available on request, see e-mail in title. The list of proposed substances for addition to the E2 regulations are shown in Tables 1, 2 and 3.

Table 1 is for the flammable substances, and for substances that can behave as explosives under certain circumstances. Both of the substances below acquired their threshold quantity due to their reactivity. Styrene's threshold was set at 4.5 tonnes because of its potential to BLEVE (boiling liquid expanding vapour explosion), while

ammonium nitrate's threshold was set at 20 tonnes due to its capability to explode in the solid form.

Table 1 Proposed for Addition to Part 1 of Schedule 1

CAS Number	Name of Substance	Threshold Quantity (Tonnes)	Concentration (%)
100-42-5	Styrene	4.5	10
6484-52-2	Ammonium nitrate (in solid form only)	20	60
6484-52-2	Ammonium nitrate (in liquid form only)	20	81

Table 2 shows those substances that possess at least 10 mmHg vapour pressure and can cause a toxic inhalation plume. These thresholds were determined using the Risk Management Process from the United States Environmental Protection Agency (US EPA). The formula for the calculation can be found in Ketcheson and Shrives, (2005a).

Table 2 Proposed for Addition to Part 2 of Schedule 1

CAS Number	Name of Substance	Threshold Quantity (Tonnes)	Concentration (%)
64-19-7	Acetic acid ¹	6.8	95
75-09-2	Dichloromethane ²	9.1	1
2551-62-4	Sulphur hexafluoride ⁴	9.1	10

1 IDLH (Immediately Dangerous to Life and Health) = 50 ppm

2 IDLH = 2300 ppm

3 IDLH = 1000 ppm

4 Inhalation LCLo mammal unspecified 300 g/m³

Table 3 are a compilation of substances that may be a human and/or animal carcinogen, and/or are toxic to fish. Some of the substances may have more than one Chemical Abstract Service Number (CAS Number) due to hydrates. All of the substances below have less than 10 mmHg vapour pressure and, hence, cannot be associated with Part 2.

Table 3 Proposed for Addition to Part 3 of Schedule 1

CAS Number	Name of Substance	Threshold Quantity (Tonnes)	Concentration (%)
56-23-5	Carbon tetrachloride (Tetrachloromethane)	0.22	1
79-01-6	Trichloroethylene ³	1.13	1
91-20-3	Naphthalene (in liquid form only)	4.5	10
91-94-1	3,3'-dichlorobenzidine	1.13	1

CAS Number	Name of Substance	Threshold Quantity (Tonnes)	Concentration (%)
117-81-7	Bis(2-ethylhexyl) phthalate (DEHP)	0.22	1
127-18-4	Tetrachloroethylene (Perchloroethylene, Perc)	1.13	1
373-02-4	Nickel acetate	0.22	10
1303-28-2	Arsenic pentoxide	0.22	10
1306-19-0	Cadmium oxide	0.22	10
1306-23-6	Cadmium sulphide (Cadmium sulfide)	0.22	10
1313-99-1	Nickel oxide	0.22	10
1327-53-3	Arsenic trioxide (Arsenic(III) oxide)	0.22	10
3333-67-3	Nickel carbonate	0.22	10
7440-38-2	Arsenic	0.22	10
7718-54-9	Nickel chloride	0.22	10
7775-11-3	Sodium chromate	0.22	10
7778-39-4	Arsenic acid	0.22	10
7778-43-0; 10048-95-0	Sodium arsenate	0.22	10
7784-46-5	Sodium arsenite	0.22	10
7786-81-4; 10101-97-0	Nickel sulphate (Nickel sulfate)	0.22	10
7789-00-6	Potassium chromate	0.22	10
7738-94-5; 1333-82-0	Chromic acid (Chromium trioxide)	0.22	10
10108-64-2	Cadmium chloride	0.22	10
10124-36-4	Cadmium sulphate (Cadmium sulfate)	0.22	10
10588-01-9	Sodium dichromate	0.22	10
13138-45-9; 13478-00-7	Nickel nitrate	0.22	10
15699-18-0	Nickel ammonium sulphate (Nickel ammonium sulfate)	0.22	10
81741-28-8	Tributyl tetradecyl phosphonium chloride (TTPC)	0.22	10
25154-52-3; 104-40-5; 84852-15-3	Nonylphenol	1.13	10

4 Methodology for Determining Thresholds for Table 3

There were two different thresholds used to assist Environment Canada in determining the toxicity of substances to the environment. One was to examine the potential of the substance to enter into freshwater and its capacity to harm aquatic life in the event of an acutely toxic spill. The other method was to note those chemicals that can cause cancer and have the capacity to persist in the environment for at least 5 years. A more detailed discussion will follow.

4.1 Aquatic Thresholds

Acute toxicity is determined using primarily a fish 96 hour LC₅₀. Scoring for acute toxicity of aquatic species is based on the classification table from the Organization for Economic Cooperation and Development (OECD, 2001). In addition, a robust study evaluation will determine which value will be used for classification. The most sensitive value for a freshwater fish will be selected for the robust study. If the value fails the robust study, then the next most sensitive species will be selected. Only data on Canadian species are used.

Table 4 shows the fish toxicity criteria table with its corresponding scale. Values for 96 hour LC₅₀ fish toxicity data that are less than or equal to 100 mg/L may require an E2 plan. Any value over 100 mg/L is classified as practically non-toxic and was not included for environmental thresholds.

Table 4 Acute Toxicity 96 Hrs LC₅₀ Rating for Aquatic Species

Category	Aquatic Toxicity (mg/L)
Extremely Toxic	≤ 0.1
Highly Toxic	> 0.1 to ≤ 1
Moderately Toxic	>1 to ≤ 10
Slightly Toxic	>10 to ≤ 100
Practically Non-Toxic	>100

(OECD, 2001)

The assessment of the aquatic toxicity threshold will also include data from persistence and bioaccumulation, when available. The persistence and bioaccumulation criteria have been selected and can be seen in Table 5 below. CEPA has classified the virtual elimination criteria for the persistence of a substance in sediment to be greater than or equal to 1 year. Since the water persistence for CEPA virtual elimination is greater than or equal to 6 months, then the water criteria was selected over the sediment value.

When the persistence, bioaccumulation, fish toxicity, and thresholds are placed together, they result in table 5, as shown below. The first step in using the table is to locate where the value for the most sensitive fish is located within the Acute Aquatic Toxicity row. If there is no available information on persistence (P) or bioaccumulation (B), then the fish toxicity value is related to the threshold quantity, which is the bottom row. If P and B criteria exist, then the acute aquatic toxicity defaults to the lower column of the P or B values with the corresponding drop in threshold quantity. If the P and B criteria are higher than the fish toxicity, then the lower threshold quantity is maintained. For example, suppose the acute aquatic toxicity is 15 mg/L. This value corresponds to a threshold quantity of 9.1 tonnes. Other data on the same substance suggests that the P value is 8 months and the BCF

is 750. Thus, the acute aquatic toxicity defaults to 0.22 tonnes because the P value falls within the classification of an extreme hazard. The BCF criteria was only classified as a very high hazard, thus it is not the dominant criteria for the acute aquatic toxicity.

Due to this system, any substance that can remain in water for long periods of time will continue to contribute to the aquatic toxicity. Also, if a substance is bioaccumulative in water, then the substance may accumulate in the organism and may be transported along the higher trophic levels of the food chain. Due to the inherent hazardous potential of substances that are persistent and bioaccumulative, these parameters have been taken into account along with the acute aquatic toxicity information.

Table 5 Acute Aquatic Toxicity Thresholds

Criteria	Extremely Toxic	Highly Toxic	Moderately Toxic	Slightly Toxic
Persistence (water)	≥ 6 months	≥ 2 months to < 6 months	N/A	N/A
Bioaccumulation	BCF ≥ 5000 or Log Kow ≥ 5	BCF ≥ 500 to < 5000 or Log Kow ≥ 4 to < 5 (unless BCF < 500)	N/A	N/A
Acute Aquatic Toxicity (96 hrs LC ₅₀ – mg/L)	≤ 0.1	> 0.1 to ≤ 1	> 1 to ≤ 10	> 10 to ≤ 100
Threshold Quantity (Tonnes – lbs)	0.22 (500 lbs)	1.13 (2 500 lbs)	4.50 (10 000 lbs)	9.10 (20 000 lbs)

The thresholds quantities for the aquatic toxicity were taken from the Risk Management Planning (RMP) quantities used for the vapour cloud explosion potential partially shown in Table 6, (Environment Canada, 2002). The most hazardous of the aquatic toxicity was assigned a value of 0.22 tonnes. The largest fish toxicity parameter was given the highest threshold quantity of 9.10 tonnes. The rest of the values between 0.1 and 100 mg/L were evenly staggered between the threshold ranges.

Table 6 Threshold Values Index

Fish Toxicity (mg/L)	Threshold Quantities metric tonnes (lbs)
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≤ 0.1	0.22 (500)
--	0.45 (1 000)
> 0.1 to ≤ 1	1.13 (2 500)
--	2.27 (5 000)
> 1 to ≤ 10	4.50 (10 000)
--	6.80 (15 000)
> 10 to ≤ 100	9.10 (20 000)

Since ground water, drainages, tributaries and rivers can all lead to contamination of a water body it is proposed that these acute toxicity thresholds would apply even if a fixed facility did not have any visible water body within the boundaries of the company's location.

4.1.1 Inorganics and Metals

For metals, and inorganics the moiety of concern can be used to ascertain the aquatic toxicity threshold. However, this is an estimation of the toxicity to fish. If another value exists that passes a robust study analysis, this value would be more applicable since it is an actual experiment with the substance and not estimation.

The moiety of concern involves isolating the most relevant toxic portion of the compound to the environment or humans. For example, the substance CdO is an ionic substance which dissociates into water as: Cd^{2+} and O^{2-} . The most toxic atom in this case is the cadmium ion. This atom then would be referred to as the 'moiety of concern'.

From time to time in the literature, a fish toxicity parameter may mention that the endpoint is 0.004 mg (Cd)/L. This implies that only the Cadmium was measured in solution and not the entire substance to which the cadmium is a part of. However, the substance may have been, for example, CdO or cadmium oxide as the actual toxicant within the solution. In order to be useful for the aquatic toxicity assessment, the entire mass of the substance must be calculated and not simply the moiety of concern. An example of how to extrapolate a moiety of concern to the entire substance is shown below:

The moiety of concern is 0.0014 mg/L of Cd, but the substance is CdO.

$$\frac{Cd}{CdO} = \frac{112.41 \frac{g}{mol}}{128.4094 \frac{g}{mol}} = \frac{0.0014 \frac{mg}{L} (Cd)}{X \frac{mg}{L} (CdO)}$$

$$X = \frac{(128.4094)(0.0014)}{(112.41)} = 0.0016 \frac{mg}{L} CdO \quad (1)$$

This extrapolated value is the number that will be used to define the aquatic toxicity threshold. See Figure 1 for a schematic on the decision making process for determining aquatic toxicity thresholds.

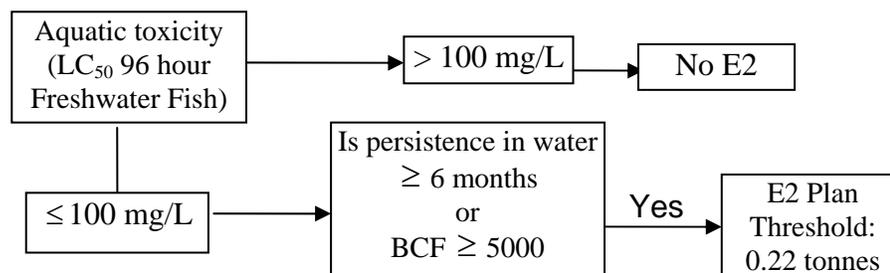


Figure 1 Flow-chart Showing Aquatic Toxicity Threshold Determinations

4.2 Carcinogenic Thresholds

Previously, it was concluded that 10 years was sufficient time for a carcinogenic substance to cause cancer in humans. Due to new evidence, the exposure time for a substance to cause cancer was lowered to 5 years in accordance with the precautionary principle. It has been shown that an infant is ten times more at risk than an adult.

According to the revised *Guidelines for Carcinogen Risk Assessment* published by the US EPA, a substance is classified based on various parameters. For example, a chemical could have a different effect on someone with a disease than a healthy person. There are numerous factors that must be considered such as mode of action, weight of evidence, dose-response assessment, susceptible populations and lifestyles.

“The risk attributable to early-life exposure often appears modest compared with the risk from lifetime exposure, but it can be about 10-fold higher than the risk from an exposure of similar duration occurring later in life” (US EPA, 2005a).

“The 10-fold adjustment represents an approximation of the weighted geometric mean tumor incidence ration from juvenile or adult exposures in the repeated dosing studies” (US EPA, 2005b).

A latent period of up to 20 years or longer is often associated with cancer development, for adults.

“Rarely are there studies that directly evaluate risks following early-life exposure. Standard animal bioassays generally begin dosing after the animals are several weeks old, when many organ systems are mature. This could lead to an understatement of risk, because an accepted concept in the science of carcinogenesis is that young animals are usually more susceptible to the carcinogenic activity of a chemical than are mature animals. Moreover, prenatal exposure to some agents, including vinyl chloride and saccharin can induce different tumors that are not seen in standard bioassays” (US EPA, 2005a).

In accordance with the precautionary principle, a substance will be classified as a carcinogen when it is classified by the US EPA or International Agency for Research on Cancer (IARC) as a potential or known human or animal carcinogen, and is persistent. A substance is classified as persistent, in this case, when it is indefinitely persistent or is persistent for greater than five years in any media. In these cases, the thresholds will be 0.22 tonnes for the protection of humans and the environment.

There are two sets of carcinogenicity ratings that are often listed; the International Agency for Research on Cancer (IARC, 1999), and the U.S. EPA (U.S. EPA, 2002). Both systems use a multi-level grading system to rate a chemical's carcinogenicity potential. In these schemes, a chemical is carcinogenic to humans, probably carcinogenic, carcinogenic in animals and potentially carcinogenic to humans, is unclassifiable, or is not carcinogenic. If the two systems disagree on a chemical's rating, the most conservative assessment will be used. Figure 2 shows a flow-chart depicting the decision making process for inhalation, as well as, carcinogenic thresholds.

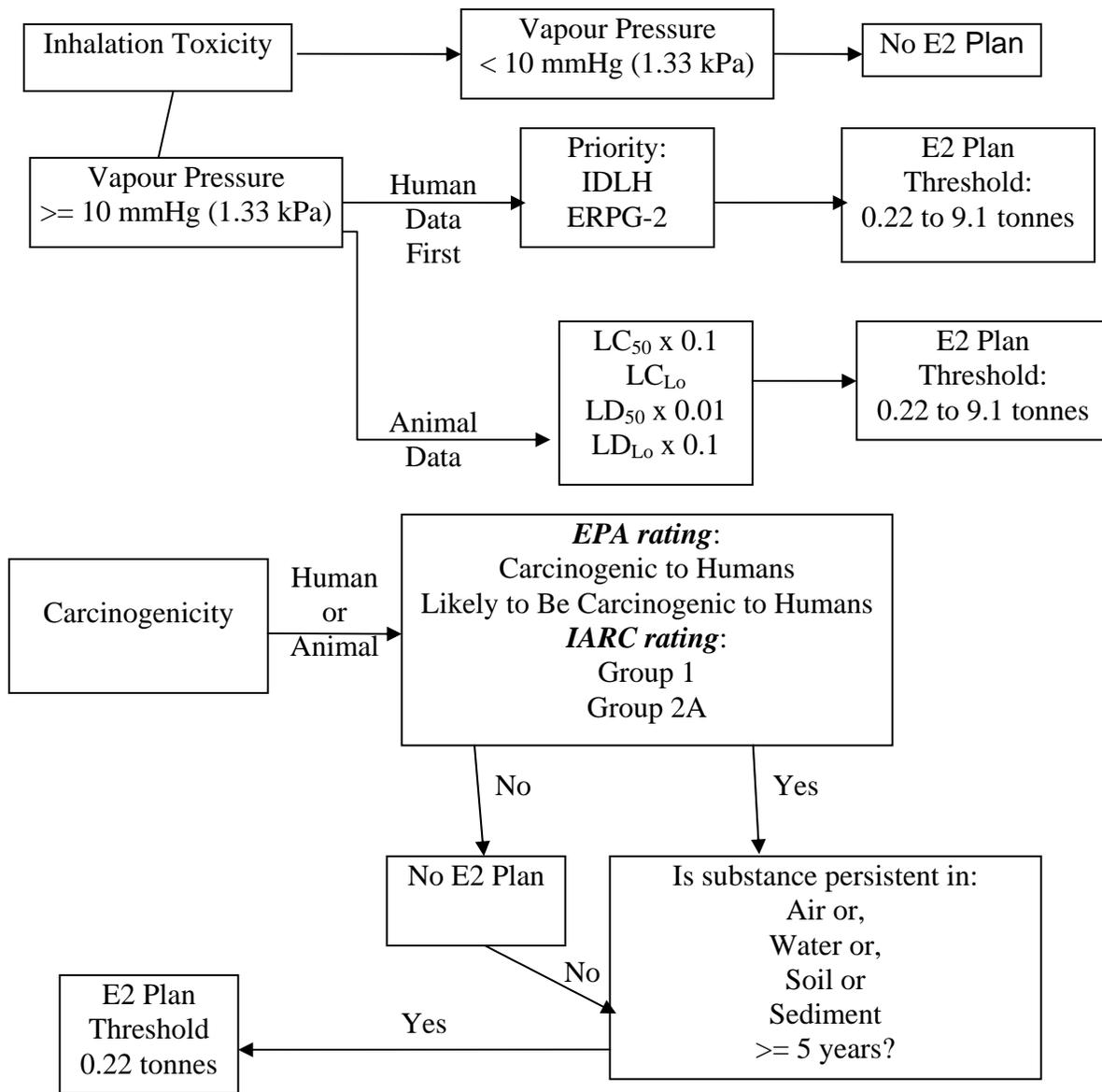


Figure 2 Flow-chart Showing Carcinogenic and Inhalation Threshold Determinations

5 Mixtures

The current regulations and the amendments show a threshold quantity that is given as 100% purity. Mixtures for substances listed in the regulations under Part 1 and 2 already have methods to determine what the threshold quantity would be for mixtures. However, for the substances in Part 3 it was decided to divide the threshold quantity by the percent purity. This process is familiar to industry since it is already used to determine the threshold quantity for toxics. For example, if the threshold

quantity for a certain substance in the regs is 1.13 tonnes, and the percentage purity is 36%, then the new threshold quantity would be:

$$\frac{1.13}{0.36} = 3.14 \text{ tonnes} .$$

This is the standard approach, but there is nothing preventing a company from using the aquatic toxicity guideline written by Environment Canada. This guideline has been written with Canadian and OECD guidelines in mind. Thus, the guideline has been harmonized between countries to give a standardized scientific approach to determining the LC₅₀ 96 hours for aquatic fish species. The guideline is called, “*Guidance Document on Statistical Methods for Environmental Toxicity Tests (EPS 1/RM/46-March 2005)*”, and another useful document is called, “*Guidance Document on Application and Interpretation of Single-species Tests in Environmental Toxicology (EPS 1/RM/34-1999)*”. In this manner instead of estimating the toxicity level, one could experimentally determine the LC₅₀ value with a credited laboratory for a mixture, and then subsequently determine the threshold quantity, instead of a calculation. The calculation method is an acceptable method to deduce the new threshold quantity.

6 Conclusion

Environment Canada has created environmental threshold quantities in order to fulfill the requirements of CEPA, which is to protect humans and the environment. Since the current set of regulations only took into account potential human impacts as a result of spills, then the amendments provide additional considerations for potential spills to the environment with these set of substances. Hence, at some point in the future, all of the current substances will be re-examined to determine their possible impacts to the environment in the event of a spill.

Establishing threshold quantities for aquatic life can be difficult especially when some chemicals can affect aquatic species with varying degrees of effects when conditions such as: pH, temperature, and hardness of water are constantly changing. This methodology provides a means of demonstrating that those substances capable of causing harm to fish, with bioaccumulation and persistence criteria included, will have lower threshold quantities assigned.

Some of the substances may have more than one threshold quantity assigned such as tetrachloroethylene. This substance had the following thresholds; 1.13 tonnes for aquatic, and 6.8 tonnes for air inhalation toxicity. The amendments will state the most stringent threshold quantity, which in this case is 1.13 tonnes. Due to the danger of the substance entering the water and the air environments, it is expected that the E2 plan would cover both such possibilities.

It is expected that the proposed regulations will be published in Canada Gazette I by the spring of 2006, and after a consultation period of 60 days, the substances will then be published Canada Gazette II for the fall of 2006. Consultations have already taken place with key stakeholders, and industry but the amendments have not formally been accepted or reviewed by the public at large. Thus, there may be unanticipated changes to the amendments in the near future after the consultation period has passed.

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