TECHNICAL GUIDELINES

FOR THE ENVIRONMENTAL EMERGENCY REGULATIONS, 2019

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Environnement et Changement climatique Canada

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GLOSSARY

Alternative scenario	Means an environmental emergency that could reasonably be expected to occur at the facility. Typically, alternative scenarios have a higher chance of occurring than the worst-case scenario.
CAS registry number	Means the identification number assigned to a substance by the Chemical Abstracts Service, a division of the American Chemical Society.
CEPA 1999	Means the *Canadian Environmental Protection Act, 1999*.
Container system	Means any receptacle or network of receptacles that is used to contain a substance—including any connected pipelines or piping—except any part of that network that is automatically or remotely segregated from the rest of the network by shut-off valves, or other mechanisms in the event of any environmental emergency.
E2	Environmental emergency.
ECCC	Environment and Climate Change Canada.
Environmental emergency	Section 193 of CEPA 1999 defines an environmental emergency as (a) an uncontrolled, unplanned or accidental release, or release in contravention of regulations or interim orders made under this Part [Part 8 of CEPA 1999], of a substance into the environment; or (b) the reasonable likelihood of such a release into the environment.
Facility	Means a property on which one or more fixed onshore installations are located and where a substance is present.
Full-scale simulation exercise	Means an action-based simulation exercise requiring the deployment of personnel, resources and equipment.
Maximum capacity	Means in respect of a container system, its full physical capacity, expressed in tonnes, including any capacity that is beyond the safe-fill limit set by the manufacturer

	of the receptacles that compromise the container system.
Mixture	Means a combination of two or more substances where the substances retain their individual substance properties so that no reaction between them occurs. For the purposes of the Regulations, a mixture can include one or more Schedule 1 substances.
PID	Piping and Instrumentation Diagram.
Regulatee	Facility that meets the requirements of the Regulations.
Regulations	*Environmental Emergency Regulations, 2019.*
Responsible person	Means any person who owns or has the charge, management or control of a substance that is located at a facility.
SDS	Safety Data Sheet.
Simulation exercise	Means an exercise simulating the response to an environmental emergency involving the release of a substance.
Worst–case scenario	Means a reasonable scenario that involves the total quantity of an E2 substance contained in the largest container system or of the total quantity on-site that is not contained.

1.0 PURPOSE OF THE TECHNICAL GUIDELINES

The Technical Guidelines for the Environmental Emergency Regulations, 2019 (the E2 Technical Guidelines 2019) are intended for the use of any person[1] who owns or has the charge, management or control of a substance listed in Schedule 1 of the *Environmental Emergency Regulations, 2019* (the Regulations).

The E2 Technical Guidelines 2019 are designed to help you, as a regulatee, better understand what the requirements of the Regulations are and how to comply with them. This document will provide clarification and guidance on important questions such as the following.

- Do the Regulations apply to me?
- How do I calculate on-site substance quantities and container capacity?
- What are the benefits of E2 planning?
- Do I need to prepare an E2 plan?
- How do I prepare an E2 plan? What should it include?
- How do I notify the Minister that I have the charge, management or control of an E2 substance?
- How does Environment and Climate Change Canada evaluate chemical substances for environmental emergency hazards?
- What happens if I fail to comply with the Regulations?

Other helpful information is provided in tables, figures and references, located mostly in the appendices below:

- Appendix 1 – Suggested references for environmental emergencies prevention, preparedness and response measures and the development of E2 plans
- Appendix 2 – Regional contact information for the Regulations
- Appendix 3 – Determination of container capacity and substance quantity
- Appendix 4 – Additional guidance on certain exclusions
- Appendix 5 – Checklist to prepare an E2 plan
- Appendix 6 – Suggested endpoints for the Regulations

IMPORTANT: The Technical Implementation Guidelines 2019 are intended to provide contextual information on the Regulations, 2019, as amended in 2011 and the *Canadian Environmental Protection Act, 1999* (CEPA 1999.). They do not replace CEPA 1999 or the Regulations, 2019. Regulatees should refer to CEPA 1999 at http://laws-lois.justice.gc.ca/eng/acts/C-15.31/ and the Regulations at canada.ca/environmental-emergency-regulations to ensure they are in compliance with the law. Some provisions

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1. The term "person" may refer to a company, an individual or a government body.

of CEPA 1999 and the Regulations have been quoted for convenience of reference only and have no official sanction. Should any inconsistencies be found between the Technical Guidelines 2019 and CEPA 1999 or the Regulations, CEPA 1999 and the Regulations will prevail.

2.0 ENVIRONMENTAL EMERGENCY AUTHORITIES UNDER PART 8 OF CEPA 1999

This section provides information on the authorities granted under CEPA 1999, and under the Regulations.

The goal of the Government of Canada is to achieve "the highest level of environmental quality for all Canadians," as stated in the Preamble to CEPA 1999, paragraph 2(1)(a.1), also requires the Government of Canada to "take preventive and remedial measures to protect, enhance and restore the environment."

Part 8 of CEPA 1999 on environmental emergencies (sections 193 to 205) provides various authorities to address the **prevention** of, **preparedness** for, **response** to and **recovery** from environmental emergencies caused by uncontrolled, unplanned or accidental releases, and to reduce any foreseeable likelihood of releases of toxic or other hazardous substances listed in Schedule 1 of the Regulations.

In investigating various measures to increase the safety and security of Canadians in the event of an environmental emergency, the Government of Canada has identified sections 199, 200 and 200.1 of Part 8 as important tools. These sections allow the Government of Canada to require the preparation of environmental emergency plans (E2 plans) for toxic or other hazardous substances. The primary objective for requiring environmental emergency planning is to have the appropriate risk management practices adopted and implemented to reduce the potential risks associated with the manufacture, storage and use of toxic and other hazardous substances in Canada.

Schedule 1 of the Regulations contains lists of substances (Part 1) and solutions (Part 2) that, should they enter the environment as a result of an environmental emergency, may be harmful to the environment, its biological diversity or human life or health. Minimum quantities and concentrations have been established for these substances at or above which the Minister may require notice of identification of the substance and place, as well as preparation and implementation of E2 plans under the Regulations.

There are strict penalties for failing to comply with the provisions of CEPA 1999 or its regulations. In sections 272 to 274, Part 10 (Enforcement) outlines various offences and penalties for contraventions of provisions of CEPA 1999 or its regulations, for knowingly or negligently providing false or misleading information, or for causing intentional or reckless damage to the environment or showing wanton or reckless disregard for the lives or safety of other persons and leading to the risk of death or harm to persons.

3.0 BENEFITS OF ENVIRONMENTAL EMERGENCY PLANNING

Environmental emergency planning is not just about compliance with the Regulations. For today's modern enterprise, effective planning for emergency events is an essential part of good business management.

When E2 planning is properly developed and implemented, benefits to the environment, human health and industry ensue. An industry-wide study[2] conducted by the Center for Chemical Process Safety (CCPS) of the American Institute of Chemical Engineers confirms that E2 planning provides measurable benefits by

- **saving lives and reducing human injury**;
- **reducing property damage costs**, preventing the sometimes extreme costs of a major industrial incident;
- **shortening business interruptions**, which can be four times as costly as the property damage mentioned above;
- **lessening loss of market share**, which continues after an incident until the company's production and reputation are restored;
- **lowering litigation costs**, which are unavoidable after an incident and can total five times the cost of the regulatory fines;
- **reducing incident investigation costs**, as well as corrective actions, which can cost millions of dollars; and
- **reducing regulatory penalties**.

E2 planning also provides non-measurable benefits by

- greatly **reducing the risk of catastrophic events**, resulting in less severe incidents, which
- **engages employees** at all levels by increasing morale, loyalty and retention;
- **reduces concerns within the local community**;
- **helps regulators understand your facility's credibility and unique considerations**;
- **improving your corporate image;** and
- **enhancing your lenders' confidence**, thus promoting capital expansion.

An important step in E2 planning is the analysis of all kinds of risks found during the handling, storage, production process use or disposal of any hazardous materials. When the proper measures to eliminate or mitigate these risks are implemented, other benefits follow:

- **Productivity increases while production and maintenance costs decrease**, due to the correction of unproductive processes and the adherence to effective and well-timed maintenance procedures.
- **Lower insurance premiums** may be obtained when meticulous emergency planning is implemented to prevent minor incidents and greatly reduce major incidents.

[2] CCPS Business Case Study: https://www.aiche.org/ccps/resources/publications/summaries/business-case-process-safety

4.0 THE REGULATIONS – AM I REGULATED?

This section is designed to help you determine whether the Regulations apply to a particular facility. Depending on the situation, the Regulations, may not apply to a specific facility, while in other cases, the facility may be subject to one or multiple requirements of the regulations.

The figure below is a quick reference diagram of the Regulations to help determine if and how a facility is subject to the Regulations and the steps that need to be followed when they apply. The following questions need answers before consulting and following the steps in Figure 1:

1. Is the substance (Part 1) or solution (Part 2) listed in Schedule 1 by a CAS number in column 1 and by name in column 2?
   a. If yes, then proceed to Step 2 in Figure 1.
   b. If no, then proceed to the next question below.
2. Is a mixture present that has not been identified by a CAS number?
   a. If yes, then the constituents of the mixture need to be assessed to explain the concentration and proportion of the substances it contains. Once the ingredients of the mixture are understood, proceed to Step 1 in Figure 1 to determine if it contains one or more substances that are subject to the Regulations.
   b. If no, then proceed to the next question.
3. Is the substance identified by a CAS number that is not in Schedule 1?
   - If yes, then consult the material safety data sheet (MSDS) or safety data sheet (SDS) for the substance to determine if it contains one or more substances listed by a CAS number in column 1 and a name in column 2 of Schedule 1.
     - If a substance from Schedule 1 is present and the concentration is known, note the concentration and proceed to Step 2 in Figure 1 to determine if and how the Regulations apply.
     - If a substance from Schedule 1 is present and the exact concentration is not known, use the upper range of concentration by weight that is listed for the substance as the regulated substance's concentration and as the proportion of the regulated substance within the substance. Once the regulated substance(s) is/are identified by CAS and name and the concentration is known, proceed to Step 2 in Figure 1 to determine if and how the Regulations apply.
     - If a substance from Schedule 1 is not present and all the previous questions have been answered negative, then the substance, mixture or solution is not subject to the Regulations.

*****NOTE***:** The flow chart covers the most commonly used schedules. Not all schedules are included in Figure 1. Other schedules may apply to a facility that is required to have an E2 plan. Please consult section 4.1.1 to see a full list of schedules.

Environmental Emergency Regulations, 2019 – Quick Reference

PLEASE NOTE: You must consult the text in section 4.0 to determine what step to start at in the process.

STEP 1: Is the substance listed in Parts 1 or 2 of Schedule 1 by CAS in column 1 and by name in column 2? If so, choose the relevant substance.
Section 2 of the Regulations

Yes → **STEP 2: Does the substance have a concentration (by weight) ≥ its threshold concentration (Schedule 1, column 3)?**

NO → Facility not Subject to the Regulations

Yes →

STEP 3: Do any of the following substance exclusions apply?

- A substance identified in column 5 of Part 1 of Schedule 1 as combustible (C) or likely to explode (E) <u>and</u>
    - is in a mixture that has a flashpoint >23°C <u>and</u> a boiling point >35°C, <u>or</u>*
    - is a component of natural gas in its gaseous form.
- A substance identified in column 5 of Schedule 1 as an inhalation hazard (I) and is in a mixture, in gaseous or liquid form, that has a total vapour pressure < 1.33 kPa.
- A substance used to fuel a heating appliance or generate power at the facility where it is located and is present in a quantity < the quantity in column 4 of Part 1 of Schedule 1 for that substance.
- A substance regulated under the *Transportation of Dangerous Goods Act, 1992,* or the *Canada Shipping Act, 2001*.*
- A substance in a pipeline regulated under the *National Energy Board Onshore Pipeline Regulations* or in a processing plant under the *National Energy Board Processing Plant Regulations.*
- A substance in a pipeline located entirely within a province on a property where there are no fixed onshore installations other than pipelines, compressor stations or pump stations.
- A substance that is in a fuel tank that is connected to and supplies an engine of conveyance used for transportation.
- Naphthalene in solid form.
- Nickel oxide in the form of solid particles > 10 µm.
- Phosphorus in a form other than white phosphorus.

*additional explanation of these exclusions can be found in Appendix 4

Subsection 2(2) of the Regulations

YES → Facility not Subject to the Regulations

NO →

STEP 4: Is the total quantity <u>OR</u> capacity of the largest container system for the substance ≥ the threshold quantity after the following quantity exclusions are considered? (Schedule 1, column 4)

All quantities located at a facility must be included, except the following:

- Substance stored at a facility for 72 hours or less unless it is loaded or unloaded at the facility;*
- Quantity in small containers (30 kg or less);
- Quantities found in slag, waste rock, tailings, solid residues, ores and ore concentrates;
- Propane in a container system with a maximum capacity of less than 10 t and the container system is located ≥ 360 m from all points along the boundary of the facility; and
- Anhydrous ammonia or ammonia solution used on-site as an agricultural nutrient in farming operations.

*additional explanation of this exclusion can be found in Appendix 4

Subsection 3(2) of the Regulations

NO → Facility not Subject to the Regulations; END, However,

YES →

STEP 5: Submit Notice Regarding Substances Located at a Facility (Schedule 2) within 90 days after the later of i) the day on which the Regulations come into force (Aug 24, 2019) or ii) the day the total quantity at the facility or the maximum capacity of the largest container is ≥ the threshold value.
Subsection 3(1) of the Regulations

STEP 6: Is some or all of the substance not in a container system and does the total quantity exceed the threshold amount?
OR
Are both the total quantity at the facility <u>AND</u> the maximum capacity of the largest container system for the substance ≥ the threshold amount?
Subsection 4(1) of the Regulations

NO → END, However,

END, However,

Be ready to face an emergency:

- Provide a verbal notification (see Chapter 6);
- Take all reasonable measures to prevent, repair, reduce or mitigate negative effects on humans and the environment;
- Make a reasonable effort to notify the public who may be affected; and
- Provide a written report under section 201 of CEPA 1999 (see Chapter 6).

YES →

STEP 7: Submit Notice Regarding the Preparation of an Environmental Emergency Plan (Schedule 3) within 6 months after the day on which an E2 Plan is required.
Section 5 of the Regulations

STEP 8: Submit Notice Regarding the Bringing into Effect of an Environmental Emergency Plan (Schedule 4) within 12 months after the day on which an E2 Plan is required.
Section 6 of the Regulations

STEP 9: Annual Exercise and E2 Plan Review: Update and test the plan at least once a year based on a simulation exercise that uses at least one substance from each of the hazard categories that are applicable at the facility. Every year, a different exercise must be simulated with respect to any substance within a hazard category until all the environmental emergencies that have been identified in the plan for the substance(s) have been exercised. Once all exercises have been simulated, they must be cycled through again. Keep records of annual exercises and E2 Plan revisions from the previous 7 years so they can be inspected upon request.

Paragraph 7(1)(a), Subsection 7(2), and Sections 8 and 10 of the Regulations

STEP 10: Conduct full-scale simulation exercise and Submit Notice Regarding Simulation Exercises Conducted in Relation to an Environmental Emergency Plan (Schedule 5) within 5 years after the day on which the E2 Plan is brought into effect.
Paragraph 7(1)(b) and Section 9 of the Regulations

Facility not Subject to the Regulations

4.1 The Regulations – reporting to ECCC

This section is designed to help you determine what, when and how to submit information to Environment and Climate Change Canada (ECCC). Depending on the situation, the Regulations may not apply to a specific facility, while in other cases the facility may be subject to one or multiple reporting requirements of the Regulations.

4.1.1 Reporting to ECCC

The Regulations require that the information be provided to ECCC through a notice submission. This information allows the Department to fulfil its mandate by keeping a record of potential risks to the environment and human health within Canada as identified in CEPA 1999.

Do you own several facilities?

You must submit separate notices and keep separate records for each facility.

4.1.2 What and when do I need to report to ECCC?

The following table provides a list of all schedules that may need to be provided to ECCC, the information they are meant to contain along with their required timelines.

Schedule	Notice	Time for Notifying
Schedule 2	Notice Regarding Substance Located at Facility	Within 90 days of meeting or exceeding the specific threshold, and every 5 years thereafter; and
		Within 60 days after the reported company information has changed or either of the maximum expected quantity or maximum capacity has increased by 10% or more
Schedule 3	Notice Regarding the Preparation of an Environmental Emergency Plan	Within 6 months of meeting or exceeding both the substance quantity and container capacity thresholds or only the quantity threshold for a substance that is not in a container system
Schedule 4	Notice Regarding the Bringing into Effect of an Environmental Emergency Plan	Within 12 months of meeting or exceeding both the substance quantity and container capacity thresholds or only the quantity threshold for a substance that is not in a container system
Schedule 5	Notice Regarding Simulation Exercises Conducted in Relation to an Environmental Emergency Plan	Within 5 years after the day on which the E2 plan is brought into effect, and every 5 years thereafter
Schedule 6	Notice Regarding a Change in Quantity or Capacity	Within 60 days after the end of a 12-month period during which the threshold is no longer met

Schedule 7	Notice of Cessation of Operation	Within 30 days before the day on which the operations are to cease, or as soon as feasible in the case of extraordinary circumstances
	or Transfer of Operation	On or before the date of transfer
Schedule 8	Information to Be Included in the Written Report of Environmental Emergency	As soon as possible in the case of 1. an environmental emergency involving the release of a hazardous substance that a. has or may have an immediate or long-term harmful effect on the environment, or b. constitutes or may constitute a danger to the environment on which human life depends, or c. constitutes or may constitute a danger in Canada to human life or health 2. The reasonable likelihood of an occurrence of an environmental emergency

4.1.3 How to report to ECCC

In order to help regulatees with reporting under the Regulations, ECCC has developed an E2 Regulations Reporting System which is accessed through ECCC's Single Window Information Management (SWIM) system.

The system represents a modern and convenient way to submit and update information related to regulated facilities, hazardous substance(s) and environmental emergency planning. It also sends email reminders to registered regulatees to inform them of deadlines for the submission of schedule. Furthermore, the system acts as a mechanism for regulatees to submit electronic written reports when an environmental emergency occurs with a substance that is subject to the Regulations.

For detailed step-by-step guidance on how to navigate ECCC's Single Window Information Management system and operate the Environmental Emergency Regulations Reporting System, please visit the following link: https://www.canada.ca/en/environment-climate-change/services/environmental-emergencies-program.html.

4.1.4 Notices and Reports description

E2 regulatees may be required to submit different types of notices and reports to ECCC. An explanation of each is provided below.

Schedule 2: Notice Regarding Substance Located at a Facility

Regulatees are required to identify the name and location of the facility, the range that reflects the maximum number of employees working at the facility, the person responsible for the E2 plan, contacts at the facility with knowledge of the plan, and details for each of the E2 regulated substances at the site, including their concentration, maximum expected quantity and, if applicable, the capacity of the largest container system in which the substance resides. Not all facilities that are required to provide a Schedule 2 for a particular substance need to prepare an E2 plan. They must, however, report releases of a regulated substance that meet or exceed the requirements set out in subsection 18(1) of the Regulations (See Schedule 8).

Schedule 2 will need to be edited and resubmitted if there are changes to the facility information or substance stored (i.e. substances added or 10% increase to quantity and or capacity of existing substances).

Please note that a Schedule 2 will need to be resubmitted every five years.

<u>Schedule 3</u>: Notice Regarding the Preparation of an Environmental Emergency Plan

Submission of Schedule 3 informs ECCC that the facility has finished developing an E2 plan for a particular substance. Details such as the plan's origin, local authorities and local community or interest groups that contributed to the plan, the date the plan was prepared, the predicted impact distances and, if applicable, a description of the area around the facility that may be impacted by an environmental emergency are included in the Schedule 3 submission.

<u>Schedule 4</u>: Notice Regarding the Bringing Into Effect of an Environmental Emergency Plan

Submission of Schedule 4 provides ECCC with the date on which an E2 plan is complete and ready to be used in the event of an environmental emergency at the facility.

<u>Schedule 5</u>: Notice Regarding Simulation Exercises Conducted in Relation to an Environmental Emergency Plan

Submission of Schedule 5 informs ECCC that the E2 plan has been through a full-scale exercise. At submission, confirmation is also required to indicate that the annual simulation exercises were conducted.

<u>Schedule 6</u>: Notice Regarding a Change in Quantity or Capacity

Submission of Schedule 6 informs ECCC that the facility has a quantity of the substance capacity of the container system under its specific thresholds for a period of one year or more.

Schedule 7: Notice of Cessation of Operations or Transfer of Ownership

Submission of Schedule 7 informs ECCC that either the facility will stop its operation for one year or more, for reasons other than maintenance, or the date on which ownership of the facility changed and the name of the new owner.

Schedule 8: Information to Be Included in the Written Report of Environmental Emergency

Submission of Schedule 8 informs ECCC that an environmental emergency involving a chemical that meets the definition of a substance in the Regulations has occurred. The release of a regulated substance must be reported if it meets at least one of the following criteria:

1. Has or may have an immediate or long-term harmful effect on the environment;
2. Constitutes or may constitute a danger to the environment on which human life depends; or
3. Constitutes or may constitute a danger in Canada to human life or health.

Protecting Confidential Information

In accordance with section 313 of CEPA 1999, any person submitting information to the Minister under CEPA 1999 is entitled to submit, with their information, a written request that the information be treated as confidential. Information for which a request for confidentiality has been made will not be disclosed by the Minister except in accordance with section 315, 316 or 317 of CEPA 1999.

5.0 ENVIRONMENTAL EMERGENCY PLANS

This section will explain the requirements of an E2 plan and help you determine if your facility has to prepare one under the Regulations.

*****NOTE***:** Even if your facility does not meet the criteria for creating an E2 plan, ECCC strongly recommends that you create an emergency plan voluntarily to protect people, the environment and property.

Who Should Prepare an E2 plan?

An E2 plan is required of any person who owns or has the charge, management or control of any of the regulated substances under certain conditions. To see if you are required to prepare, implement and carry out an E2 plan, refer to Chapter 4.

5.1 Approach to developing a plan

The purpose of emergency planning is to reduce and/or eliminate the risks of natural or human-induced disasters for human life and the environment.

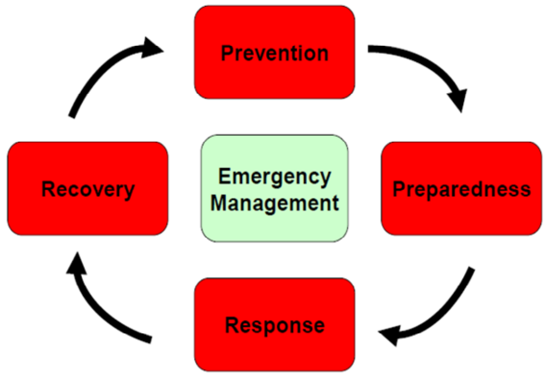
E2 plans should integrate all relevant aspects of risk management. Undesirable events such as the release of hazardous substances could occur as a result of process, procedure or equipment failures. E2 plans should account for these scenarios by providing proactive identification, assessment and mitigation measures.

A risk assessment conducted at a facility will

1. Identify multiple scenarios that could occur that would lead to the release of the substance from the facility;
2. Assess the probability of such scenarios occurring;
3. Predict the impact distances from the scenarios for each substance; and
4. Describe the consequences of each scenario on human health and the environment.

The impact distance in the Regulations reflects the radius of the impact zone inside which the consequences for human health and the environment are unacceptable (see Appendix 6 for a description of the endpoints we recommend be used to determine impact distances for the various hazard classes that have been assigned to the substances that are subject to the Regulations).

Prevention, preparedness, response and recovery are the **four main pillars** involved in E2 plan development. Below are some general concepts associated with each of these main pillars.



Prevention

Environmental emergencies can be averted or their severity limited by identifying in advance the cause of their probable frequency, potential consequences and impacts.

Preventing environmental emergencies begins with evaluating the risks associated with the regulated substance(s) stored at the facility. Studying past spill events at the regulatee's site and at similar sites in Canada allows for a more accurate prediction of the range of potential scenarios, including worst-case scenarios. This understanding is critical to assessing a facility's capabilities and resources for dealing with a crisis.

The consequences of an accidental release is addressed through both active and passive mitigation. **Active mitigation** requires power or human intervention whereas passive mitigation does not and active mitigation is intended to function on its own without any external assistance. The use of water curtains around process vessels to knock down harmful atmospheric releases is an example of active mitigation. In contrast, **passive mitigation** includes spill containment, such as dykes and catch basins, around tanks. The frequency of accidental releases can be controlled through standard operating procedures and management systems that consider process design and operation. Other examples of prevention include protection of propane tanks via concrete blocks, checking piping that is concealed under insulation for potential corrosion and knowing the shelf life of equipment and for battery replacement.

Success Stories – Industry Prevention

- The quantity of the substance on-site was reduced.
- Very large tanks were replaced by tanks of a smaller size.
- Less hazardous alternatives were substituted for highly hazardous substances.
- A less hazardous energy source was adopted (e.g. electric boiler replaces a gas boiler).
- More reliable technologies and automated substance feed into the processes were adopted.
- Substance concentration was reduced to below the E2 concentration threshold.

Prevention is essential for reducing the frequency and severity of environmental emergencies. Through preventive actions, problems can be anticipated, corrective actions taken and risks managed to avoid environmental damage. The most effective risk management practices combine prevention activities with appropriate preparedness and response. Analyses of insurance claims show that implementing an appropriate risk management program (RMP) in advance is far less expensive than dealing with the human health problems and environmental damage in the area surrounding a facility following an emergency.

Prevention refers not only to mitigation measures such as maintenance, preventing corrosion, installing the appropriate valve specification and spill containment; it also refers to the management systems used for process design and operation, training and facility operation.

To prevent process-related injuries and accidents, many process industries in Canada use chemical process safety management (PSM). PSM is the application of management principles and systems for the identification, understanding, avoidance and control of process hazards to prevent, mitigate, prepare for, respond to and recover from process-related incidents.

In Canada, the first edition of the CSA Z767-17 standard on PSM was published in 2017. The CSA Standard identifies the requirements of a PSM system for facilities and worksites handling or storing materials that are potentially hazardous, either due to an inherent chemical, biological, toxicological or physical property of those materials, or due to the material's potential or kinetic energy.

There are four foundational pillars for PSM outlined in the CSA Z767-17 Process Safety Management Standard:

a) process safety leadership;
b) understanding hazards and risks;
c) risk management; and
d) review and improvement.

Each of the pillars contains a number of elements. The 16 PSM elements under the CSA Z767-17 Standard are:

- Accountability
- Regulations, codes and standards
- Process safety culture
- Conduct of operations – senior management responsibility
- Process knowledge and documentation
- Project review and design procedures
- Process risk assessment and risk reduction
- Human factors
- Training and competency
- Management of Change (MOC)
- Process and equipment integrity
- Emergency management planning
- Investigation
- Audits process
- Enhancement of process safety knowledge
- Key performance indicators

The CSA Z767-17 Standard indicates that all PSM pillars and their respective requirements should be met when developing a PSM approach and that the Plan-Do-Check-Act continuous improvement model be followed as well.

The CAN/CSA-Z767-17 Process Safety Management Standard also recommends that when developing a PSM program, organizations should ensure that their policies, practices, and procedures strive to align with the principles of inherent safety, which can result in a reduction in the number, complexity and severity of hazards that need to be managed, without transferring the risk elsewhere. CAN/CSA-Z767-17 defines inherent safety as the concept that incorporates safety as part of the fundamental design of a process rather than through employing additional safeguards. The four main principles associated with inherent safety are the following:

a) minimization – can the amount of hazardous material or energy present within a process or facility be reduced?

b) substitution – can material be replaced with a different, less hazardous material?

c) moderation – can a hazardous material be used in a safer manner (e.g., at a lower pressure)?

d) simplification – can the systems be made less complicated to operate to reduce the likelihood of errors?

Preparedness

In preparing an E2 plan, it is important to involve key people, particularly first responders and representatives of potentially affected stakeholder groups in and around a regulatee's facility. Such consultation enhances the level and effectiveness of preparedness.

When preparing the E2 plan, you should resolve identified gaps, consider options such as upgrading equipment, expanding staff, and increasing communication with and among neighbouring facilities, community officials, public safety agencies, etc. The communication of risk to surrounding communities is an important component of both prevention and preparedness activities.

Success Stories – Industry Preparedness

- Warning sirens were installed at the plant.
- Procedures were established to stop emergency ventilation in the event of a major leak (to reduce the distance of impact).
- Response and training teams were created.
- Updated facility equipment was installed, and safer and more reliable technologies (e.g. magnetic sealless pump) were adopted.

Ensuring public safety during and following an environmental emergency is an important component of preparedness. In preparing an E2 plan, therefore, it is critical that you communicate the plan to members of the public so that they know what to do in an environmental emergency. Communication of this nature can help dispel undue community fears over imagined risks that are not present, and reassure people that any real risks that are present are under proper control.

A regulatee must identify and include reference in their plan to adequate training and resources to enable responders to respond to potential emergencies. Preparedness planning should reveal, depending on the significance and possible escalating nature of particular events, a facility's capabilities and resources to effectively respond to an event adequately.

Resources and equipment could be obtained through arrangements or mutual aid agreements with other industries and outside agencies. Under mutual aid agreements, organizations that lack the resources to respond effectively to emergencies on their own can collaborate with other companies to the mutual benefit of all parties. Various types of mutual aid agreements exist. They can involve companies in the same vicinity or, where the distance between an accident location and the party responsible for responding is considerable, in the same local region. These agreements can be effective in improving response, reducing costs and administrative burdens, and avoiding overlap and duplication. Please be advised that simulation exercises conducted at a different facility under a mutual aid agreement will not comply with the Regulations. See Section 5.3 for more information.

Preparedness measures should identify all activities essential to ensuring a high degree of readiness for a prompt and effective response to an environmental emergency. Testing the preparedness of a facility's resources and equipment to manage and reduce the severity of such events can be achieved through exercises and focused training for key personnel who are tasked with responding to environmental emergencies at a facility. Equipment needed during an emergency should be readily available and regularly maintained and tested. An inventory of equipment currently available on and off site, along with the quantity and location, must be included in the plan and made accessible to responders.

An E2 plan must be tested and updated annually so that changes within the facility are integrated into the plan. By implementing effective prevention measures (such as risk management programs that address all probable emergency situations), persons preparing and implementing an E2 plan can determine the necessary level of preparedness for each situation. Updating an E2 plan annually involves more than checking telephone numbers: it considers any changes in the process or substances, any new level of toxicity hazard, any new development in the software used, etc. The public should be informed about these updates when they are relevant to the protective actions they should take in the event of an emergency.

Response

Response to an environmental emergency is intended to include all aspects of managing the emergency situation until the emergency phase of the event is considered over. These needs can vary greatly in scope, depending on the nature and magnitude of the emergency.

Effective emergency response includes, but is not limited to, the following:

- quick activation of the emergency plan;
- adequate resource mobilization;
- rapid assessment of the probable path and impacts of the emergency;
- proper notification of the emergency to first responders and affected parties, including alerting and warning the public;
- maintenance of communication systems between stakeholders;
- evacuating, confining and accounting for personnel and members of the public present at a facility’s site, if needed; and
- adequate reporting.

Quick and effective response relies on sound planning and pre-established partnerships. Effective emergency response calls for co-operation between industries, communities, local organizations and government through partnerships formed before emergencies occur. Such partnerships can be strengthened through the regular testing of the E2 plan with all of those involved. Communication from the facility to off-site agencies, to the public and among responders is important and necessary for a coordinated and successful response effort.

Recovery

Recovery of an environmental emergency is more than just the recovery of the spilled product. Recovery refers to the restoration of any part of the environment damaged by or during the emergency. Recovery affects both the operating entity itself and the surrounding community. The issue of recovery is best managed through discussions among all involved parties to assess the damage and agree on a restoration plan. The level of environmental restoration is determined by many factors, such as the size, persistence and toxicity, or hazardous nature of a release. Recovery of an area to its natural state is not always possible. Thus, restoration plans are situation-specific and would need to be defined in terms of acceptability to affected stakeholders.

The regulatee, in consultation with public authorities, should initiate recovery processes as soon as possible, striving for a rapid recovery from environmental damage. Those leading the recovery effort must be aware that rapid response without assessing the risks associated with the recovery effort can lead to increased damage and longer recovery times for the environment. The recovery process can either begin during response or can be initiated in stages until normal operations are restored. Planning for the recovery phase during preparedness phase will improve recovery time and reduce impacts on the environment.

5.2 Environmental Emergency Plan contents

The Regulations set out the required elements that regulatees need to include in an E2 plan, but the Regulations do not prescribe the methodology to be used.

Subsection 4(2) of the Regulations requires an E2 plan prepared under the Regulations to include the following elements:

(a) a description of the properties and characteristics of the substance and the maximum expected quantity of the substance at the facility;

A good source for this information would be a safety data sheet (SDS) from the supplier. Examples of properties and characteristics are as follows:

- Properties – pH, vapour pressure, boiling point, density, solubility and other physical/chemical properties.
- Characteristics – toxicity data, reactivity, incompatibilities, flammability and state (liquefied gas under pressure).

The maximum expected quantity should match up with the quantity submitted in the Schedule 2 notice that was submitted for the facility.

(b) a description of the commercial, manufacturing, processing or other activity involving the substance that takes place at the facility;

This requires describing what the substance is used for on-site (stored, produced, reacted, used as a refrigerant, etc.). If the substance is used within a larger system, the facility may wish to also represent that system in a figure (see figure 2 below). This diagram as well as a description of the activity in which the substance is involved will better describe the use of the substance on-site.

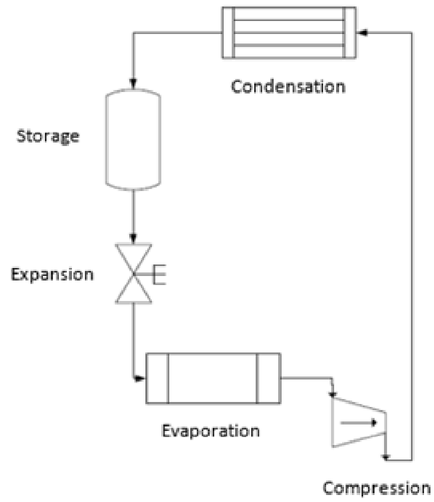


Figure 2. Mechanical Refrigeration Cycle

Example: XYZ Cold Storage is a cold storage facility that operates mechanical compression refrigeration systems. Anhydrous ammonia is used as the refrigerant and is handled in a closed loop.

(c) a description of the facility and of the area surrounding the facility that may be affected by an environmental emergency referred to in paragraph (d), including any hospitals, schools, residential, commercial or industrial buildings and any highways, public transit infrastructure, parks, forests, wildlife habitats, water sources or water bodies;

Both the facility and the surrounding area that could be impacted by an environmental emergency need to be described. Some recommendations for both are provided below:

Facility description

The facility may provide

- Maps / schematics / diagrams / piping and instrumentation diagrams (P & IDs)
- The location of substance(s) and other potential hazards (i.e. contributing factors)
- Descriptions of containers, reactors, process, piping, etc.

Providing a facility map detailing the layout of the facility may also fulfil the requirements of 4(2)(o).

Area surrounding facility description

Sensitive receptors in the surrounding area that need to be identified and reported are not limited to the list provided in paragraph 4(2)(c) of the Regulations. The examples provided should be included if present; however, other sensitive receptors such as child care, senior citizen and long-term care facilities; public camping facilities; water bodies; wetlands; etc. should also be described if relevant.

The facility may provide maps or a table with distances to the different receptors similar to the following example.

Receptors	Potential Impact	Distance (m)	Contact Information
Residential Area	Public Safety	400	12 Maple Lane Ottawa, Ontario 123-456-7890 Contact: Mr. Rideau
Commercial Area	Public Safety	300	345 Commercial Road Ottawa, Ontario 456-789-0123 Contact: Ms. Boulanger
Industrial Area	Public Safety	700	6 Industrial Avenue Ottawa, Ontario 789-012-3456 Contact: Mr. Parker
New District School	Public Safety	800	789 Learning Road Ottawa, Ontario 147-258-0369 Contact: Ms. Granger
123 Highway	Transportation and Infrastructure	200	N/A
Clear River	Environmental	300	N/A
City Park	Environmental	500	N/A

(d) an identification of any environmental emergency that could reasonably be expected to occur at the facility and that would likely cause harm to the environment or constitute a danger to human life or health, including the environmental emergency referred to in paragraph (e) and, if applicable, the environmental emergency that is more likely to occur than the environmental emergency referred to in paragraph (e) and that would have the longest impact distance outside the boundary of the facility;

The facility should identify any environmental emergencies that could **reasonably** be expected to occur at the facility. A “reasonable” scenario is a scenario that may realistically happen on-site. Typically, alternative scenarios have a higher chance of occurring than the worst-case scenario, which has a lower probability of occurrence with higher consequences. The alternative scenario chosen for an exercise would have the longest impact distance outside the boundary of the facility. Appendix 6 include some suggested the endpoints that can be used to determine impact distance.

Use of a risk analysis approach is recommended to help reduce the probability that an environmental emergency involving an E2 substance will occur. This approach will help reduce or minimize the consequences arising from an environmental emergency, highlight existing preventive or protection barriers and identify whether additional safety barrier or risk control measures should be added to manage any residual risks.

The steps involved in risk analysis (adapted from CRAIM, 2017) include

- Hazard identification
    - Identify the hazards that are inherent to the E2 substance (i.e. SDS);
    - Identify the hazards associated with the process;
    - Identify accident scenarios – worst case, alternate worst case (more likely than worst case but long impact distance) and reasonable less severe scenarios.
- Identify and estimate the possible consequences of the accident scenarios associated with those hazards (i.e. impact distance modelling where possible). It is recommended domino effects also be considered as part of the analysis.
- Estimate the probability (or likelihood) of identified accident scenarios.
- Estimate the risk (i.e. risk matrix).

(e) an identification of the harm to the environment or danger to human life or health that would likely result from an environmental emergency involving the release of

(i) the maximum quantity of the substance that could be contained in the container system that has the largest maximum capacity, if a quantity of the substance is in a container system, and

(ii) the maximum expected quantity of the substance that will not be in a container system, if a quantity of the substance is not in a container system;

The facility should identify the harm from a reasonable scenario that may involve the total quantity of an E2 substance contained in the largest container system or of the total quantity on-site that is not contained. In the context of the Regulations, this scenario is referred to as the “worst-case scenario”.

An example of a quantity not contained could be an explosion involving the total quantity of ammonium nitrate that is stored in a pile on the ground.

(f) an identification of the harm to the environment or danger to human life or health that would likely result from the environmental emergency identified under paragraph (d), if any, that is more likely to occur than the environmental emergency referred to in paragraph (e) and would have the longest impact distance outside the

boundary of the facility;

The facility should identify the harm from alternative scenarios that would have an impact outside the limits of the facility site boundary, including the one that would have the longest impact distance outside the site boundary. Alternative scenarios usually involve the release of lesser quantities of the regulated substance(s) and/or the release of the total quantity with longer release time than in the worst-case scenario. These scenarios should take into account domino effects.

Examples of possible alternative release scenarios include, but are not limited to, the following:

- Pump – due to cracks
- Corrosion of means of the containment system
- Weld failure
- Process piping – leaking valve, flange, seal, joint
- Transfer hose
- Release of inhalation toxic of short duration

Please refer to Appendix 6 – Suggested Endpoints. It provides examples of endpoints that can be used to measure harm.

(g) a description of the measures to be taken to prevent and prepare for the environmental emergencies identified under paragraph (d) and the measures that will be taken to respond to and recover from such emergencies if they were to occur;

The facility should describe the preventive measures that will be implemented for every scenario identified in the E2 plan and how planning will enhance preparedness for, response to and recovery from the scenarios that have been identified.

(h) a list of the position titles of the persons who will make decisions and take a leadership role in the event of an environmental emergency and a description of their roles and responsibilities;

The list should include the position titles, roles and responsibilities of the person(s) that will be involved in carrying out the E2 plan in the event of an environmental emergency on-site. ECCC recommends that you identify alternates for those who would carry out the E2 plan in case of absence/shift change, etc.

(i) a list of the environmental emergency training that has been or will be provided to prepare personnel at the facility who will respond in the event that an environmental emergency identified under paragraph (d) occurs;

The facility is responsible for ensuring the readiness and expertise of their personnel required to activate the E2 plan. An example of a training list is provided below.

POSITION	TRAINING	DATE	RENEWAL
Emergency Response Coordinator (ERC)	E2 Emergency Plan – Awareness Workshop	YYYY-MM-DD	Upon Hire (N/A)
	E2 Emergency Plan – Tabletop Exercise	YYYY-MM-DD	X Year(s)
	E2 Emergency Plan – Full Simulation	YYYY-MM-DD	X Year(s)
	ICS (100, 200, 300, 400)	YYYY-MM-DD	X Year(s)
Communications Officer (CO)	Media Relations Training	YYYY-MM-DD	X Year(s)
	Public Relations Training	YYYY-MM-DD	X Year(s)
Safety Officer (SO)	Occupational Health and Safety Training	YYYY-MM-DD	X Year(s)
	Public Safety Training	YYYY-MM-DD	X Year(s)
Response Officer (RO)	NFPA 600 Industrial Fire Brigade Standards Training Courses	YYYY-MM-DD	X Year(s)
	H2S Alive	YYYY-MM-DD	X Year(s)
	First Aid	YYYY-MM-DD	X Year(s)
	Fire Awareness Training	YYYY-MM-DD	X Year(s)
	Hazardous Material Training	YYYY-MM-DD	X Year(s)
	Flammable Liquids Training	YYYY-MM-DD	X Year(s)
	Transportation of Dangerous Goods	YYYY-MM-DD	X Year(s)
	WHMIS	YYYY-MM-DD	X Year(s)
	ERP Live Exercises	YYYY-MM-DD	X Year(s)
	Annual Fit Testing	YYYY-MM-DD	X Year(s)
	Product Transfer	YYYY-MM-DD	X Year(s)
	Grounding & Bonding	YYYY-MM-DD	X Year(s)
	Gas Detection	YYYY-MM-DD	X Year(s)

(j) a list of the emergency response equipment that is necessary for the measures described in paragraph (g) and the equipment's location;

The equipment must be readily accessible and specifically for use in response to the environmental emergency scenarios that have been developed for the substances at the facility. The equipment must also be ready to use and properly maintained.

Key considerations

Ensure that detectors are placed appropriately. Do not place detectors that are designed to monitor a potential leak of a dense inhalation vapour high up on the wall. Do not place detectors near ventilation shafts, where in the event of an inhalation leak, most of the vapours will be drawn out of the building before the detector is able to sound alarm of a potential leak. When installing a detector within an enclosure of hazardous substances, ensure that a person will know if there is a leak within the enclosure before the door to the enclosure is opened.

(k) a description of the measures that will be taken by a responsible person or by a responsible person and local authorities, acting jointly, to communicate with the members of the public who may be adversely affected by the environmental emergency referred to in paragraph (f) to inform them, before the environmental emergency occurs, of

(i) the possibility that the environmental emergency could occur,

(ii) the potential effects of the environmental emergency on the environment and on human life or health, taking into account the factors referred to in paragraphs (a) to (c), and

(iii) the measures that will be taken by the responsible person to protect the environment and human life or health, and the means by which the responsible person will communicate with them, in the event that the environmental emergency occurs;

Please refer to Notification Section 5.4 for further information.

(l) a description of the measures that will be taken by a responsible person or by a responsible person and local authorities, acting jointly, to, in the event that an environmental emergency involving the release of a substance occurs, communicate with the members of the public who may be adversely affected to provide them, during and after its occurrence, with information and guidance concerning the actions that could be taken by them to reduce the potential harm to the environment and danger to human life or health, including an explanation of how those actions may help to reduce the harm or danger;

Please refer to Public Notification Section 5.4 for further information.

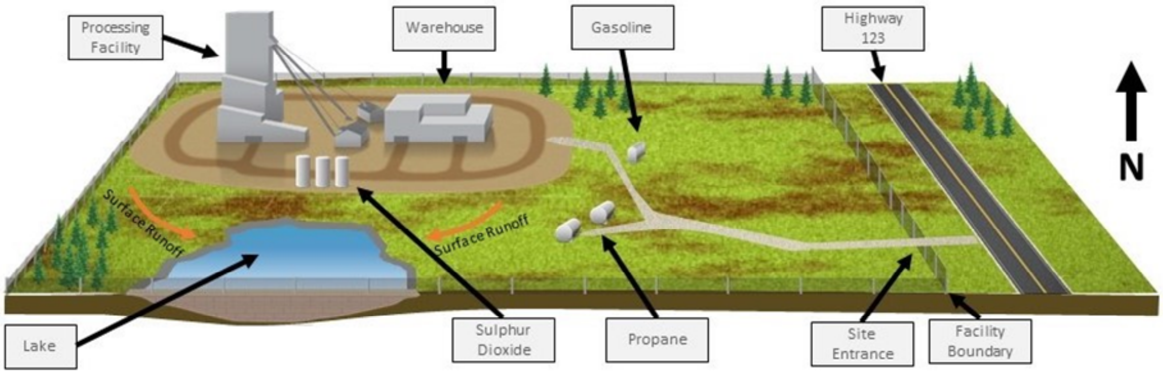
(m) the position title of the person who will communicate with the members of the public referred to in paragraphs (k) and (l);

Please refer to Public Notification Section 5.4 for further information.

(n) a description of the consultations that a responsible person had with local authorities, if any, with respect to the measures referred to in paragraphs (k) and (l); and

Please refer to Public Notification Section 5.4 for further information.

(o) a plan of the facility showing the location of any substances in relation to the physical features of the facility.



A **list of references** is provided in Appendix 1 and may be used when preparing an E2 plan. The references cover prevention, preparedness, response and recovery. A **checklist** is provided in Appendix 5 with details for preparing an E2 plan.

> **Contractor Services**
>
> If the facility is hiring a contractor to provide emergency response services, the facility is still responsible for the quality of the training, equipment and response capabilities of the contractor.
>
> The responsible person is ultimately liable for compliance with the Regulations.

5.3 Exercising an Environmental Emergency Plan

Environmental emergency exercises involve a simulation relating to an emergency that can reasonably be expected to occur with substance(s) at the facility that are subject to the Regulations. The simulations are meant to explore, learn from and prepare for scenarios described within the E2 plan that potentially have harmful effects on the environment or human life or health. Exercising the E2 plan provides those who are responsible for the plan with valuable information regarding the facility's readiness to respond to one or multiple elements of their plan. Any lessons learned via the exercise can be used to update and improve the plan.

The Regulations require that E2 plans be exercised on an annual basis. A full-scale exercise must also be conducted every five years. Based on these exercises, the E2 plans must be reviewed and updated, as required. The responsible person is required to keep a record of the results of these annual and full-scale simulation exercises, including the date and summary of the exercise, the results of the exercise and any modifications made to the plan as a result. ECCC recommends an Appendix be placed within the E2 plan to record this information so it can be presented for inspection upon request.

A responsible person must review and update the E2 plan as needed. A record of the review and the date it was reviewed should be maintained for at least seven years beginning on the day the record is made. The plan must be readily available in the event of any type of emergency.

ECCC recommends that an appropriate exercise design process be composed of the following four main steps:

1. planning the annual exercise;
2. conducting the exercise;
3. evaluating and reporting on the outcomes; and
4. correcting and updating the E2 plan with lessons learned.

The main objective is to ensure that all aspects of the plan are fully evaluated over the five-year testing cycle. Further information on exercising of E2 plans can be found in some of the suggested references in Appendix 1.

Typically, facilities subject to the E2 planning requirements of the Regulations that participate in mutual aid exercises at other facilities cannot count their participation as an exercise of the E2 plan for their facility. Although lessons can be learned from participation, an exercise of the E2 plan for the participating facility is still required.

In addition, a full-scale simulation exercise involving one of the E2 regulated substances at the facility is required every five years. The full-scale exercise requires the deployment of personnel, resources and equipment based on the procedures described in the plan. ECCC encourages participation of the local first response community where possible and recommends that regulatees keep records of attempts to involve them.

5.3.1 Annual simulation exercise

The E2 plan must be exercised at least once per year beginning on the day on which the plan is brought into effect, using one E2 substance identified in the plan from each of the hazard categories at the facility. For example, if you have three hazard categories in the E2 plan, you must select and exercise one substance within each of the three hazard categories annually. Hazard categories are listed in column 5 of Schedule 1 for each substance of the Regulations and include the following:

- aquatically toxic (A)
- combustible (C)

- explosion hazard (E)
- pool fire hazard (F)
- inhalation hazard (I)
- oxidizer that may explode (O)

Although Schedule 1 contains only predominant hazard category for each substance, it is important to note that each substance has the potential to be associated with other hazards. This fact is important to consider when completing the risk analysis and developing the emergency plan. For example, one might consider that the corrosive effects of hydrochloric acid for a particular facility may pose a significant environmental or human health, in addition to its inhalation effects risk.

It is recommended that key response stakeholders identified in the plan be involved in discussions during the planning stage of the E2 plan exercise, when applicable. This involvement will reinforce their role in the plan and enable the responders and other participants to react in the proper manner through adequate pre-planning. However, once the skills and knowledge have been acquired, the scenario can be developed without participants' prior knowledge, to simulate a more realistic situation. Records of the exercises are not required to be submitted to ECCC, but must be stored on-site for seven years and will be verified through inspection.

The type of exercise chosen depends on its purpose, the time of year, the availability of resources and the limitations of conducting exercises that apply to the location of operations. Examples of annual exercises include the following:

- **Drills** are supervised activities that provide the opportunity for emergency response team members to validate a specific operation or function, usually focused on one or two key skills (shutdown procedures, valve operation, etc.). Drills can also be used to determine whether plans can be executed as designed, to assess whether more training is required or to reinforce best practices. For example, if a drill is testing the closing of emergency doors, ensure that vapour cannot pass under the door by sliding paper underneath it.

- **Tabletop** exercises are table-based activities typically held in an informal setting and presented by the facilitator. This type of exercise is intended to generate discussion of various issues regarding a hypothetical, simulated emergency. Tabletop exercises can be used to enhance general awareness of sensitive areas, validate plans and procedures, rehearse concepts and/or assess the types of systems needed to guide the prevention of, preparedness for, response to and recovery from a defined incident.

- **Functional** exercises fall between a tabletop exercise and a full-scale exercise. They are more than a tabletop, where participants only discuss what they might do, but less than a full-scale exercise, where resources are actually deployed as necessary. In a functional exercise, the Command Post Team "takes action"—makes decisions, simulates the deployment of resources and responds to new developments. A functional exercise provides a more realistic simulation of an emergency compared to a tabletop and is typically conducted in real time in a classroom setting or a designated site for a Command Post. Functional exercises should include outside partners, as applicable, in order to evaluate response times.

Cycle for annual exercise

A different simulation exercise for each hazard category must be carried out annually so that all of the environmental emergencies identified in the E2 plan will be exercised over time. If your facility has more than one substance from the same hazard category, you must simulate one environmental emergency identified in the E2 plan for one substance in that hazard category. ECCC recommends rotating substances when available, if applicable

Example – Annual Exercise Cycle

Site A stores propane, butane, anhydrous ammonia and unleaded gasoline on-site. All four substances are stored at quantities and concentrations above the thresholds set out in Schedule 1, so an emergency plan must be developed and exercised. Site A has identified the following as potential environmental emergencies for its site:

	Propane CAS #: 74-98-6, explosion hazard (E)	**Butane** CAS #: 106-97-8, explosion hazard (E)	**Anhydrous Ammonia** CAS #: 7664-41-7, inhalation hazard (I)	**Unleaded Gasoline** CAS #: 8006-61-9, combustible hazard (C)
Environmental Emergency	Fire	Fire	Spill or release – contained in facility	Fire
	Spill or release from valve	Spill or release from valve	Spill or release from valve	Spill or release from valve

For the purposes of conducting an annual exercise, taking into consideration that the site has multiple hazard categories, multiple substances in the same hazard category and the various environmental emergencies identified above, the following will provide a possible annual exercise cycle:

Year 1:

- Propane (E) – Fire
- Anhydrous ammonia (I) – Spill or release – contained in facility
- Unleaded gasoline (C) – Fire

Year 2:

- Butane (E) – Spill or release from valve

- Anhydrous ammonia (I) – Spill or release from valve
- Unleaded gasoline (C) – Spill or release from valve

Year 3:

- Butane – Fire
- Anhydrous ammonia (I) – Spill or release – contained in facility
- Unleaded gasoline (C) – Fire

Site A has exercised all hazard categories and environmental emergencies and is therefore required to cycle back through them. When there are multiple substances in the hazard category (such as above – explosive), ECCC recommends rotating the substances being exercised. Therefore, Site A may wish to exercise “Propane – Spill or release from valve” in year four.

5.3.2 Full-scale exercise

A full-scale exercise is an action-based exercise with the deployment of personnel, resources and equipment. It is typically conducted in real time and with current weather conditions. Full-scale exercises give the response team an opportunity to practise and validate their plans, policies and a wide variety of the skills covered in response training.

Under the Regulations, a full-scale simulation exercise must be completed within five years of the E2 plan being brought into effect, using only one of the E2 substances stored on-site; this can be from any hazard category. The E2 plan must then be exercised at least once every five years thereafter. ECCC recommends rotating through all hazard categories and using worst-case or alternative worst-case emergency scenarios associated with those hazard categories. These exercises may involve other agencies, although role-players representing other agencies can be used if desired.

Once the full-scale exercise is completed, a Notice Regarding Simulation Exercises Conducted in Relation to an E2 Plan (Schedule 5) must be submitted.

When designing an exercise, the responsible person should take into consideration any lessons learned during previous exercises.

5.3.3 Record keeping

In addition to the E2 plan, the following records are also required to be kept at the facility:

- In accordance with section 8 of the Regulations, a record of E2 plan exercises (including both annual and full-scale exercises). The record should include the date, a summary and the results of the exercise. Any modifications required to the plan that were identified during the exercise should also be recorded.

- In accordance with section 10 of the Regulations, a record of the E2 plan review/update. A responsible person is required to review/update the E2 plan at least once per year and record the date it was completed. This is done to ensure its effectiveness and adherence to the Regulations.

Note, these records are required to be kept at the facility for seven years.

5.4 Public notification

The purpose of public communication regarding environmental emergencies is to let members of the public know about what they should or need to do during an environmental emergency.

As part of the development of the E2 plan and its implementation, the facility is responsible for public notifications with members of the public who may be affected by an environmental emergency from this facility. This includes communicating before an incident to create awareness of the potential effects to human health and the environment, providing notification of an emergency, as well as giving timely updates during and after the emergency. Members of the public could include, but are not limited to, community associations, public safety authorities (i.e., firefighters and police) and local residents.

The members of the public reached by these notifications should include the public members within the area that could be impacted by an environmental emergency. This area is identified by predicting the greatest impact distance beyond the facility boundary of a potential substance release, such as an ammonia leak or an oil spill. When identifying the affected members of the public by this alternative scenario, the following questions should also be answered to properly inform that public of the risks and possibilities related to an environmental emergency:

- Who/what could be affected?
- How will they be affected (health toxicity effects)?
- What information needs to be given to the public in the case of an environmental emergency?

Even though the Regulations do not specify how to communicate with the public, as each facility situation is unique, it is expected that members of the public receive accurate and up-to-date information. Some examples include public meetings / information sessions, flyers, posters, stickers, website, newsletters, open house meetings, safety day, information booths at events, door-to-door direct contact, partnering with a local Community Awareness and Emergency Response group or involving the public in exercises/drills.

ECCC recommends that the responsible person share information with the public on the possibilities and the measures that would be taken in case of an environmental emergency. This information should include:

- the possibility of an environmental emergency;

- the potential effects on the environment and human health, taking into consideration the site specifics;
- the measures that would be taken to protect the environment and human health; and
- the means by which the facility would communicate with members of the public during an environmental emergency.

In the event of an environmental emergency, members of the public should be notified as soon as possible using a suitable method (i.e. siren, automated phone message, media release, police/fire services, etc.). The public should also be updated regularly until the emergency is resolved. It is important to note that the responsibility to notify the public ultimately lies with the responsible person/facility. The responsible person at the facility is strongly recommended to include public safety authorities as a way of communicating with and protecting members of the public.

ECCC recommends that the following information be shared with members of the public during and after an environmental emergency:

- Information and guidance concerning the actions taken by the facility or local authority to reduce potential harm to the environment and danger to human health
- An explanation of how the actions taken by the facility or local authority may help reduce harm or danger

Once the environmental emergency has been resolved, members of the public should be notified as soon as possible. Communications regarding damage assessment, investigation, and potential compensation should also be included in an “after event” notification. If warranted, the E2 plan should be revised to incorporate changes that have been implemented to prevent a recurrence of the incident.

5.5 Other important considerations in plan development

5.5.1 Deadline for preparing and implementing an Environmental Emergency Plan

An E2 plan must be

- created within 6 months of meeting or exceeding the concentration, substance quantity and container capacity thresholds or only the quantity threshold for a substance that is not in a container system

- implemented within 12 months after the day on which an environmental emergency plan is required to be prepared

5.5.2 Existing plan

In order to prevent duplication of effort, subsection 4(3) of the Regulations allows facilities to use an existing environmental emergency plan that has been prepared on a voluntary basis, either for another government or under another act of Parliament. Where such a plan does not meet all the requirements identified within the Regulations, the plan must be amended to meet the remainder of those requirements. It is also possible for regulatees to use old E2 plans prepared under the previous Regulations. However, as some requirements have changed, facilities must verify that the old E2 plan satisfies all the requirements of the current Regulations.

5.5.3 Adequate measures

Subsection 4(4) requires that an E2 plan include adequate measures to address the objectives of preventing, preparing for, responding to and recovering from the environmental emergencies identified under paragraph 4(2)(d). If the prepared E2 plan is not appropriate/adequate for the environmental emergency planned, the facility will be held responsible. It is expected that the responsible person will modify the E2 plan to correct any outstanding inadequate measures.

5.5.4 Location of Environmental Emergency Plan documentation

In order to comply with section 11 of the Regulations, the responsible person for the facility must keep the E2 plan readily available at the facility for the individuals who are responsible to execute the plan and at any other location where the plan may need to be consulted by these individuals. Components of the E2 plan can be located within multiple binders or files; however, all the information that completes the E2 plan must be accessible to those who carry out the E2 plan in the event of an environmental emergency.

6.0 NOTIFICATION OF AN ENVIRONMENTAL EMERGENCY

6.1 Obligation to report environmental emergencies under CEPA 1999 – Verbal notification

6.1.1 Authority

Section 201 of CEPA 1999 sets out the obligation to notify the environmental emergencies to the Department.

This section requires that, when an environmental emergency occurs in respect of any of the substances listed under the Regulations or interim orders (i.e., Schedule 1 of the Regulations), any person who owned or had the charge, management or control of the substance immediately before the environmental emergency, or any person who caused or contributed to the environmental emergency, must, as soon as possible, notify the regional enforcement officer or any other person designated by the regulations.

6.1.2 What is a reportable environmental emergency?

Section 193 of CEPA 1999 defines an environmental emergency as

> *(c) an uncontrolled, unplanned or accidental release, or release in contravention of regulations or interim orders made under this Part [Part 8 of CEPA 1999], of a substance into the environment; or*
>
> *(d) the reasonable likelihood of such a release into the environment.*

If there is any doubt as to whether the incident is a reportable environmental emergency, the incident should be reported.

6.1.3 Which substances are required to be reported?

Environmental emergencies involving substances listed in Schedule 1 of the Regulations are required to be reported as soon as possible. The obligation to report environmental emergencies applies whether or not the quantities of substances or container capacity are met or are above the specified quantity threshold, as stated in column 4.

6.1.4 Who is responsible to notify?

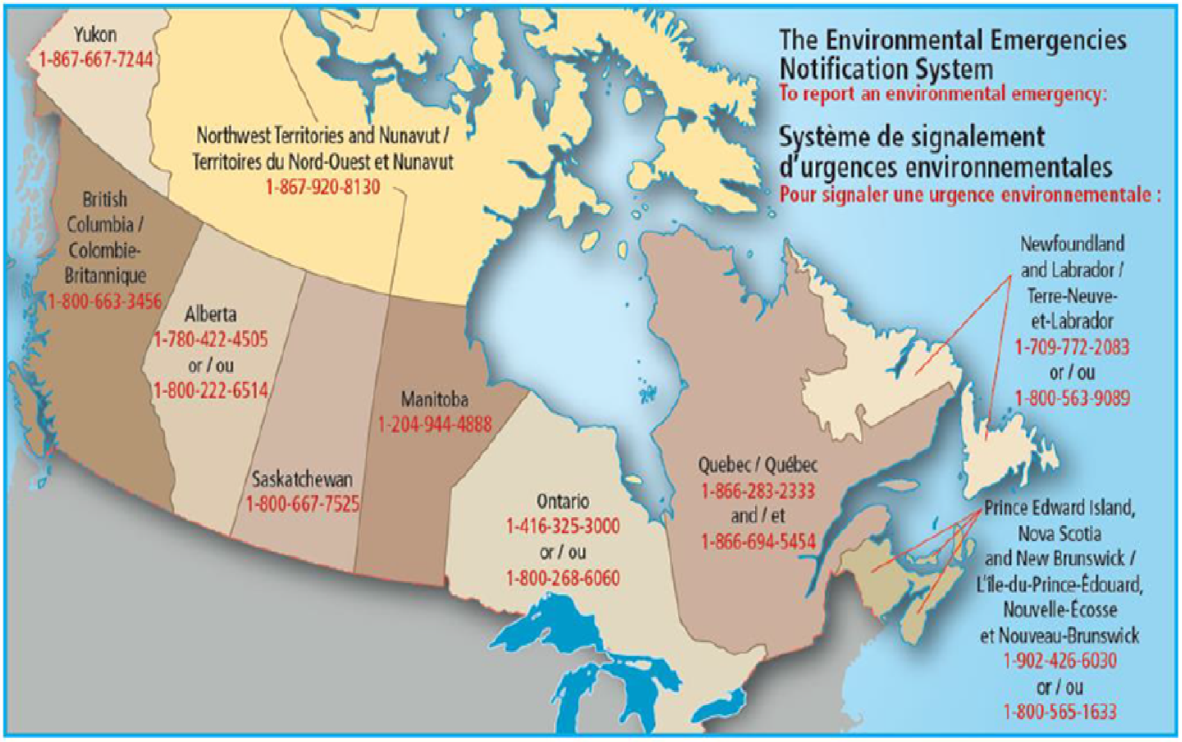
Any person who owned or had the charge, management or control of the substance immediately before the environmental emergency, or any person who caused or contributed to the environmental emergency is responsible to notify. Whether or not the person meets any other requirement under the Regulations, they may still be required to report a Schedule 1 substance release that meets the definition of an environmental emergency.

6.1.5 When must verbal notification occur?

The notification must occur as soon as possible.

6.1.6 How to notify?

When an environmental emergency occurs, you must call the applicable phone number identified below associated with the province or territory where the emergency occurred.



6.2 Obligation to report environmental emergencies under CEPA 1999 and the Regulations – Written report

6.2.1 Authority

Authority established under CEPA 1999. See section 6.1 for additional information.

6.2.2 What is a reportable environmental emergency?

Section 18 of the Regulations clarifies that written reports must be provided only when the environmental emergency meets at least one of the following three criteria:
(a) has or may have an immediate or long-term harmful effect on the environment;
(b) constitutes or may constitute a danger to the environment on which human life depends; or
(c) constitutes or may constitute a danger in Canada to human life or health.

If there is any doubt as to whether the incident is a reportable environmental emergency, a written report should be provided.

6.2.3 Which substances are to be reported?

The substances of concern are the same as for verbal notifications (see above). See section 5.1.2.

6.2.4 Who is responsible for providing the written report?

See section 6.1.4.

6.2.5 When must the written report be provided?

Notification occurs as soon as possible in the circumstances.

6.2.6 How to report?

A written environmental emergency report (a.k.a. a Schedule 8 Notice) must be submitted in the online E2 reporting system, accessed through the Single Window Information Management (SWIM) system (available at: https://ec.ss.ec.gc.ca).

6.2.7 What must be included in a written report?

The Schedule 8 report must include:

- The reporter's contact information.
- If applicable, the name of the facility or person responsible for the emergency
- If applicable, the North American Industry Classification System (NAICS) codes
- The date and time of the release
- The location of the release
- The CAS number and, if applicable, the UN number of the substance
- The quantity and concentration of the substance released
- A description of the container system and its condition
- A description of the potential harmful effects of the emergency
- If known, a description of the circumstances leading to the emergency, and measures taken to mitigate any harmful effects
- A description of all measures taken to prevent similar events

6.3 Considerations during an environmental emergency

In the event of an emergency, the responsible party must notify ECCC through the submission of a **Schedule 8 – Written Report of an Environmental Emergency.**

1. Take all reasonable emergency measures consistent with the protection of the environment and public safety to repair, reduce or mitigate any negative effects on

the environment or human life or health that result from the environmental emergency or that may reasonably be expected to result from it.

2. Make a reasonable effort to notify any member of the public who may be adversely affected by the environmental emergency.

7.0 ACCESS TO INFORMATION FOR PUBLIC SAFETY AUTHORITIES

To the extent that such access is legally permissible, and on a need-to-know basis only, public safety authorities (PSAs) may request access to Environmental Emergencies database information that is classified for either confidential business or national security reasons. PSAs may obtain this access by registering under the “Public Safety Authorities” section of the Environmental Emergencies Reporting System. The system is accessed via Environment and Climate Change Canada’s Single Window Interface: https://ec.ss.ec.gc.ca.

7.1 Benefits for PSAs

Information in the E2 database can be beneficial for PSAs in various ways. This access can

- increase planning capacity
- improve training to focus on real scenarios that could occur at facilities in the area
- inform where best to stage equipment for response
- inform municipalities so they are better prepared to assist with public notification if needed
- make them better prepared to assist with public notification if needed

8.0 COMPLIANCE AND ENFORCEMENT

ECCC evaluates the accuracy and completeness of the notices and reports submitted under the Regulations. This evaluation assists the Department in determining

- whether the regulatee must submit E2 plan reports and notifications;
- when the regulatee must submit E2 plan reports and notifications; and
- whether ECCC should refer possible situations of non-compliance to enforcement officers for investigation.

As part of an ongoing monitoring process, ECCC may request that copies of E2 plans be submitted to the Department for review. Such action will help ECCC determine whether departmental guidance on environmental emergency planning is adequate and being properly interpreted. Ongoing auditing of E2 plans is also necessary to assess the effectiveness of the E2 plans in protecting Canadians' safety and security.

8.1 Investigation of possible non-compliance

Enforcement officers apply the Compliance and Enforcement Policy for CEPA 1999 when verifying compliance with the Regulations. This policy sets out the range of possible responses to alleged violations: warnings, directions, environmental protection compliance orders (EPCOs), ticketing, ministerial orders, injunctions and prosecution, as well as environmental protection alternative measures (EPAMs). The Compliance and Enforcement Policy for CEPA 1999 can be accessed at: https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/publications/compliance-enforcement-policy.html

For the purposes of enforcing the Regulations under section 218 of CEPA 1999, enforcement officers are authorized to enter places and inspect E2 plans and any other relevant records in order to confirm compliance with the Regulations.

When an enforcement officer discovers an alleged violation, the officer will choose the appropriate enforcement action based on the following factors:

- Nature of the alleged violation: This includes consideration of how serious the harm or potential harm is, what the reason for the alleged violation is, whether this is a repeated occurrence and whether attempts have been made to conceal information or otherwise subvert the objectives and requirements of CEPA 1999.

- Effectiveness in achieving the desired result with the alleged violator: The desired result is compliance with CEPA 1999, within the shortest possible time and with no further occurrence of violation. Factors to be considered include:
    - the violator's history of compliance with CEPA 1999 and, if applicable, with regulations by a provincial, territorial or Indigenous government that are deemed, by order in council, to be equivalent to those under the CEPA 1999;

    - the violator's willingness to co-operate with enforcement officers;
    - evidence of corrective action already taken; and
    - the existence of enforcement actions under other statutes by other federal authorities or by provincial, territorial or Indigenous governments as a result of the same activity.
- Consistency in enforcement: Enforcement officers strive to achieve consistency in their responses to alleged violations. Accordingly, officers consider how similar previous situations were handled when deciding what enforcement action to take.

9.0 SUMMARY OF THE RISK EVALUATION FRAMEWORK

This section introduces the evaluation methodology that ECCC has developed and is using to evaluate the properties of chemical substances that would prove hazardous in the event of an environmental emergency, and to calculate the threshold quantity for substances listed in Schedule 1 of the Regulations.

The Risk Evaluation Framework (REF) is designed to

- evaluate the risk posed by a substance to the environment and human health;
- determine the need to add this substance to Schedule 1 of the Regulations, based on the risk evaluation results obtained; and
- calculate the minimum quantity (the threshold) for substances listed in Schedule 1 of the Regulations.

Section 200 of CEPA 1999 is the authority that allows the Governor in Council to make regulations establishing a list of substances that, should they enter the environment as a result of an environmental emergency, might be harmful to the environment, or to human life or health. Section 200 also gives the Governor in Council the authority to prescribe a minimum quantity for these substances.

In 2003, when the Regulations were published, the REF had not yet been developed. As a result, most of the substances in Schedule 1 (parts 1 and 2) were adopted from the USEPA regulations and some substances came from the Major Industrial Accidents Reduction Council (MIARC), known as the Conseil pour la réduction des accidents industriels majeurs (CRAIM) in French. These thresholds, therefore, were not generated by the REF. The rationale for the MIARC list focused almost entirely on human health and safety criteria (CRAIM 2002; J.P. Lacoursière Inc. 2002). The first amendment to the Regulations added substances from the Toxic Substances List (CEPA 1999), and other substances of concern. The new substances added to the 2019 Regulations are mostly substances evaluated under the Chemical Management Plan (CMP).

The regulated list is not a static one. ECCC continues to assess CEPA 1999 substances and other substances of concern (reactives, petroleum substances, inhalation toxics, etc.) for possible inclusion in the Regulations. As part of this ongoing process, substances may be added to or removed from Schedule 1 of the Regulations (for example, nickel carbonate was present in the 2011 Regulations, but was removed in the new 2019 Regulations), or thresholds may be adjusted if new data show such adjustments to be warranted.

APPENDIX 1

Suggested References for Environmental Emergencies Prevention, Preparedness and Response Measures, and the Development of Environmental Emergency Plans

EMERGENCY MANAGEMENT

1. Canadian Standards Association (CSA). *Emergency Preparedness and Response: A National Standard of Canada* (CAN/CSA-Z731-03 (R2014). Toronto: CSA, 2003. This document can be ordered from CSA International at 1-800-463-6727 or from the CSA website at https://store.csagroup.org/

2. Canadian Standards Association (CSA). *Emergency Preparedness and Response for Petroleum and Natural Gas Systems* (CAN/CSA-Z246.2-18). Toronto: CSA, 2018. This document can be ordered from CSA International at 1-800-463-6727 or from the CSA website at https://store.csagroup.org/

3. National Fire Protection Association (NFPA). *NFPA 1600: Standard on Continuity, Emergency, and Crisis Management, 2019 Edition*. Quincy, Massachusetts: NFPA, 2007. This document can be ordered from the NFPA at 1-800-344-3555 or from the NFPA website at https://catalog.nfpa.org/Codes-and-Standards-C3322.aspx?icid=D661

4. United Nations Environment Programme (UNEP). *APELL, Awareness and Preparedness for Emergencies at a Local Level: A process for improving community awareness and preparedness for technological hazards and environmental emergencies*. Paris: UNEP, 2nd Edition 2015. This document can be downloaded from http://apell.eecentre.org/Modules/GroupDetails/UploadFile/APELL_Handbook_2016_-_Publication.pdf

5. Organization for Economic Co-operation and Development (OECD). *OECD Guiding Principles for Chemical Accident Prevention, Preparedness and Response: Guidance for Public Authorities, Industry (including Management and Labour), Communities and Other Stakeholders.* Paris: OECD, 2003. Available through the OECD Chemical Accident Prevention, Preparedness and Response website at https://www.oecd.org/env/ehs/chemical-accidents/Guiding-principles-chemical-accident.pdf

PROCESS SAFETY / RISK MANAGEMENT

6. American Petroleum Institute (API). *Recommended Practice 750, Management of Process Hazards*. Washington, D.C.: API, 1990. This document is available from API in Washington, D.C. (at 202-682-8000 or at its website at www.api.org).

7. Canadian Standards Association (CSA). Process Safety Management (CAN/CSA-Z7670-17). Toronto: CSA, 2017. This document can be ordered from CSA International at 1-800-463-6727 or from the CSA website at https://store.csagroup.org/

8. Canadian Chemical Producers' Association. *Site Self-Assessment Tool*. Ottawa:, 1999. This document can be downloaded from https://www.cheminst.ca/communities/divisions/psm/psm-publications/

9. Canadian Society for Chemical Engineering (CSChE). *Guidelines for Site Risk Communication*, 3rd Edition 2012, Ottawa: CSChE 2012. This document can be downloaded from https://www.cheminst.ca/communities/divisions/psm/psm-publications/

10. Conseil pour la réduction des accidents industriels majeurs (CRAIM) / Major Industrial Accidents Reduction Council (MIARC). *Risk Management Guide for Major Technological Accidents*, 7th Edition, 2017, Montréal. This document is currently available in both English and French at www.craim.ca

11. U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) – *Process Safety Management (PSM) standards*. All standards are available from OSHA at https://www.osha.gov/SLTC/processsafetymanagement/standards.html

12. U.S. Environmental Protection Agency (EPA). *Areal Locations of Hazardous Atmospheres (ALOHA).* This software, as well as associated documentation, is available from the EPA website at https://www.epa.gov/cameo/aloha-software

13. U.S. Environmental Protection Agency (EPA). *General Guidance on Risk Management Programs for Chemical Accident Prevention (40 CFR Part 68)* (EPA-555-B-04-001). Washington, D.C.: U.S. EPA, 2009. This document is available from the EPA website at

https://www.epa.gov/rmp/guidance-facilities-risk-management-programs-rmp#general

14. U.S. Environmental Protection Agency (EPA). Risk Management Program Guidance for Offsite Consequence Analysis (40 CFR Part 68) (EPA-555-B-99-009). Washington, D.C.: U.S. EPA, 2009. This document is available from the EPA website at https://www.epa.gov/rmp/rmp-guidance-offsite-consequence-analysis

15. U.S. Environmental Protection Agency (U.S. EPA). *RMP*Comp™ Modelling Program for Risk Management Plans.* RMP*Comp™ is a free computer program that can be used to complete off-site consequence analyses for the substances that originate from the Environmental Protection Agency's Risk Management Program list. This software can be downloaded from https://www.epa.gov/rmp/rmpcomp

APPENDIX 2

Regional Contact Information for the Regulations

If you require assistance regarding the Regulations or filing notices, please contact your regional representative. For all other enquiries regarding the Regulations, please contact the national office.

Region	Regional Environment and Climate Change Canada Office	Written Report[3]
Atlantic Region: • Nova Scotia • New Brunswick • Newfoundland and Labrador • Prince Edward Island	Compliance Promotion - Environmental Emergencies Program Atlantic Region Environment and Climate Change Canada 45 Alderney Drive, 15th Floor, Queen Square Dartmouth, Nova Scotia B2Y 2N6 Phone: 1-800-668-6767 Email: ec.ue-atl-e2.ec@canada.ca	Regional Director, Environmental Enforcement Directorate Atlantic Region Environment and Climate Change Canada Queen Square 45 Alderney Drive Dartmouth NS B2Y 2N6 Fax: 902-426-7924
Quebec Region	Compliance Promotion - Environmental Emergencies Program Quebec Environment and Climate Change Canada 351 St-Joseph Blvd Gatineau, Quebec K1A 0H3 Phone: 1-800-668-6767 Email: ec.ue-qc-e2.ec@canada.ca	Regional Director, Environmental Enforcement Directorate Quebec Region Environment and Climate Change Canada 105 McGill Street (3rd Floor) Montréal QC H2Y 2E7 Fax: 514-496-2087

3. Electronic submission is mandatory except in special cases where an electronic version is impossible.

Region	Regional Environment and Climate Change Canada Office	Written Report[3]
Ontario Region	Compliance Promotion - Environmental Emergencies Program Ontario Region Environment and Climate Change Canada 4905 Dufferin Street Downsview, Ontario, M3H 5T4 Phone: 1-800-668-6767 Email: ec.ue-on-e2.ec@canada.ca	Regional Director, Environmental Enforcement Directorate Ontario Region Environment and Climate Change Canada 845 Harrington Court Burlington ON L7N 3P3 Fax: 905-333-3952
Prairie and Northern Region: • Alberta • Saskatchewan • Manitoba • Northwest Territories • Nunavut	Compliance Promotion - Environmental Emergencies Program Prairie and Northern Region Environment and Climate Change Canada 9250 – 49th Street NW Edmonton, Alberta, T6B 1K5 Phone: 1-800-668-6767 Email: ec.ue-pn-e2.ec@canada.ca	Regional Director, Environmental Enforcement Directorate Prairie and Northern Region Environment and Climate Change Canada Twin Atria Building 4999 – 98th Avenue, Room 200 Edmonton AB T6B 2X3 Fax: 780-495-2451
Pacific and Yukon Region: • British Columbia • Yukon	Compliance Promotion – Environmental Emergencies Program Pacific and Yukon Region Environment and Climate Change Canada 201 – 401 Burrard Street Vancouver, British Columbia, V6C 3S5 Phone: 1-800-668-6767 Email: ec.ue-py-e2.ec@canada.ca	Regional Director, Environmental Enforcement Directorate Pacific and Yukon Region Environment and Climate Change Canada 201 – 401 Burrard Street (4th Floor) Vancouver BC V6C 3S5 Fax: 604-666-9059

Region	Regional Environment and Climate Change Canada Office	Written Report[3]
National Office	Environmental Emergencies Program Environment and Climate Change Canada 351 St. Joseph Boulevard Gatineau, Quebec, K1A 0H3 Phone: 1-800-668-6767 Email: ec.ue-e2.ec@canada.ca	

APPENDIX 3

Determination of Container Capacity and Substance Quantity

TABLE OF CONTENTS

Container system

In the Regulations, a container system means *any receptacle or network of receptacles that is used to contain a substance—including any connecting pipelines or piping—except any part of that network that is automatically or remotely segregated from the rest of the network by shut-off valves, or other mechanisms, in the event of an environmental emergency (section1(1)).*

In the Regulations, a container system can be segregated by either automatic or remote shut-off valves, but not by manual valves. A manual valve by design requires someone to shut off the flow of the substance by hand. This approach to preventing potential spills of hazardous substances is not considered the safest procedure since one may be exposed to the substance, nor the quickest method since one may be required to put on protective clothing first before attempting to close the valve or one may not be able to access the valve at all. As a result, manual valves are not considered to be an acceptable mechanism for segregating portions of a container system into their own distinct vessels.

The term "*other mechanisms"* has been intentionally left ambiguous for the purpose of allowing other valves that may serve in the same manner and function as automatic or remote valves, but have not been specifically identified. To be clear, all "*other mechanisms"* must also have the means to shut off the flow of a substance without the need to send an employee to manually turn or push a mechanism to stop the flow. For example, flare/flame arrestors are designed to stop fuel combustion by extinguishing a flame. Since the mechanism does not stop the flow of the substance, this would not be considered an "*other mechanism."*

Single container system

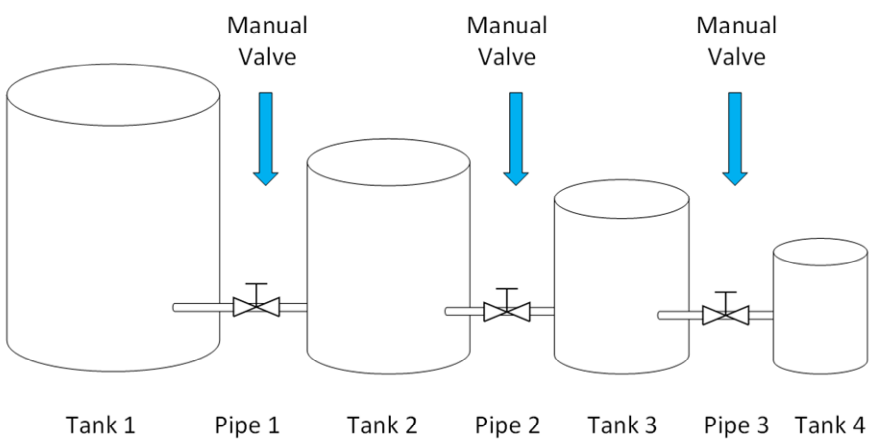


Figure 1: Graphic representation of a single container system.

This series of containers shows only manual valves, which do not separate containers automatically or remotely. Therefore, this is considered to be one container system.

Two container systems

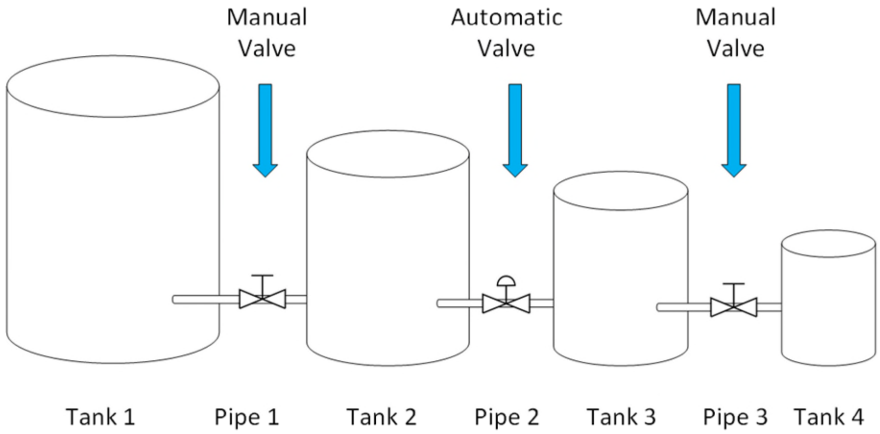


Figure 2: A graphic representation of a series of containers that constitute two container systems.

An automatic valve on pipe 2 is separating the series of containers into two container systems, starting from the left:

Container system 1: Tank 1 + pipe 1 + Tank 2 + ½ pipe 2
Container system 2: ½ pipe 2 + tank 3 + pipe 3 + tank 4

Three container systems

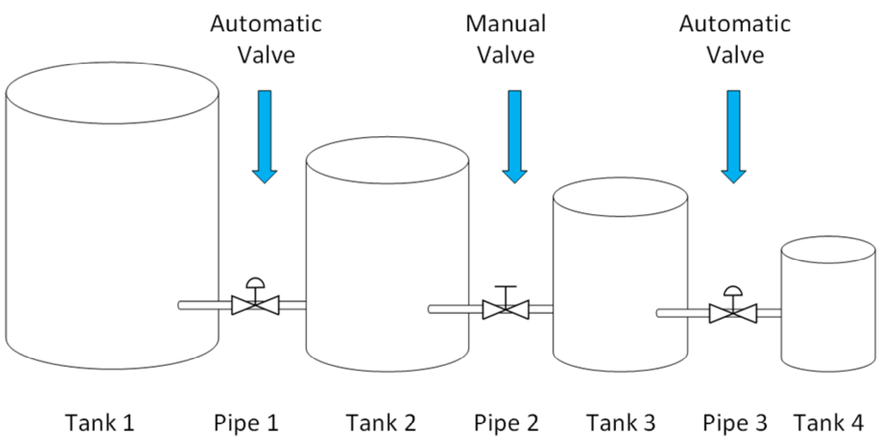


Figure 3: A graphic representation of a series of containers that constitute three container systems. In this example there are two automatic valves and one manual valve. The manual valve is ignored. In this case, this means that there are three container systems, starting from the left:
Container system 1: Tank 1 + ½ pipe 1
Container system 2: ½ pipe 1 + tank 2 + pipe 2 + tank 3 + ½ pipe 3
Container system 3: ½ pipe 3 + tank 4

Determination of the quantity on-site and the maximum capacity of the largest container system

If the entire quantity of a substance on-site is stored in a single container system, then the total quantity on-site would be the sum of the amounts found in each tank and in each of the pipes.

If the substance stored on-site is contained in more than a single container system, then whichever container system has the higher quantity capacity will be recorded as the maximum capacity of the largest container system.

To calculate the maximum capacity, add up the maximum capacity of all of the pipes and the 100% maximum capacity of each tank, without considering the Safe Fill Limits.

Where the substance is stored in a container system and is also present in an uncontained state, the maximum capacity will be the larger value of the tonnage of uncontained material or the maximum capacity of the largest container system.

Quantity calculation examples

The densities used in the following calculation examples vary according to temperature and pressure and may not be the appropriate densities to be used in the actual calculation.

Part 1 substance (single substance)

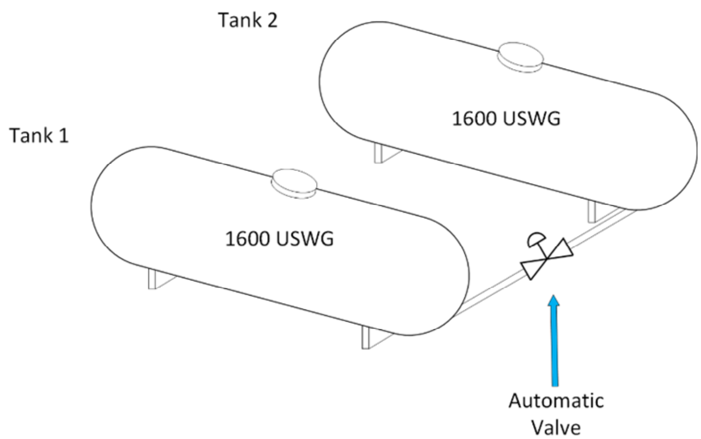
Example 1 – Propane (interconnected containers – automatic control valves)

Substance: Propane
Concentration: 100%
Density* @15C = 0.5066 g/cm^3

*Density value provided is for example purposes only. Density value of propane used in actual calculations should be based on on-site parameters (i.e. pressure, temp)

	USWG		
	Tank 1	**Tank 2**	**Piping**
Max. Capacity	2000	2000	10
Total Quantity	1600	1600	10

<u>Container System Diagram Showing Total Quantity On-site (U.S. Gallons):</u>



Propane in the Regulations:

Sch 1 Item #	Column 1 CAS Registry Number	Column 2 Name of Substance	Column 3 Concentration (% mass/mass)	Column 4 Minimum Quantity (tonnes)	Column 5 Hazard Category (Short Form)
17[1]	74-98-6	Propane	1	4.5	E

[1] Substance found under Sch 1 – page 14

Maximum Capacity of Largest Container System:

- Substance makes the concentration cut-off as shown in Column 3 in Part 1 of Schedule 1.
- Container systems are separated by automatic or remote values, not manual valves, so they are considered 2 separate container systems
- Use density of 0.5066 g/cm3 to determine maximum capacity of largest container system

1st container system (Tank 1 + ½ piping = 2000 USWG + 5 USWG):

$$2005\ US\ Gallons \times \frac{3.785\ Litres}{1\ US\ Gallon} \times \frac{1000\ cm^3}{1\ Litre} \times \frac{0.5066\ g}{1\ cm^3} \times \frac{1\ kg}{1\ 000\ g} \times \frac{1\ tonne}{1000\ kg} = 3.84\ tonnes$$

2nd container system (Tank 2 + ½ piping = 2000 USWG + 5 USWG):

$$2005\ US\ Gallons \times \frac{3.785\ Litres}{1\ US\ Gallon} \times \frac{1000\ cm^3}{1\ Litre} \times \frac{0.5066\ g}{1\ cm^3} \times \frac{1\ kg}{1000\ g} \times \frac{1\ tonne}{1000\ kg} = 3.84\ tonnes$$

The maximum capacity of the largest container system is 3.84 tonnes.

Total Quantity on Site:

1600 USWG + 1600 USWG + 10 USWG = 3210 USWG

$$3210\ US\ Gallons \times \frac{3.785\ Litres}{1\ US\ Gallon} \times \frac{1000\ cm^3}{1\ Litre} \times \frac{0.5066\ g}{1\ cm^3} \times \frac{1\ kg}{1000\ g} \times \frac{1\ tonne}{1000\ kg} = 6.16\ tonnes$$

The total quantity on site is 6.16 tonnes.

Schedules to fill out:

E2 Substance	Meets Maximum Capacity of Largest Container System (tonnes)	Total Quantity On-site vs E2 (tonnes)	Schedules to fill out
Propane	3.84 < 4.5 No	6.16 ≥ 4.5 Yes	2

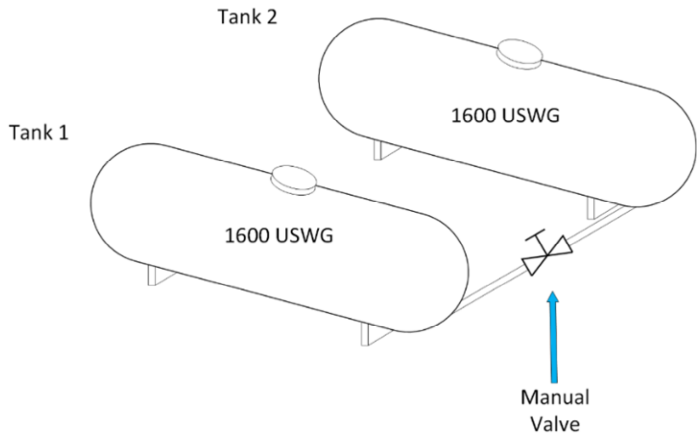
Example 2 – Propane (interconnected containers – manual valves)

Substance: Propane
Concentration: 100%
Density* @15C = 0.5066 g/cm^3

*Density value provided is for example purposes only. Density value of propane used in actual calculations should be based on on-site parameters (i.e. pressure, temp)

	USWG		
	Tank 1	**Tank 2**	**Piping**
Max. Capacity	2000	2000	10
Total Quantity	1600	1600	10

Container System Diagram Showing Total Quantity On-site (U.S. Gallons):



Propane in the Regulations:

	Column 1	Column 2	Column 3	Column 4	Column 5
Sch 1 Item #	**CAS Registry Number**	**Name of Substance**	**Concentration (% mass/mass)**	**Minimum Quantity (tonnes)**	**Hazard Category (Short Form)**
17[1]	74-98-6	Propane	1	4.5	E

[1] Substance found under Sch 1 – page 14

Maximum Capacity of Largest Container System:

- Substance makes the concentration cut-off as shown in Column 3 in Part 1 of Schedule 1.
- Manual value does not distinguish between container systems. Therefore, this is considered to be one large container system.
- Use density of 0.5066 g/cm3 to determine maximum capacity of largest container system

1st container system (Tank 1 + Tank 2 + 1 pipe = 2000 USWG + 2000 USWG + 10 USWG):

$$4010\ US\ Gallons \times \frac{3.785\ Litres}{1\ US\ Gallon} \times \frac{1000\ cm^3}{1\ Litre} \times \frac{0.5066\ g}{1\ cm^3} \times \frac{1\ kg}{1000\ g} \times \frac{1\ tonne}{1000\ kg} = 7.69\ tonnes$$

The maximum capacity of the largest container system is 7.69 tonnes.

Total Quantity on Site:

1600 USWG + 1600 USWG + 10 USWG = 3210 USWG

$$3210\ US\ Gallons \times \frac{3.785\ Litres}{1\ US\ Gallon} \times \frac{1000\ cm^3}{1\ Litre} \times \frac{0.5066\ g}{1\ cm^3} \times \frac{1\ kg}{1000\ g} \times \frac{1\ tonne}{1000\ kg} = 6.16\ tonnes$$

The total quantity on site is 6.16 tonnes.

Schedules to fill out:

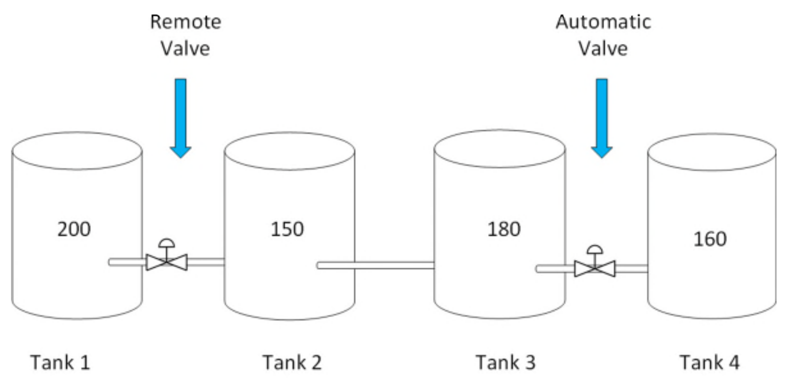
E2 Substance	Meets Maximum Capacity of Largest Container System (tonnes)	Total Quantity On-site vs E2 (tonnes)	Schedules to fill out
Propane	7.69 > 4.5 Yes	6.16 ≥ 4.5 Yes	2, 3, 4, 5

Example 3 – Cyclohexane

Substance: Cyclohexane
Concentration: 100%

	Tonnes				
	Tank 1	**Tank 2**	**Tank 3**	**Tank 4**	**Pipes**
Max. Capacity	250	250	250	250	0.215
Total Quantity	200	150	180	160	0.215

Container system diagram showing total quantity on-site (tonnes)



Cyclohexane in the Regulations (Sch 1 – page 17)

	Column 1	Column 2	Column 3	Column 4	Column 5
Item	**CAS Registry Number**	**Name of Substance**	**Concentration (% mass/mass)**	**Minimum Quantity (tonnes)**	**Hazard Category (Short Form)**
94[1]	110-82-7	Cyclohexane	1	550	C

[1] Substance found under Sch 1 – page 17

Considerations when determining the maximum capacity of the largest container system

- Substance exceeds the threshold set out in Column 3 in Part 1 of Schedule 1.
- Amount of substance that will need to be calculated for the maximum capacity within the largest container system.
- Containers are separated by automatic or remote valves.

Maximum capacity calculations

1st container system (Tank 1 + ½ pipe): 250 + ½ pipe (0.215) = 250.1075 tonnes

2nd container system (Tank 2 + Tank 3 + 1 pipe + two ½ pipes): 250 + 250 + 1.0 pipe (0.215) + 0.5 pipe (0.215) + 0.5 pipe (0.215) = 500.43 tonnes

3rd container system (Tank 4 + ½ pipe): 250 + ½ pipe (0.215) = 250.1075 tonnes

The maximum capacity of the largest container system is 500.43 tonnes.

Total quantity on-site calculation

200 + 150 + 180 + 160 + (3 x 0.215) = 690.645 tonnes

Schedules to fill out

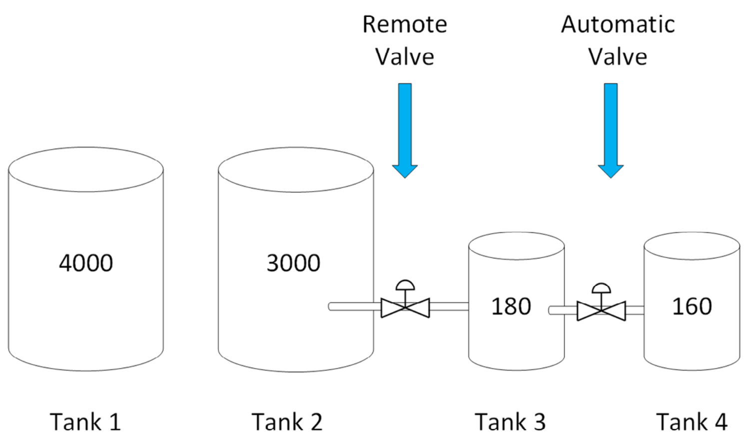
E2 Substance	Meets Maximum Capacity of Largest Container System (tonnes)	Total Quantity On-site vs E2 (tonnes)	Schedules to fill out
Cyclohexane	500.43 < 550 No	690.645 ≥ 550 Yes	2

Example 4 – Crude oil, oil sand

Substance: Crude oil, oil sand
Concentration: 100%

	Tonnes				
	Tank 1	**Tank 2**	**Tank 3**	**Tank 4**	**Pipes**
Max. Capacity	5000	4000	225	200	1
Total Quantity	4000	3000	180	160	1

Container system diagram showing total quantity on-site (tonnes)



Crude oil, oil sand in the Regulations (Sch 1 – page 22)

	Column 1	**Column 2**	**Column 3**	**Column 4**	**Column 5**
Item	**CAS Registry Number**	**Name of Substance**	**Concentration (% mass/mass)**	**Minimum Quantity (tonnes)**	**Hazard Category (Short Form)**
234[1]	128683-25-0	Crude oil, oil sands	1	2500	F

[1] Substance found under Sch 1 – page 22

Considerations when determining the maximum capacity of the largest container system

- Substance exceeds the threshold set out in Column 3 in Part 1 of Schedule 1.
- Amount of substance will need to be calculated for the maximum capacity within the largest container system.
- Container systems are separated by automatic or remote valves.

Maximum capacity calculations

1st container system (tank 1): 5000 tonnes

2nd container system (tank 2 + ½ pipe): 4000 + 0.5 = 4 000.5 tonnes

3rd container system (tank 3 + ½ pipe + ½ pipe) = 225 + 0.5 + 0.5 = 226 tonnes

4th container system (take 4 + ½ pipe) = 200 + 0.5 = 200.5 tonnes

The maximum capacity of the single largest container system is 5000 tonnes.

Total quantity on-site calculation

4000 + 3000 + 180 + 160 + (2 x 1) = 7342 tonnes

Schedules to fill out

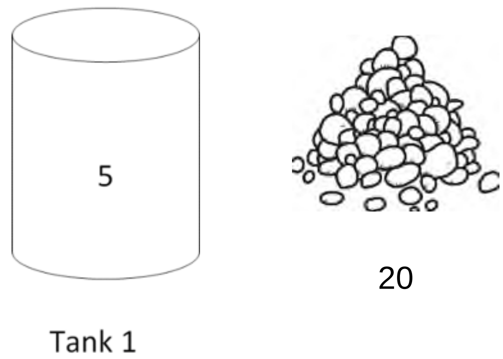
E2 Substance	Meets Maximum Capacity of Largest Container System (tonnes)	Total Quantity On-site vs E2 (tonnes)	Schedules to fill out
Crude oil, oil sand	5000 ≥ 2 500 Yes	7342 ≥ 2 500 Yes	2, 3, 4, 5

Example 5 – Uncontained and contained

Substance: Ammonium nitrate
Concentration: 100%

	Tonnes	
	Tank 1	**Uncontained**
Max. Capacity	10	20
Total Quantity	5	20

Diagram showing contained and uncontained total quantity on-site (tonnes):



Ammonium nitrate, solid in the Regulations (Sch 1 – page 19)

	Column 1	Column 2	Column 3	Column 4	Column 5
Item	**CAS Registry Number**	**Name of Substance**	**Concentration (% mass/mass)**	**Minimum Quantity (tonnes)**	**Hazard Category (Short Form)**
152[1]	6484-52-2	Ammonium nitrate, solid	60	20	O

[1] Substance found under Sch 1 – page 19

Maximum capacity of the largest container system

- Substance makes the concentration cut-off as shown in Column 3 in Part 2 of Schedule 1.
- An uncontained amount of ammonium nitrate, solid, is also present at the site.

Container system (tank 1): 10 tonnes
Uncontained: 20 tonnes

The maximum capacity of the single largest container system is 10 tonnes, but the amount of the substance in an uncontained state is 20 tonnes. Therefore, 20 tonnes will be reported as the maximum capacity.

Total quantity on-site
5 + 20 = 25 tonnes

Schedules to fill out

E2 Substance	Meets Maximum Capacity of Largest Container System (tonnes)	Total Quantity On-site vs E2 (tonnes)	Schedules to fill out
Ammonium nitrate, solid	20 ≥ 20 Yes	25 ≥ 20 Yes	2, 3, 4, 5

Part 1 substance (mixture)

Example 6 – Inhalation mixture

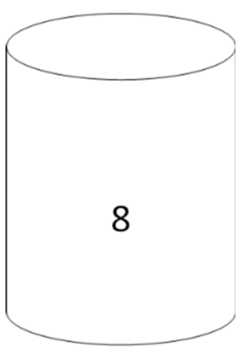
Substance: inhalation mixture with an overall vapour pressure of 3.33 kPa (No CAS # assigned to this mixture).

	Tonnes	
	Tank 1	**Pipes**
Max. Capacity	10	0
Total Quantity	8	0

Composition of tank

E2 Substance	% (by weight in tonnes)
Cyanogen bromide	60
Cyanogen chloride	40

Container system diagram showing total quantity on-site (tonnes)



Tank 1

Substances found within the inhalation mixture in the Regulations (Sch 1 – page 18)

	Column 1	Column 2	Column 3	Column 4	Column 5
Item	CAS Registry Number	Name of Substance	Concentration (% mass/mass)	Minimum Quantity (tonnes)	Hazard Category (Short Form)
119[1]	506-63-3	Cyanogen bromide	10	4.5	I
120[1]	506-77-4	Cyanogen chloride	10	4.5	I

[1] Substance found under Sch 1 – page 18

Maximum capacity of the largest container system

- All substances make the concentration cut-off as shown in Column 3 in Part 2 of Schedule 1.

The largest container system has 10 tonnes.

Total quantity on-site calculation

The total quantity on-site is 8 tonnes. Each individual E2 substance will need to be calculated for the total quantity on-site.

E2 Substance	%	8 Tonnes x % (on-site)
Cyanogen bromide	60	4.8
Cyanogen chloride	40	3.2

Schedules to fill out

E2 Substance	Meets Maximum Capacity of Largest Container System (tonnes)	Meets Total Quantity On-site vs E2 (tonnes)	Schedules to fill out
Cyanogen bromide	10 ≥ 4.5 Yes	4.8 ≥ 4.5 Yes	2, 3, 4, 5
Cyanogen chloride	10 ≥ 4.5 Yes	3.2 < 4.5 No	2

Example 7 – Mixture containing C and/or E substances

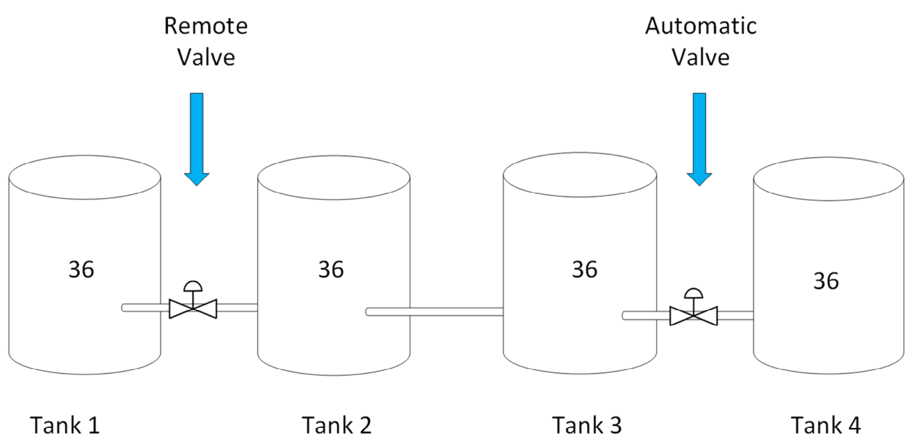
Substance: A mixture with an overall boiling point of 45 ºC and an overall flashpoint of 6 °C (No CAS # is assigned to this mixture)

	Tonnes				
	Tank 1	**Tank 2**	**Tank 3**	**Tank 4**	**Pipes**
Max. Capacity	45	45	45	45	0.1
Total Quantity	36	36	36	36	0.1

Composition of tanks

E2 Substance	%
Methane	30
Ethane	25
Propane	10
Styrene	25
Cyclopropane	9.4
Benzene	0.5
Xylenes	0.1

Container system diagram showing total quantity on-site (tonnes)



Substances found within the mixture from the Regulations

	Column 1	Column 2	Column 3	Column 4	Column 5
Item	**CAS Registry Number**	**Name of Substance**	**Concentration (% mass/mass)**	**Minimum Quantity (tonnes)**	**Hazard Category (Short Form)**
7[1]	74-82-8	Methane	1	4.5	E
9[1]	74-84-0	Ethane	1	4.5	E
17[1]	74-98-6	Propane	1	4.5	E
60[3]	100-42-5	Styrene	1	4.5	E
28[2]	75-19-4	Cyclopropane	1	4.5	E
6[1]	71-43-2	Benzene	1	10	C

	Column 1	Column 2	Column 3	Column 4	Column 5
Item	**CAS Registry Number**	**Name of Substance**	**Concentration (% mass/mass)**	**Minimum Quantity (tonnes)**	**Hazard Category (Short Form)**
146[4]	1330-20-7	Xylenes	1	8000	C

[1] Substance found under Sch 1 – page 14
[2] Substance found under Sch 1 – page 15
[3] Substance found under Sch 1 – page 16
[4] Substance found under Sch 1 – page 19

Maximum capacity of the largest container system

- Not all substances make the concentration cut-off as shown in Column 3 in Part 2 of Schedule 1. Benzene and xylene do not meet the cut-off concentration.
- Container systems are separated by automatic or remote valves, but not manual valves.

Maximum capacity calculations

1st container system (tank 1 + ½ pipe): 45 + ½ pipe (0.1) = 45.05 tonnes

2nd container system (tank 2 + tank 3 + 1 pipe + two ½ pipes): 45 + 45 + 1 pipe (0.1) + ½ pipe (0.1) + ½ pipe (0.1) = 90.2 tonnes

3rd container system (tank 4 + ½ pipe): 45 + ½ pipe (0.1) = 45.05 tonnes

The maximum capacity of the single largest container system is 90.2 tonnes.

Total quantity on-site calculations

Tank 1 + tank 2 + tank 3 + tank 4 + 3 pipes = 36 + 36 + 36 + 36 + (3 x 0.1) = 144.3 tonnes

Each individual E2 substance will need to be calculated for the total quantity on-site for that substance.

E2 Substance	%	144.3 Tonnes x % (on-site)
Methane	30	43.29
Ethane	25	36.08
Propane	10	14.43
styrene	25	36.08
Cyclopropane	9.4	13.56

<u>Schedules to fill out</u>

E2 Substance	Meets Maximum Capacity of Largest Container System (tonnes)	Meets Total Quantity On-site vs E2 (tonnes)	Schedules to fill out
Methane	90.2 ≥ 4.5 Yes	43.29 ≥ 4.5 Yes	2, 3, 4, 5
Ethane	90.2 ≥ 4.5 Yes	36.08 ≥ 4.5 Yes	2, 3, 4, 5
Propane	90.2 ≥ 4.5 Yes	14.43 ≥ 4.5 Yes	2, 3, 4, 5
Styrene	90.2 ≥ 4.5 Yes	36.08 ≥ 4.5 Yes	2, 3, 4, 5
Cyclopropane	90.2 ≥ 4.5 Yes	13.56 ≥ 4.5 Yes	2, 3, 4, 5
Benzene	Concentration Not Met		None
Xylenes	Concentration Not Met		None

Example 8 – Aquatic toxic mixture

Substance: An aquatically toxic mixture (No CAS # assigned to this mixture).

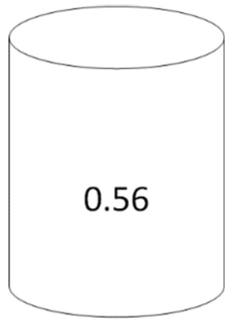
	Tonnes	
	Tank 1	**Pipes**
Max. Capacity	0.7	0
Total Quantity	0.56	0

Composition in the tank

Substances	%
Nickel(II) nitrate, hexahydrate	30
Nickel ammonium sulphate	25
Nickel nitrate	10
Nickel carbonate*	35

* This substance has been removed from the 2019 Regulations

Container system diagram showing total quantity on-site (tonnes):



Tank 1

Substances found within the aquatic toxic mixture in the Regulations

	Column 1	Column 2	Column 3	Column 4	Column 5
Item	**CAS Registry Number**	**Name of Substance**	**Concentration (% mass/mass)**	**Minimum Quantity (tonnes)**	**Hazard Category (Short Form)**
207[1]	13478-00-7	Nickel(II) nitrate, hexahydrate	10	0.22	A
208[1]	15699-18-0	Nickel ammonium sulphate	10	0.22	A
204[2]	13138-45-9	Nickel nitrate	10	0.22	A

[1] Substance found under Sch 1 – page 21
[2] Substance found under Sch 1 – page 20

Maximum capacity of the largest container system

- All the substances listed in Schedule 1 make the concentration cut-off as shown in Column 3 in Part 2 of Schedule 1.

Maximum capacity calculation

The maximum capacity of the single largest container system is 0.7 tonnes.

Total quantity on-site

Only one tank – total quantity of mixture is 0.56 tonnes.

Each individual E2 substance will need to be calculated for the total quantity on-site for that substance.

E2 Substance	%	0.56 Tonnes x % (on-site)
Nickel(II) nitrate, hexahydrate	30	0.17
Nickel ammonium sulphate	25	0.14
Nickel nitrate	10	0.06

Schedules to fill out

E2 Substance	Meets Maximum Capacity of Largest Container System (tonnes)	Meets Total Quantity On-site vs E2 (tonnes)	Schedules to fill out
Nickel(II) nitrate, hexahydrate	0.7 ≥ 0.22 Yes	0.17 < 0.22 No	2
Nickel ammonium sulphate	0.7 ≥ 0.22 Yes	0.14 < 0.22 No	2
Nickel nitrate	0.7 ≥ 0.22 Yes	0.06 < 0.22 No	2
Nickel carbonate	Not an E2 Substance		none

Example 9 – Mixture containing C and/or E substances (% range)

Substance: A mixture with an overall boiling point of 145 °C and an overall flashpoint of 20 °C (No CAS # is assigned to this mixture)

	Tonnes						
	Tank 1	Tank 2	Tank 3	Tank 4	Pipe 1	Pipe 2	Pipe 3
Max. Capacity	400	250	125	80	2	1	1
Total Quantity	300	200	100	50	2	1	1

Composition of tanks and estimated calculation percentage

Substances	%	Use highest % in range [e.g., (30 - 100), use 100]	Adjust to 100% (e.g., 100 ÷ 190.5 = 52.5%)
Propane	30 - 100	100	52.5
Methane	20 - 60	60	31.5
1,3-pentadiene, (*E*)-	10 - 15	15	7.9*

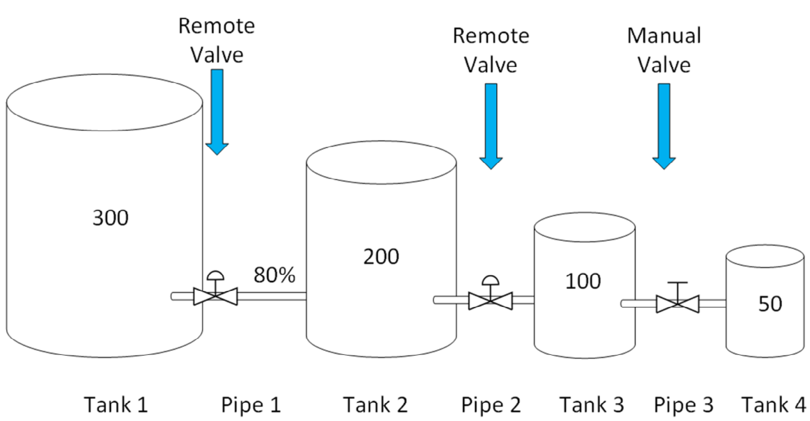
Substances	%	Use highest % in range [e.g., (30 - 100), use 100]	Adjust to 100% (e.g., 100 ÷ 190.5 = 52.5%)
Toluene	5 - 10	10	5.2
Benzene	0.5 - 5	5	2.6
Xylene	0.1 – 0.5	0.5**	0.3
	Total =	**190.5 %**	**100.0%**

* Not an E2 substance (CAS #2004-70-8), will not be included in calculations
** Below concentration of Schedule 1 Column 3 concentration threshold for substance therefore not carried forward in the total quantity calculations

Substances and percentages that are recommended for use in calculations

E2 Substances	%
Propane	52.5
Methane	31.5
Toluene	5.2
Benzene	2.6

Container system diagram showing total quantity on-site (tonnes)



Substances found within the mixture from the Regulations

	Column 1	Column 2	Column 3	Column 4	Column 5
Item	**CAS Registry Number**	**Name of Substance**	**Concentration (% mass/mass)**	**Minimum Quantity (tonnes)**	**Hazard Category (Short Form)**
17[1]	74-98-6	Propane	1	4.5	E
7[1]	74-82-8	Methane	1	4.5	E
83[2]	108-88-3	Toluene	1	2500	C
6[1]	71-43-2	Benzene	1	10	C

	Column 1	Column 2	Column 3	Column 4	Column 5
Item	CAS Registry Number	Name of Substance	Concentration (% mass/mass)	Minimum Quantity (tonnes)	Hazard Category (Short Form)
146[3]	1330-20-7	Xylenes	1	8000	C

[1] Substance found under Sch 1 – page 14
[2] Substance found under Sch 1 – page 16
[3] Substance found under Sch 1 – page 19

Maximum capacity of largest container system

- Not all substances make the concentration cut-off as shown in Column 3 in Part 2 of Schedule 1. Xylene does not meet the cut-off concentration.
- Container systems are separated by automatic or remote valves, but not manual valves.

Maximum capacity calculations

1st container system (tank 1 + 20% pipe 1): 400 + 0.2 (2) = 400.4 tonnes

2nd container system (tank 2 + 80% pipe 1 + 50% pipe 2): 250 + 0.8(2) + 0.5 (1) = 252.1 tonnes

3rd container system (tank 3 + 0.5% pipe 2 + pipe 3 + tank 4) = 125 + 0.5(1) + 1 + 80 = 206.5 tonnes

The maximum capacity of the single largest container system is 400.4 tonnes.

Total quantity on-site

Tank 1 + tank 2 + tank 3 + tank 4 + 3 pipes = 300 + 200 + 100 + 50 + 2 + 1 + 1 = 654 tonnes

Each individual E2 substance will need to be calculated for the total quantity on-site for that substance.

E2 Substance	%	654 Tonnes x % (on site)
Propane	52.5	343.35
Methane	31.5	206.01
Toluene	5.2	34.01
Benzene	2.6	17.00

Schedules to fill out

E2 Substance	Meets Container System Site vs E2 (tonnes)	Meets Total Quantity On-site vs E2 (tonnes)	Schedules needed to be completed
Propane	400.4 ≥ 4.5 Yes	343.35≥ 4.5 Yes	2, 3, 4, 5
Methane	400.4 ≥ 4.5 Yes	206.01 ≥ 4.5 Yes	2, 3, 4, 5
Toluene	400.4 < 2 500 No	34.01 < 2 500 No	none
Benzene	400.4 ≥ 10 Yes	17.00 ≥ 10 Yes	2, 3, 4, 5
Xylenes	Concentration Not Met		None

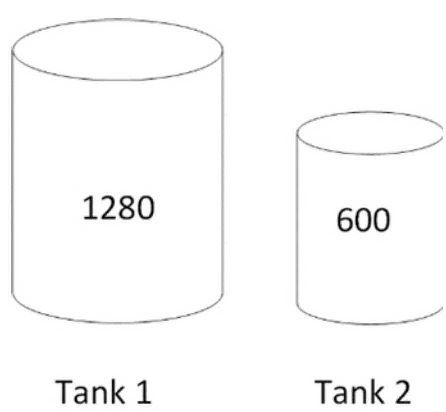
Part 2 substance (single substance, 2 tank systems, 2 substance concentrations)

Example 10 – Hydrochloric acid

Substance: Hydrochloric acid
Maximum capacity of individual tanks
Tank 1: Concentration: 40% with density: 1.198 g/cm^3
Tank 2: Concentration: 34% with density: 1.1691 g/cm^3

	Litres		
	Tank 1	**Tank 2**	**Pipes**
Max. Capacity	1600	800	0
Total Quantity	1280	600	0

Container system diagram showing total quantity on-site (litres):



Hydrochloric acid in the Regulations (Sch 1 – page 22)

	Column 1	Column 2	Column 3	Column 4	Column 5
Item	**CAS Registry Number**	**Name of Substance**	**Concentration (% mass/mass)**	**Total Quantity (tonnes)**	**Hazard Category (Short Form)**
7[1]	7647-01-0	Hydrochloric acid	30	6.8	I

[1] Substance found under Sch 1 – page 14

Maximum capacity of the largest container system

- Substance makes the concentration cut-off as shown in Column 3 in Part 2 of Schedule 1.

1st container system (tank 1)

$$tank\ 1 \times \frac{1600\ L}{tank\ 1} \times \frac{1000\ cm^3}{1\ L} \times \frac{1.198\ g}{1\ cm^3} \times \frac{1\ kg}{1000\ g} \times \frac{1\ tonne}{1000\ kg} = 1.93\ tonnes$$

2nd container system (tank 2)

$$tank\ 2 \times \frac{800\ L}{tank\ 2} \times \frac{1000\ cm^3}{1\ L} \times \frac{1.1691\ g}{1\ cm^3} \times \frac{1\ kg}{1000\ g} \times \frac{1\ tonne}{1000\ kg} = 0.94\ tonnes$$

The maximum capacity of the single largest container system is 1.93 tonnes.

Total quantity on-site calculation

$$tank\ 1 \times \frac{1280\ L}{tank\ 1} \times \frac{1000\ cm^3}{1\ L} \times \frac{1.198\ g}{1\ cm^3} \times \frac{1\ kg}{1000\ g} \times \frac{1\ tonne}{1000\ kg} \times 0.4 = 0.61\ tonnes$$

$$tank\ 2 \times \frac{600\ L}{tank\ 2} \times \frac{1000\ cm^3}{1\ L} \times \frac{1.1691\ g}{1\ cm^3} \times \frac{1\ kg}{1000\ g} \times \frac{1\ tonne}{1000\ kg} \times 0.34 = 0.24\ tonnes$$

Total quantity on-site: 0.61 + 0.24 = 0.85 tonnes

Schedules to fill out

E2 Substance	Meets Maximum Capacity of Largest Container System (tonnes)	Total Quantity On-site vs E2 (tonnes)	Schedules to fill out
Hydrochloric acid	1.93 < 6.80 No	0.85 < 6.80 No	none

Part 2 substance (mixture)

Example 11 – Mixtures containing C and/or E substance

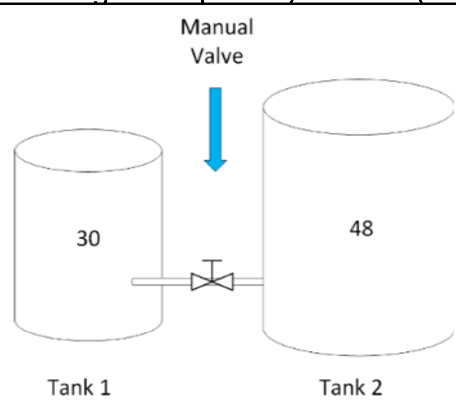
Substance: A mixture with an overall boiling point of 80 ºC and an overall flashpoint of -10 ºC (No CAS # assigned to this mixture)

	Tonnes		
	Tank 1	**Tank 2**	**Pipes**
Max. Capacity	50	60	1
Total Quantity	30	48	1

Composition of both tanks

E2 Substance	% (by Weight in Tonnes)
Naphtha	10
Methane	20
Propane	60
Benzene	5
2,2-dimethylpropane	5

Container system diagram showing total quantity on-site (tonnes)



Substances found within the mixture from the Regulations

	Column 1	Column 2	Column 3	Column 4	Column 5
Item	**CAS Registry Number**	**Name of Substance**	**Concentration (% mass/mass)**	**Minimum Quantity (tonnes)**	**Hazard Category (Short Form)**
191[1]	8030-30-6	Naphtha	1	50	C
7[2]	74-82-8	Methane	1	4.5	E
17[2]	74-98-6	Propane	1	4.5	E
6[2]	71-43-2	Benzene	1	10	C
117[3]	463-82-1	2,2-dimethylpropane	1	4.5	E

[1] Substance found under Sch 1 – page 20
[2] Substance found under Sch 1 – page 14
[3] Substance found under Sch 1 – page 18

<u>Maximum capacity of the largest container system</u>

- All substances make the concentration cut-off as shown in Column 3 in Part 2 of Schedule 1.
- Container systems are separated by manual, but not automatic or remote, valves.

Tank #1 (50 tonnes) + Tank #2 (60 tonnes) + pipe = 50 tonnes + 60 tonnes + 1.0 tonnes = 111 tonnes

The maximum capacity of the single largest container system is 111 tonnes.

<u>Total quantity on-site calculation</u>

Tank #1 (30 tonnes) + Tank #2 (48 tonnes) + pipe (1 tonne)
= 30 tonnes + 48 tonnes + 1.0 tonnes = 79 tonnes

Each individual E2 substance will need to be calculated for the total quantity on-site.

E2 Substance	%	79 Tonnes x % (on-site)
Naphtha	10	7.9
Methane	20	15.8
Propane	60	47.4
Benzene	5	3.95
2,2-dimethylpropane	5	3.95

Schedules to fill out

E2 Substance	Meets Maximum Capacity of Largest Container System (tonnes)	Total Quantity On-site vs E2 (tonnes)	Schedules to fill out
Naphtha	111 ≥ 50 Yes	7.9 < 50 No	2
Methane	111 ≥ 4.5 Yes	15.8 ≥ 4.5 Yes	2, 3, 4, 5
Propane	111 ≥ 4.5 Yes	47.4 ≥ 4.5 Yes	2, 3, 4, 5
Benzene	111 ≥ 10 Yes	3.95 < 10 No	2
2,2-dimethylpropane	111 ≥ 4.5 Yes	3.95 < 4.5 No	2

Example 12 – Aquatic mixture with acids

Substance: An aquatically toxic mixture (No CAS # assigned to this mixture)

Tank 1 = Chromic acid 26% with density: 0.3172 g/cm^3 (15 °C)
Arsenic acid 30% with density: 0.3699 g/cm^3 (15 °C)

No density for mixture provided – will be required to calculate overall density as part of example.

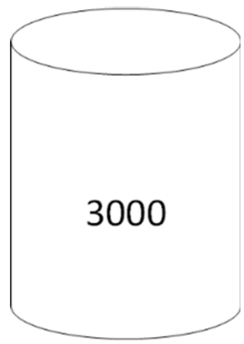
Composition in the tank

Substance	% (by volume)
Chromic Acid	26
Arsenic Acid	30
Water*	44

* not an E2 substance

	U.S. Gallons	
	Tank 1	Pipes
Max. Capacity	5000	0
Total Quantity	3000	0

Container system diagram showing total quantity on-site (U.S. gallons):



Tank 1

Substances found within the aquatic mixture in the Regulations (page 22)

	Column 1	**Column 2**	**Column 3**	**Column 4**	**Column 5**
Item	**CAS Registry Number**	**Name of Substance**	**Concentration (% mass/mass)**	**Minimum Quantity (tonnes)**	**Hazard Category (Short Form)**
12[1]	7738-94-5	Chromic acid	10	0.22	A
13[1]	7778-39-4	Arsenic acid	10	0.22	A

[1] Substance found under Sch 1 – page 14

Maximum capacity of the largest container system

- Check: Every substance meets the concentration shown in Column 3.
- Must be converted from U.S. gallons to tonnes.

- Will need to calculate the overall density of the mixture to determine the tonnes using this formula:

$$Density\ \left(\frac{g}{cm^3}\right) = \frac{Mass\ (g)_{Chromic\ acid} + Mass\ (g)_{Arsenic\ acid} + Mass\ (g)_{water}}{Volume\ (cm^3)_{Total}}$$

- Use the density of water as 1.0 g/cm^3

Calculating mass and volume

Mass (g)$_{\text{Chromic acid}}$

$$5\ 000\ US\ gallons \times \frac{3.785\ L}{1\ US\ gallon} \times \frac{1000\ cm^3}{1\ L} \times \frac{0.3172\ g}{1\ cm^3} \times 0.26 = 1.56078 \times 10^6\ g$$

Mass (g)$_{\text{Arsenic acid}}$

$$5\ 000\ US\ gallons \times \frac{3.785\ L}{1\ US\ gallon} \times \frac{1000\ cm^3}{1\ L} \times \frac{0.3699\ g}{1\ cm^3} \times 0.3 = 2.10011 \times 10^6\ \text{g}$$

Mass (g)water

$$5\,000\ US\ gallons \times \frac{3.785\ L}{1\ US\ gallon} \times \frac{1000\ cm^3}{1\ L} \times \frac{1.0\ g}{1\ cm^3} \times 0.44 = 8.327 \times 10^6\ \text{g}$$

Volume (cm^3)Total

$$5\,000\ US\ gallons \times \frac{3.785\ L}{1\ US\ gallon} \times \frac{1000\ cm^3}{1\ L} = 1.8925 \times 10^7\ cm^3$$

Calculating the density of the overall solution

$$Density\ \left(\frac{g}{cm^3}\right) = \frac{Mass\ (g)_{Chromic\ acid} + Mass\ (g)_{Arsenic\ acid} + Mass\ (g)_{water}}{Volume\ (cm^3)_{Total}}$$

$$= \frac{1.56078 \times 10^6 + 2.10011 \times 10^6 + 8.327 \times 10^6}{1.8925 \times 10^7 cm^3} = 0.633442\frac{g}{cm^3}$$

Calculating the tonnage of maximum capacity of the largest single container system

$$5\,000\ US\ gallons \times \frac{3.785\ L}{1\ US\ gallon} \times \frac{1000\ cm^3}{1\ L} \times \frac{0.633442\ g}{1\ cm^3} \times \frac{1\ kg}{1000\ g} \times \frac{1\ tonne}{1000\ kg} = 11.99\ tonnes$$

The maximum capacity of the single largest container system is 11.99 tonnes.

Total quantity on-site

Each individual E2 substance will need to be calculated for the total quantity on-site.

Chromic acid total quantity on-site

$$1\ tank \times \frac{3000\ US\ gallons}{1\ tank} \times \frac{3.785\ L}{1\ US\ gallon} \times \frac{1000\ cm^3}{1\ L} \times \frac{0.3172\ g}{1\ cm^3} \times \frac{1\ kg}{1000\ g} \times \frac{1\ tonne}{1000\ kg} \times 0.26 = 0.94\ tonnes$$

Arsenic acid total quantity on-site

$$1\ tank \times \frac{3000\ US\ gallons}{1\ tank} \times \frac{3.785\ L}{1\ US\ gallon} \times \frac{1000\ cm^3}{1\ L} \times \frac{0.3699\ g}{1\ cm^3} \times \frac{1\ kg}{1000\ g} \times \frac{1\ tonne}{1000\ kg} \times 0.3 = 1.26\ tonnes$$

E2 Substance	%	Tonnes (on-site)
Chromic acid	26	0.94
Arsenic acid	30	1.26

Schedules to fill out

E2 Substance	Meets Container System Site vs E2 (tonnes)	Meets Total Quantity On-site vs E2 (tonnes)	Schedules to fill out
Chromic acid	11.99 ≥ 0.22 Yes	0.94 ≥ 0.22 Yes	2, 3, 4, 5
Arsenic acid	11.99 ≥ 0.22 Yes	1.26 ≥ 0.22 Yes	2, 3, 4, 5

Example 13 – Inhalation mixture with acids

Substance: An inhalation toxic mixture (No CAS # assigned to this mixture)

Tank 1 = Acetic acid 95% with density: 1.00748 g/cm^3 (20 °C)
Peracetic acid 5% with density: 1.15 g/cm^3 (20 °C)
Overall density of mixture = 1.0146 g/cm^3

Composition in the tank

E2 Substance	% (by volume)
Acetic Acid	95
Peracetic Acid	5

	U.S. Gallons	
	Tank 1	Pipes
Max. Capacity	2 000	0
Total Quantity	1 600	0

Container system diagram showing total quantity on-site (U.S. gallons):

<u>Substances found within the inhalation mixture in the Regulations (page 22)</u>

	Column 1	Column 2	Column 3	Column 4	Column 5
Item	**CAS Registry Number**	**Name of Substance**	**Concentration (% mass/mass)**	**Minimum Quantity (tonnes)**	**Hazard Category (Short Form)**
2[1]	64-19-7	Acetic acid	95	6.80	A
4[1]	79-21-0	Peracetic acid	10	4.50	A

[1] Substance found under Sch 1 – page 22

<u>Maximum capacity of the largest container system</u>

- Use density of 1.0146 g/cm^3 to determine maximum capacity of largest container system

$$2\,000\ US\ gallons \times \frac{3.785\ L}{1\ US\ gallon} \times \frac{1000\ cm^3}{1\ L} \times \frac{1.0146\ g}{1\ cm^3} \times \frac{1\ kg}{1000\ g} \times \frac{1\ tonne}{1000\ kg} = 7.68\ tonnes$$

The maximum capacity of the single largest container system is 7.68 tonnes.

<u>Total quantity on-site</u>

- Peracetic acid is below the concentration and will not be considered in the calculations.

Acetic acid (95%) total quantity on-site

$$1\,600\ US\ gallons \times \frac{3.785\ L}{1\ US\ gallon} \times \frac{1000\ cm^3}{1\ L} \times \frac{1.00748\ g}{1\ cm^3} \times \frac{1\ kg}{1000\ g} \times \frac{1\ tonne}{1000\ kg} \times 0.95 = 5.80\ tonnes$$

E2 Substance	%	Tonnes (on-site)
Acetic acid	95	5.80

<u>Schedules to fill out</u>

E2 Substance	Meets Container System Site vs E2 (tonnes)	Meets Total Quantity On-site vs E2 (tonnes)	Schedules to fill out
Acetic acid	7.68 ≥ 6.80 Yes	5.80 < 6.80 No	2

E2 Substance	Meets Container System Site vs E2 (tonnes)	Meets Total Quantity On-site vs E2 (tonnes)	Schedules to fill out
Peracetic acid	Did Not Meet Concentration		None

Example 14 – Inhalation mixture with acids

Tank 1 and Tank 2 = Nitric acid 13% with density 1.072 g/cm^3 (20 °C)
Hydrochloric acid 40% with density 1.198 g/cm^3 (20 °C)
No density for mixture provided – will be required to calculate overall density as part of example

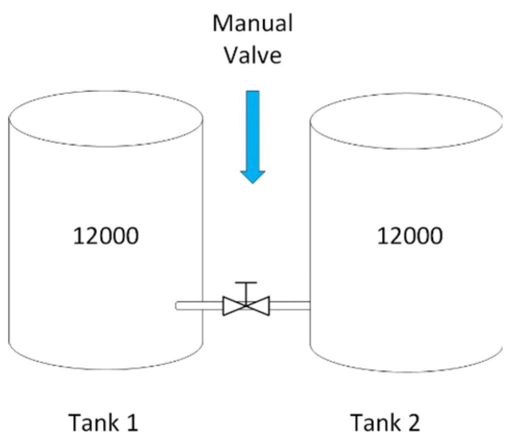
Composition in the tank

E2 Substance	% (by volume)
Nitric Acid	13
Hydrochloric Acid	40
Water*	47

* Not an E2 substance

	Litres		
	Tank 1	Tank 2	Pipes
Max. Capacity	20 000	20 000	20
Total Quantity	12 000	12 000	20

<u>Container system diagram showing total quantity on-site (litres):</u>



Substances found within the inhalation mixture in the Regulations (page 22)

	Column 1	Column 2	Column 3	Column 4	Column 5
Item	**CAS Registry Number**	**Name of Substance**	**Concentration (% mass/mass)**	**Minimum Quantity (tonnes)**	**Hazard Category (Short Form)**
7[1]	7647-01-0	Hydrochloric acid	30	6.80	I
10[1]	7697-37-2	Nitric acid	80	6.80	I

[1] Substance found under Sch 1 – page 22

Maximum capacity of the largest container system

- Check: Every substance meets the concentration shown in Column 3.
- Manual valve does not distinguish between container systems. Therefore, this is considered to be one large container system.
- Will need to calculate the overall density of the mixture to determine the tonnes using this formula:

$$Density\ \left(\frac{g}{cm^3}\right) = \frac{Mass\ (g)_{Nitric\ acid} + Mass\ (g)_{Hydrochloric\ acid} + Mass\ (g)_{water}}{Volume\ (cm^3)_{Total}}$$

- Use the density of water as 1.0 g/cm^3
- Total volume in litres is 20 000 + 20 000 + 20 = 40 020 litres

Calculating mass and volume

Mass (g)$_{\text{Nitric acid}}$

$$40\ 020\ litres \times \frac{1000\ cm^3}{1\ L} \times \frac{1.072\ g}{1\ cm^3} \times 0.13 = 5.57719 \times 10^6 g$$

Mass (g)$_{\text{Hydrochloric acid}}$

$$40\ 020\ litres \times \frac{1000\ cm^3}{1\ L} \times \frac{1.198\ g}{1\ cm^3} \times 0.4 = 1.91776 \times 10^7 \text{g}$$

Mass (g)$_{\text{water}}$

$$40\ \ 020\ litres \times \frac{1000\ cm^3}{1\ L} \times \frac{1.0\ g}{1\ cm^3} \times 0.47 = 1.88094 \times 10^7 \text{g}$$

Volume (cm^3)$_{\text{Total}}$

$$40\ \ 020\ litres \times \frac{1000\ cm^3}{1\ L} = 4.002 \times 10^7 cm^3$$

Calculating the density of the overall solution

$$Density\ \left(\frac{g}{cm^3}\right) = \frac{Mass\ (g)_{Nitric\ acid} + Mass\ (g)_{Hydrochloric\ acid} + Mass\ (g)_{water}}{Volume\ (cm^3)_{Total}}$$

$$= \frac{5.57719 \times 10^6 + 1.91776 \times 10^7 + 1.88094 \times 10^7}{4.002 \times 10^7 cm^3} = 1.08856\frac{g}{cm^3}$$

Calculating the tonnage of the maximum capacity of the largest single container system

$$40\ 020\ litres \times \frac{1000\ cm^3}{1\ L} \times \frac{1.08856\ g}{1\ cm^3} \times \frac{1\ kg}{1000\ g} \times \frac{1\ tonne}{1000\ kg} = 43.56\ tonnes$$

The maximum capacity of the single largest container system is 43.56 tonnes.

Total quantity on-site

- Nitric acid does not reach the concentration specified in Column 3 of Part 2 and therefore is not considered a substance under the Regulations. Nitric acid will not be used in the calculations below.

There are two tanks and one pipe between the tanks.
The total quantity is 12 000 L + 12 000 L + 20 L = 24 020 L

Hydrochloric acid (40%) total quantity on-site

$$24\ 020\ litres \times \frac{1000\ cm^3}{1\ Litre} \times \frac{1.198\ g}{1\ cm^3} \times \frac{1\ kg}{1000\ g} \times \frac{1\ tonne}{1000\ kg} \times 0.40 = 11.51\ tonnes$$

E2 Substance	%	Tonnes (on-site)
Hydrochloric acid	40	11.51

Schedules to fill out

E2 Substance	Meets Container System Site vs E2 (tonnes)	Meets Total Quantity On-site vs E2 (tonnes)	Schedules to fill out
Hydrochloric acid	43.56 ≥ 6.80 Yes	11.51 ≥ 6.80 Yes	2, 3, 4, 5
Nitric acid	Concentration Not Met		None

Example 15 – Inhalation mixture with acids

Tank 1, Tank 2 and Tank 3 all contain:

Hydrochloric acid at 30% (v/v) at 20 °C has a density of 1.1493 g/cm^3

Hydrofluoric acid at 60% (v/v) at 0 °C has a density of 1.235 g/cm^3

Hydrobromic acid at 10% (v/v) at 25 °C has a density of 1.728 g/cm^3

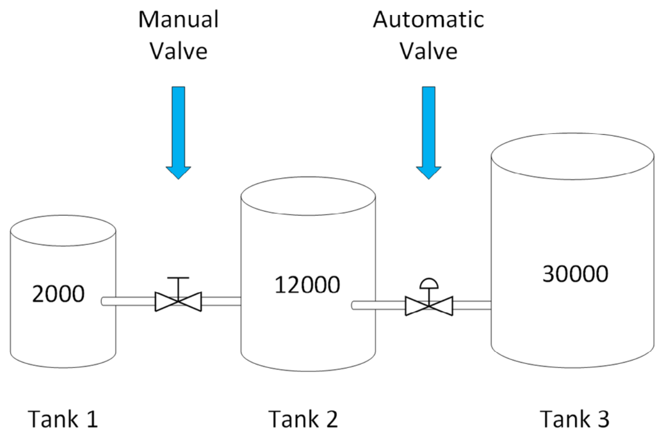
Density of solution = 1.2586 g/cm^3

Composition in the tank

E2 Substance	% (U.S. Gallons by Volume)
Hydrochloric acid	30
Hydrofluoric acid	60
Hydrobromic acid	10

	U.S. Gallons			
	Tank 1	Tank 2	Tank 3	Pipes
Max. Capacity	2500	15 000	37 500	100
Total Quantity	2000	12 000	30 000	100

Container system diagram showing total quantity on-site (U.S. gallons)



Substances found within the inhalation mixture in the Regulations (page 22)

	Column 1	Column 2	Column 3	Column 4	Column 5
Item	**CAS Registry Number**	**Name of Substance**	**Concentration (% mass/mass)**	**Minimum Quantity (tonnes)**	**Hazard Category (Short Form)**
7	7647-01-0	Hydrochloric acid	30	6.80	I
8	7664-39-3	Hydrofluoric acid	50	0.45	I
15	10035-10-6	Hydrobromic acid	10	1.13	I

Maximum capacity of the largest container system

- All substances make the concentration cut-off as shown in Column 3 in Part 2 of Schedule 1.
- Container systems are separated by automatic or remote valves, but not manual valves.

Maximum capacity calculations

1st container system (tank 1 + tank 2 + 1 pipe + ½ pipe): 2 500 + 15 000 + 1 pipe (100) + ½ pipe (100) = 17 650 U.S. Gallons

2nd container system (tank 3 + ½ pipe): 30 000 + ½ pipe (100) = 30 050 U.S. Gallons

The largest container system has 30 050 U.S. Gallons. Convert this value to tonnes.

$$30\ 050\ US\ gallons \times \frac{3.785\ litres}{1\ US\ gallon} \times \frac{1000\ cm^3}{1\ litre} \times \frac{1.2586\ g}{1\ cm^3} \times \frac{1\ kg}{1000\ g} \times \frac{1\ tonne}{1000\ kg} = 143.15\ tonnes$$

The maximum capacity of the single largest container system is 143.15 tonnes.

Total quantity on-site

Tank 1 + tank 2 + tank 3 + 2 pipes = 2000 + 12 000 + 30 000 + 2 pipes (each 100) = 44 200 U.S. gallons

Each individual E2 substance will need to be calculated for the total quantity on-site.

Hydrochloric acid

$$44\ 200\ US\ gallons \times \frac{3.785\ litres}{1\ US\ gallon} \times \frac{1000\ cm^3}{1\ liter} \times \frac{1.1493\ g}{1\ cm^3} \times \frac{1\ kg}{1000\ g} \times \frac{1\ tonne}{1000\ kg} \times 0.3 = 57.68\ tonnes$$

Hydrofluoric acid

$$44\ 200\ US\ gallons \times \frac{3.785\ litres}{1\ US\ gallon} \times \frac{1000\ cm^3}{1\ Litre} \times \frac{1.235\ g}{1\ cm^3} \times \frac{1\ kg}{1000\ g} \times \frac{1\ tonne}{1000\ kg} \times 0.6 = 123.97\ tonnes$$

Hydrobromic acid

$$44\ 200\ US\ gallons \times \frac{3.785\ litres}{1\ US\ gallon} \times \frac{1000\ cm^3}{1\ Litre} \times \frac{1.728\ g}{1\ cm^3} \times \frac{1\ kg}{1000\ g} \times \frac{1\ tonne}{1000\ kg} \times 0.1 = 28.91\ tonnes$$

E2 Substance	%	Tonnes (on-site)
Hydrochloric acid	30	57.68
Hydrofluoric acid	60	123.97
Hydrobromic acid	10	28.91

Schedules to fill out

E2 Substance	Meets Container System Site vs E2 (tonnes)	Meets Total Quantity On-site vs E2 (tonnes)	Schedules to fill out
Hydrochloric acid	143.15 ≥ 6.80 Yes	57.68 ≥ 6.80 Yes	2, 3, 4, 5
Hydrofluoric acid	143.15 ≥ 0.45 Yes	123.97 ≥ 0.45 Yes	2, 3, 4, 5
Hydrobromic acid	143.15 ≥ 1.13 Yes	28.91 ≥ 1.13 Yes	2, 3, 4, 5

APPENDIX 4

Additional Guidance on Certain Exclusions

Substance exclusions

2(2)(a)

The exclusion reads as follows:

> *A substance that is identified in column 5 of Part 1 of Schedule 1 as combustible or likely to explode and*
>
> *i) Is in a mixture that has a flashpoint greater than 23 ºC and a boiling point greater than 35 ºC, or*
> *ii) Is a component of natural gas in its gaseous form;*

The first part of this exclusion targets specifically the substances listed in Part 1 of Schedule 1. More importantly, the substances that can be used for this exclusion needs to have a hazard category of either combustible (C) and/or explosion hazard (E). Thus, only substances categorized as C and/or E that are listed in Part 1 of Schedule 1 are applicable for this exclusion. Also, a mixture involving (C) and/or (E) will be excluded if the flashpoint is greater than 23 °C and the boiling point is greater than 35 °C.

Since natural gas in its gaseous form is not listed under Schedule 1, this exclusion prevents any components of natural gas, such as methane, butane, etc., from being used to capture natural gas, because natural gas in its gaseous form is to be excluded in the Regulations.

2(2)(d)

The exclusion reads as follows:

> *A substance that is regulated under the Transportation of Dangerous Goods Act, 1992 or the Canada Shipping Act, 2001;*

Any chemical that is in transportation, being loaded or offloaded from a means of transportation and regulated under either the Transportation of Dangerous Goods Act, 1992, or the Canada Shipping Act, 2001, is exempted from the Regulations. However, these acts do not apply once the substance is unloaded at site, which is when the Regulations are applicable to the substance.

Quantity exclusions

3(2)(a)

The quantity exclusion reads as follows:

> *Quantities of the substance that are located at the facility for a period of 72 hours or less, unless the substance is loaded or unloaded at the facility, if, during that period, the person keeps evidence of the date and time at which the quantities of the substance arrived at the facility.*

Before attempting to identify if this quantity exemption is valid or not, one must verify if the substance is not excluded in 2(2).

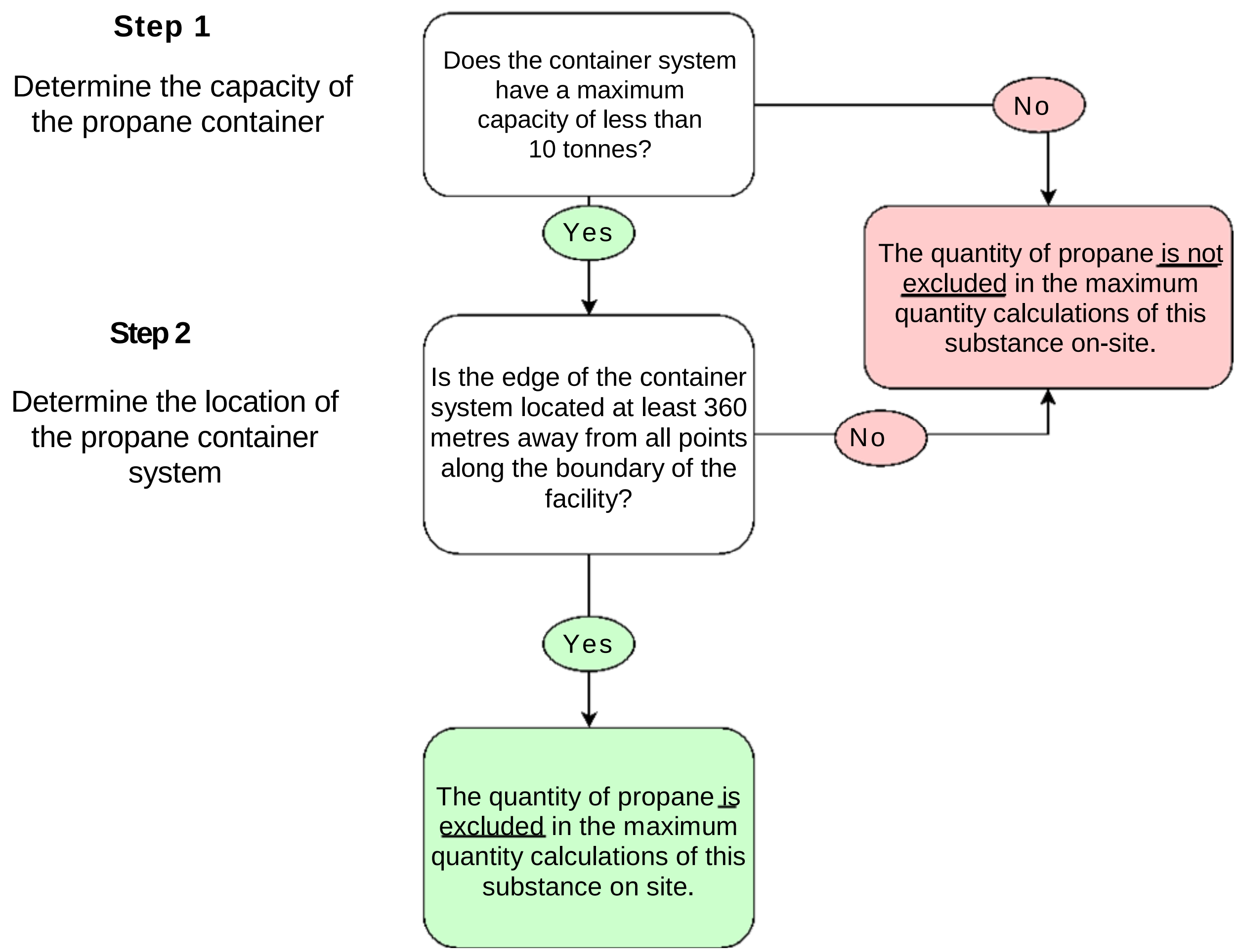
The 3(2)(a) exclusion targets the quantities that are at the facility for up to a maximum of 72 hours. The quantities of the substance are not loaded or unloaded at the site. For this exclusion to be applicable, a record of the date and time must be kept to prove the quantities of the substance were only kept on-site for the 72-hour period, and were not loaded or unloaded during this time.

3(2)(d)

The quantity exclusion reads as follows:

> *Quantities of the substance set out in item 17 of part 1 of Schedule 1 that are in a container system that has a maximum capacity of less than 10 t and is located at least 360 m from all points along the boundary of the facility;*

See flow chart below.



APPENDIX 5

Checklist to Prepare an Environmental Emergency Plan

Subsections 4(2), 4(3) and 5(1)

Checklist to Prepare an E2 plan		
Subsection or paragraph of the Regulations		Ask Yourself
4(2)(a)		*Description of properties and characteristics of the substance and the maximum expected quantity of the substance at the facility*
	☐	Is the information on the properties and the characteristics of the substances complete (e.g. colour, vapour pressure, boiling point, solubility, explosive, flammability, toxicity)?
	☐	Are there safety data sheets (SDSs) for the substances?
	☐	Are all SDS sections completed?
	☐	Are they up to date? (max. 3 years old)
4(2)(b)		*Description of activities (commercial, manufacturing, processing or other) involving the substance that takes place at the facility*
	☐	Is the type of activity involving each particular E2 substance at the facility well described?
4(2)(c)		*Description of the facility and of the area surrounding the facility that may be affected by an environmental emergency referred to in paragraph (d)*
	☐	Is there a map, detailed plan or complete description of the installation (facility) and its surroundings?
	☐	Does the surrounding area include any sensitive receptors, including hospitals, schools, residential, commercial or industrial buildings, and any highways, public transit infrastructure, parks, forests, wildlife habitats, water sources or water bodies?
	☐	Are they up to date?
	☐	Are the following elements clearly indicated on the facility plan?
	☐	Location of the dangerous substances
	☐	Location of personal protective equipment
	☐	Fire extinguishers
	☐	Emergency exits
	☐	Is there a plan or procedure to segregate incompatible substances?

	☐	Are the sensitive areas (hospitals; schools; residential, commercial or industrial buildings; highways; public railways; bus stations; specific flora; etc.) clearly identified?
	☐	Is all the information up to date?
4(2)(d)		*Identification of any environmental emergency that could reasonably be expected to occur at the facility and that would likely cause harm to the environment or constitute a danger to human life or health, including the environmental emergency referred to in paragraph (e) and, if applicable, that referred to in paragraph (f)*
	☐	Have you identified all environmental emergencies that can reasonably be expected to occur at the place and that would likely cause harm to the environment or constitute a danger to human life or health, including worst-case and alternative scenarios?
	☐	Has a history of internal accidents been compiled and kept up to date?
	☐	Has a history of external accidents in similar facilities been compiled and kept up to date?
	☐	Which analytical method was used to identify plausible scenarios (*What if*, *HAZOP, fault-tree*, etc.)?
	☐	Did a multidisciplinary team participate in identifying and evaluating risks? If so, who participated (operators, chemists, engineers, etc.)?
	☐	Did the consequence analysis use appropriate endpoints to calculate affected zones?
	☐	Is there a change management process?
	☐	Is there an accident investigation procedure?
	☐	Is there a procedure for investigating near-misses?
		Your worst-case scenario
	☐	Is a worst-case scenario presented for each substance?
	☐	Does the worst-case scenario involve the release of the maximum quantity of the substance that could be contained, **or not**, in the container system or container that has the largest maximum capacity?
	☐	Is it really the worst-case scenario?
	☐	Which software was used to calculate impact distances (RMP Comp, ALOHA, PHAST, other)? (if applicable)

	☐	Who did the modelling? Does the person have sufficient knowledge to perform it? (if applicable)
	☐	Are the modelling criteria appropriate? (if applicable)
	☐	Penalizing weather conditions?
	☐	Duration of leak?
	☐	Have passive and active mitigation measures been determined? If yes, which ones were used?
		Your alternative scenarios
	☐	Is an alternative scenario presented for each toxic substance?
	☐	Is the chosen scenario truly representative for each of these substances (site visit, verification of all scenarios to determine whether the chosen one is the best)?
	☐	Is the alternative scenario that would have the longest impact distance outside the boundary of the facility identified for each substance?
	☐	Is the justification of choices of alternative scenarios (risk evaluation: consequences × probabilities) presented?
	☐	Who did the analysis?
	☐	Was there participation of a multidisciplinary team in identifying the scenarios and risk evaluation?
	☐	Which software was used? Is this the best software? (if applicable)
	☐	Who did the modelling? Does the person have sufficient knowledge to perform modelling? (if applicable)
	☐	Are the modelling criteria appropriate? (if applicable)
	☐	Have passive and active mitigation measures been determined? If yes, which ones were used?
	☐	Are outside hazards and possible domino effects identified?
	☐	Is the predicted duration of the leak realistic?
4(2)(e)		*Identification of the harm to the environment or danger to human life or health that would likely result from an environmental emergency—that is, a* ***worst-case scenario***
	☐	Have you identified all the harm and danger from the worst-case scenario involving all regulated substances on-site?

	☐	Have you identified the harm and danger from the worst-case scenario involving the release of the maximum quantity of the contained or uncontained substance?
	☐	Is a cartographic representation of the impact areas and distances presented?
	☐	Is there a legend and a scale?
	☐	Are the locations of sensitive human elements (schools, hospitals, seniors' residences, etc.) and environmental elements (lakes, forests, wells, etc.) that may be affected clearly shown on the map?
	☐	Surroundings? (urban/rural)
4(2)(f)		*Identification of the harm to the environment or danger to human life or health that would likely result from the environmental emergency—that is, an **alternative scenario** that would have the longest impact distance outside the boundary of the facility*
	☐	Have you identified all the harm and danger from the alternative scenarios involving all regulated substances on-site?
	☐	Have you identified the harm and danger from the alternative scenario that have the longest impact distance outside the boundary of the facility?
	☐	Is a cartographic representation of the impact areas and distances presented?
	☐	Is there a legend and a scale?
	☐	Are the locations of sensitive human elements (schools, hospitals, seniors' residences, etc.) and environmental elements (lakes, forests, wells, etc.) that may be affected clearly shown on the map?
	☐	Surroundings? (urban/rural)
4(2)(g)		*Description of the measures to be taken to prevent and prepare for the environmental emergencies identified under paragraph (d) and the measures that will be taken to respond to and recover from such emergencies if they were to occur*
		Prevention
		Mitigation measures
	☐	Is there a fire protection system?
	☐	Is it verified regularly?
		Safety preventive barriers (examples)
	☐	Is there a regular maintenance program in place?
	☐	Is there a preventive maintenance program?

	☐	Do the maintenance programs reflect the manufacturers' recommendations?
	☐	Are the employees trained?
	☐	Are there detectors with alarms (i.e. high-level alarms)?
	☐	Are there automatic valves and interlock systems?
	☐	Are equipment and lines clearly identified (colour code / ID tags)?
	☐	Others?
		Safety protective barriers (examples)
	☐	Safety wall
	☐	Retention basin (good size, watertight, capacity, etc.)
	☐	Sprinklers, deluge system
	☐	Drills (testing of E2 plan)
	☐	Evacuation procedure
	☐	Others?
	☐	Redundancy, quality
	☐	Are barriers verified?
	☐	How often?
	☐	Have they been used when incidents have occurred?
	☐	Were they effective?
		Preparation (training, exercises)
		Preparation and notification measures
	☐	How are employees notified of a leak or other incident?
	☐	Do they know what the procedure is?
	☐	Do they understand the procedure?
	☐	Are there written procedures for
	☐	- the hazards of the material and substances on-site?
	☐	- the processes?
	☐	- the use of the various barriers?
	☐	Is there a mutual aid agreement with other local facilities?
		Response (internal procedure)
	☐	Is there a telephone list with government agencies that must be notified of an emergency? Is Environment and Climate Change Canada's number listed?

	☐	Is there an internal emergency response team?
	☐	Is the team adequately trained?
	☐	If there is no internal team, is there an agreement with a third party, such as local authorities, to respond in hazmat situations?
	☐	Have the third party's capabilities been evaluated? How?
	☐	Is the response path clearly explained?
	☐	Is there a response diagram?
	☐	Is there someone responsible for managing security and site access during an emergency?
	☐	Is there an investigation following an incident?
	☐	Are there recommendations?
	☐	Are they implemented?
		Restoration or recovery
	☐	Is there a procedure?
	☐	Does the company have the necessary resources?
	☐	If not, has it made provisions with a partner?
	☐	Have the partner's qualifications and abilities been assessed? How?
	☐	Are the planned measures suited to the location?
	☐	Are they appropriate with regard to the consequences?
4(2)(h)		*List of the position titles of the persons who will make decisions and take a leadership role in the event of an environmental emergency and a description of their roles and responsibilities*
	☐	Is there a list of the lead and decision-making position titles who are to bring into effect the plan in the event of an environmental emergency?
	☐	Is there a description of their roles and responsibilities?
	☐	Are the people listed aware that they are on the list?
	☐	Do these people know what their roles and responsibilities are?
	☐	Are the descriptions of the roles and responsibilities clear and complete?
	☐	Is there a chart or a table?
4(2)(i)		*List of the environmental emergency training that has been or will be provided to prepare personnel at the facility who will respond in the event that an environmental emergency identified under paragraph (d) occurs*

	☐	Is the training required to prepare personnel to respond to an environmental emergency identified?
	☐	Is the given training appropriate and in relation to the roles and responsibilities?
	☐	Has training on personal protective equipment been given?
	☐	Does it cover use and maintenance?
	☐	Has training on the detection equipment been given?
	☐	Does it cover the use, interpretation of the results, maintenance and calibration?
	☐	Has training on hazardous materials (WHMIS) been given?
	☐	Has this training been tested through exercise simulations?
4(2)(j)		*List of the emergency response equipment that is necessary for the measures described in paragraph (g) and the equipment's location*
	☐	Is a list of the emergency response equipment included?
	☐	Is the location of the equipment indicated?
	☐	Are the locations of the response equipment shown on the plan of the plant?
	☐	Does this equipment seem to be in good condition?
	☐	Is it sufficient and appropriate?
	☐	Does the regular and preventive maintenance program respect the manufacturers' recommendations?
	☐	Are the personnel qualified to maintain this equipment?
	☐	Are the personnel qualified to do the calibration?
4(2)(k)		*Description of the measures that will be taken by a responsible person or by a responsible person and local authorities, acting jointly, to communicate with the members of the public who may be adversely affected by the environmental emergency referred to in paragraph (f) to inform them,* ***before*** *the environmental emergency occurs*
	☐	Does the facility have a risk communication program for the public?
	☐	Who did the public communication: the facility or a third party? When?

	☐	Did you involve the local authorities (e.g., firefighters, police, city) in planning the measures to be taken?
	☐	What scenario was used to identify the affected public in the impact zone? If an alternative scenario, was it the one that would have the longest impact distance outside the boundary of the facility?
	☐	Does the facility participate in a local emergency preparedness or response committee or any public safety committees and group that include municipal, industry and government representatives and citizens?
	☐	What are the measures to be taken to inform the public before the environmental emergency occurs (e.g., participation in a joint coordinating committee, information session, posters, information bulletin)?
	☐	How effective are they?
	☐	How frequently have they been done? By whom?
	☐	Is the public aware of this and have they provided feedback?
	☐	Is there a reference to where more information and clarifications can be obtained?
(k)(i)		*The possibility that the environmental emergency could occur*
	☐	Information on the types of industries and all E2 substances on-site that can lead to an environmental emergency?
	☐	Information on all the types of hazard from E2 substances on-site?
	☐	Information on all possible accidents scenarios on-site that may have an adverse effect on the public outside the facility?
	☐	Information on the prevention measures that have been taken to reduce the risk of these accidents?
(k)(ii)		*The potential effects of the environmental emergency on the environment and on human life or health, taking into account the factors referred to in paragraphs (a) to (c)*
	☐	Information on the potential effects from all types of hazard on-site on human life or health (loss of life,

		permanent or temporary disability, minor injuries, etc.) of the public outside the facility?
	☐	Information on the potential effects from all types of hazard on-site on the environment (reversible or irreversible environmental damage, fire, toxic water contamination, etc.) outside the facility?
	☐	Did the potential effects adequately reflect the hazardous substances and its quantities on-site?
(k)(iii)		*The measures that will be taken by the responsible person to protect the environment and human life or health, and the means by which the responsible person will communicate with them, in the event that the environmental emergency occurs*
	☐	What are the measures to be taken to prevent an emergency (e.g., prevention and maintenance plans, surveillance and alarm systems)?
	☐	What are the measures to be taken to protect the environment and human life or health in the event that the environmental emergency occurs (e.g., evacuation, confinement)?
	☐	What are the means by which the responsible person will communicate with the affected public in the event that the environmental emergency occurs (e.g., siren, phone calls, text messages, radio, door to door)?
	☐	How effective are they?
4(2)(l)		*The measures that will be taken … to communicate with the members of the public …* ***during*** *and* ***after*** *an emergency, to provide them with information and guidance concerning the actions that could be taken by the responsible person acting alone or jointly with local authorities, to reduce the potential harm to the environment and danger to human life or health, including an explanation of how those actions help to reduce the harm or danger*
	☐	What are the measures to be taken **during** the environmental emergency to communicate with the members of the public who may be adversely affected (e.g., siren, emails, automatic calls, radio news)? Have they been accurately described in the plan?
	☐	What are the actions that could be taken by them to reduce the potential harm to the environment and danger to human life or health?
	☐	Was there an explanation of how those actions will

		help to reduce the harm or danger?
	☐	What are the measures to be taken AFTER the environmental emergency to communicate with the members of the public (e.g. press conference, news release, public meeting, evaluation presentations, social media)? Have they been accurately described in the plan?
4(2)(m)		*The position title of the individual who will communicate with the members of the public referred to in paragraphs (k) and (l)*
	☐	Is there a list of position titles of individual(s) who will communicate with the members of the public provided in the E2 plan? Was the list updated as necessary?
4(2)(n)		*The consultations that a responsible person had with local authorities, if any, with respect to the measures referred to in paragraphs (k) and (l)*
	☐	Did a responsible person consult with local authorities with respect to risk communication to the public?
	☐	Were those consultations satisfactory for both consulting parties or were there differences of opinion?
	☐	Was there an agreement between the facility and local authorities on who will do the communication to the affected public and how it will be done?
4(2)(o)		*A plan of the facility showing the location of any substances in relation to the physical features of the facility*
	☐	Does the facility plan show all the installations on-site and the exact location of any E2 substances in relation to the physical features of the facility?
	☐	Does the facility plan show distances between all E2 substances and other physical features of the facility, including property borders?

APPENDIX 6

Suggested Endpoints for the Regulations

1.0 Glossary

ADAM: Accident Damage Analysis Module – software developed in Europe for estimating impact distances for explosions, inhalation toxics and heat radiation impact distances.

AEGL-2 (1 hour): Acute Exposure Guideline Levels – the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.

ERPG-2 (1 hour): Emergency Response Planning Guidelines – the maximum concentration in air below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their ability to take protective action.

TEEL-2 (1 hour): Temporary Emergency Exposure Limits - the airborne concentration (expressed as ppm or mg/m3) of a substance above which it is predicted that the general population, including susceptible individuals, when exposed for more than one hour, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.

IDLH (30 minutes): Immediately Dangerous to Life and Health – the maximum airborne concentration from which one could escape within 30 minutes without any escape-impairing symptoms or any irreversible health effects.

2.0 Introduction

This section deals with suggested endpoints for inhalation, heat radiation and overpressure (explosion) effects that could be used within an E2 plan. The summarized endpoints are listed below:

- Inhalation endpoint: suggested endpoint would be the use of AEGL-02 (1 hour), where applicable.
- Heat radiation endpoint: suggested endpoint would be 5 kW/m^2.
- Overpressure endpoint: suggested endpoint would be 6.89 kPa (1 psi).

Specific endpoints to model or analyze the impact from substances identified as aquatically toxic have not been included. Any modelling or analysis conducted to determine the environmental emergencies that could cause harm should focus on the release and its potential pathways to a water body. The assessment and remediation of impacted water bodies may also be subject to requirements under the *Fisheries Act*.

2.1 Overpressure (explosion)

A vapour cloud explosion could yield a blast wave overpressure of 20.68 kPa (3.0 psi) at a distance of 100 metres from the blast site and could have potentially lethal effects in the community beyond the fence line. Lower overpressure levels could also potentially lead to serious or fatal injuries from indirect effects such as injury from flying glass or other debris in some cases. However, for lower pressures, the likelihood of a fatality is lower because there would be less damage to buildings and flying objects would have less force. **Typically, an E2 plan would model or analyze an endpoint of 6.89 kPa (1 psi)**. The table below describes estimated damages caused by overpressure.

Table 1: Overpressure Effects

Pressure		Effects on Structure	Effects on People
Psi	kPa		
0.3	2.07	• Safe distance • Damage limited to ceilings of houses • 10% window breakage	Thresholds of effects delineating the area of indirect effects by window breakage on people
1.0	6.9	• Partial demolition of houses rendering them uninhabitable • 90% of windows broken • Threshold of minor structural damage	Thresholds of irreversible effects delineating the “significant hazards to human life area”
2.0	13.8	• Partial collapse of house ceilings and walls; possible damage to large hydrocarbon tanks	Threshold of lethal effects delineating the “severe hazards to human life area”
3.0	20.7	• Steel structures of buildings are damaged and torn from their foundations • “Significant damage” threshold for glass domino effect threshold in which the effects must be analyzed	Significant effects threshold delineating the “very severe hazards to human life area”
4.4	30	• Threshold of very severe damage to structures	-
7.0	48.2	• Loaded transportation containers are overturned	-

CRAIM, Risk Management Guide for Major Industrial Accidents, Intended for Municipalities and Industry, p. 59, 2007.

2.2 Heat radiation

The flame from a fire can expose one to different levels of heat radiation. **Typically, an E2 plan would model or analyze an endpoint of 5 kW/m²**. There is a suggested equation to estimate the lethality base for humans exposed to heat radiation. The probit (Pr) equation comes from the software referred to as ADAM and is based on animal data.

Equation 1

$$\mathrm{Pr} = -13.65 + 2.56 \times LN[C^{1.333333} \times t]$$

Where:

$$C = \frac{kW}{m^2}$$

t = seconds

After calculating Pr, one can then enter this code into Microsoft Excel to estimate the percent human lethality = (NORMSDIST(Pr-5))*100.

This equation has been used to generate tables that may be of use for understanding exposure times and percent lethality in humans.

Table 2: Constant Time (sec) vs Increasing Heat Radiation and its Estimated Human Lethality

Time (seconds)	Concentration (kW/m^2)	% Lethality
4	5.00	0.00
4	10.00	0.00
4	15.00	0.00
4	20.00	0.00
4	25.00	0.00
4	30.00	0.02
4	35.00	0.15
4	40.00	0.60
4	45.00	1.75
4	50.00	4.02
4	55.00	7.74
4	60.00	13.01
4	65.00	19.70
4	70.00	27.44
4	75.00	35.79
4	80.00	44.28
4	85.00	52.52

Table 3: Constant Heat Radiation (kW/m2) vs Increasing Time (sec) and its Estimated Human Lethality

Concentration (kW/m2)	Time (seconds)	% Lethality
5.00	10	0.00
5.00	20	0.00
5.00	30	0.00
5.00	40	0.01
5.00	50	0.08

Concentration (kW/m2)	Time (seconds)	% Lethality
5.00	60	0.37
5.00	70	1.13
5.00	80	2.63
5.00	90	5.08
5.00	100	8.58
5.00	110	13.07
5.00	120	18.39
5.00	130	24.34
5.00	140	30.65
5.00	150	37.10
5.00	160	43.49
5.00	170	49.65

The table below describes the effects of heat radiation upon structures and humans.

Table 4: Effects of Heat Radiation

Radiation (kW/m^2)	Effects on Structure	Effects on People
1.2	-	Received from the sun at noon in summer[2]
1.6	-	Will not cause discomfort even after a long exposure period[1]
2	-	Minimum to cause pain after 1 minute[2]
3	-	Irreversible effects threshold delineating the “significant hazards to human life area”[1]
4	-	Sufficient to cause pain to employees unable to take cover within 20 seconds. However, skin blistering is possible (2nd degree burns) [1] 0% mortality[1]
Less than 5	-	Will cause pain in 15–20 seconds after injury after 30-second exposure[2]
5	Significant destruction of glass threshold[1]	Second degree burns after 20 seconds[1] Lethal effects threshold delineating the “severe hazards to human life area”[1]
Greater than 6	-	Pain within approximately 10 seconds; only rapid escape is possible[2]

Radiation (kW/m^2)	Effects on Structure	Effects on People
8	Domino effects threshold corresponding to the severe damage to structures threshold[1]	Lethal effects hazard delineating the “very severe hazards to human life area”[1]
9.5	-	Pain threshold reached after 8 seconds[1] Second degree burns after 20 seconds[1]
12.5	Minimal energy required to ignite wood in the presence of an open flame and melt plastic tubing[1] *Thin steel with insulation on the side away from the fire may reach thermal stress level high enough to cause structural failure[2]	Significant chance of fatality for medium duration exposure[2]
25	Spontaneous ignition of wood after long exposure[2] Unprotected steel will reach thermal stress temperatures that can cause failure[2]	Likely fatality for extended exposure and significant chance of fatality for instantaneous exposure[2]
35	Cellulosic material will pilot ignite within one minute’s exposure[2]	Significant chance of fatality for people exposed instantaneously[2]

1 CRAIM, Risk Management Guide for Major Industrial Accidents, Intended for Municipalities and Industry, p. 58, 2007.
2 HSE, Methods of Approximation and Determination of Human Vulnerability for Offshore Major Accident Hazard Assessment, p. 17, 2017.

2.3 Inhalation toxics

When an emergency occurs involving the release of toxic substances, there are some Public Exposure Guidelines that establish endpoints effect that will help industry predict how members of the general public would be affected. We suggest using one of the four most common endpoint values for modelling or calculating impact distances for E2 substances that are toxic by inhalation **in this specific order**: AEGL-2[4] (60-minute), ERPG-2 (60-minute), TEEL-2 (60-minute) and 1/10 of IDLH (30-minute). **AEGL-2 is recommended** to be used as a first choice endpoint since this concentration is designed to protect sensitive individuals such as old, sick, or very young people. The table below has been assembled from the Web as a convenient reference for inhalation toxic endpoints. The values indicated as (F) are final for AEGL, but other values may be subject to change over time.

Table 5: Potential endpoints for inhalation hazard substances included in the

[4] AEGL values are developed for different exposure durations (10 min, 30 min, 60 min, 4 hours and 8 hours). ECCC recommends to choose the AEGL value with the exposure duration that is equal to or above the substance release time suggested in the scenario identified in the E2 plan. For example, if your scenario has a release time of 40 minutes then you have to choose AEGL-2 60 min. For a release time of 90 minutes, you will have to choose AEGL-2 4 hours.

Regulations

Item	CAS #	E2 Substance Name	AEGL-02[a]	ERPG-02[b]	TEEL-2[c]	IDLH[d] (1/10)
1	50-00-0	formaldehyde, solution	14 (I)	10	14	20 (2)
2	57-14-7	1,1-dimethylhydrazine	3.0 (F)	None	3	15 (1.5)
3	60-34-4	methylhydrazine	0.90 (F)	None	0.9	20 (10)
4	64-19-7	acetic acid	None	35	35	50 (5)
5	67-66-3	chloroform	64 (F)	50	64	500 (50)
6	74-83-9	methyl bromide	210 (F)	50	210	250 (25)
7	74-87-3	methyl chloride	910 (F)	1000	910	2000 (200)
8	74-88-4	methyl iodide	82 (P)	50	50	100 (10)
9	74-90-8	hydrogen cyanide	7.1 (F)	10	7.1	50 (5)
10	74-90-8	hydrocyanic acid	7.1 (F)	None	7.1	None
11	74-93-1	methyl mercaptan	23 (F)	25	23	150 (15)
12	75-09-2	dichloromethane	560 (I)	750	560	2300 (230)
13	75-15-0	carbon disulphide	160 (F)	50	160	500 (50)
14	75-21-8	ethylene oxide	45 (F)	50	45	800 (80)
15	75-44-5	phosgene	0.30 (F)	0.5	0.3	2 (0.2)
16	75-55-8	propyleneimine	12 (F)	None	12	100 (10)
17	75-56-9	methyloxirane	290 (F)	250	290	400 (40)
18	75-74-1	tetramethyl lead	None	None	4 mg/m^3	40 mg (lead)/m^3 (4)
19	75-77-4	trimethylchlorosilane	22 (F)	20	22	None
20	75-78-5	dimethyldichlorosilane	11 (F)	10	11	None
21	75-79-6	methyltrichlorosilane	7.3 (F)	3	7.3	None
22	76-06-2	trichloronitromethane	0.15 (I)	0.15	0.15	2 (0.2)
23	78-00-2	tetraethyl lead	None	None	4 mg/m^3	40 mg (lead)/m^3 (4)
24	78-82-0	isobutyronitrile	2.0 (F)	30	2	None
25	79-21-0	Peracetic acid	1.6 mg/m^3 (F)	None	1.6 mg/m^3	None
26	79-22-1	methyl chloroformate	2.2 (F)	2	2.2	None
27	91-08-7	toluene-2,6-diisocyanate	0.083 (F)	0.15	0.083	None
28	106-89-8	oxirane (chloromethyl)-	24 (F)	20	24	75 (7.5)
29	107-02-8	acrolein	0.10 (F)	0.15	0.1	2 (0.2)
30	107-05-1	allyl chloride	54 (I)	40	54	250 (25)
31	107-06-2	1,2-dichloroethane	None	200	200	50 (5)

Item	CAS #	E2 Substance Name	AEGL-02[a]	ERPG-02[b]	TEEL-2[c]	IDLH[d] (1/10)
32	107-07-3	2-chloroethanol	1.2 (F)	None	1.2	7 (0.7)
33	107-11-9	allylamine	3.3 (F)	None	3.3	None
34	107-12-0	propionitrile	3.0 (F)	None	3	None
35	107-13-1	acrylonitrile	1.7 (F)	35	1.7	85 (8.5)
36	107-15-3	ethylenediamine	9.7 (F)	None	9.7	1000 (100)
37	107-18-6	allyl alcohol	1.7 (F)	None	1.7	20 (2)
38	107-30-2	chloromethyl methyl ether	0.47 (F)	1	0.47	None
39	108-05-4	vinyl acetate	36 (F)	75	36	None
40	108-23-6	isopropyl chloroformate	3.3 (F)	5	3.3	None
41	108-91-8	cyclohexylamine	8.6 (F)	None	8.6	None
42	108-95-2	phenol	23 (F)	50	23	250 (25)
43	109-61-5	propyl chloroformate	3.0 (F)	None	3.7	None
44	110-00-9	furan	6.8 (F)	None	6.8	None
45	110-89-4	piperidine	33 (F)	None	33	None
46	123-73-9	*trans*-crotonaldehyde	4.4 (F)	None	4.4	None
47	123-91-1	1,4-dioxane	320 (I)	None	320	500 (50)
48	126-98-7	methylacrylonitrile	1.0 (F)	None	1	4 (0.4)
49	151-56-4	ethyleneimine	4.6 (F)	None	4.6	100 (10)
50	302-01-2	hydrazine	13 (F)	5	13	50 (5)
51	353-42-4	boron trifluoride dimethyl etherate	None	None	29	None
52	463-51-4	ketene	0.063 (F)	None	0.063	5 (0.5)
53	506-68-3	cyanogen bromide	None	None	44	None
54	506-77-4	cyanogen chloride	None	0.05	0.05	None
55	509-14-8	tetranitromethane	0.52 (F)	None	0.52	4 (0.4)
56	542-88-1	bis(chloromethyl) ether	0.044 (F)	0.1	0.044	None
57	556-64-9	methyl thiocyanate	None	None	28	None
58	584-84-9	toluene-2,4-diisocyanate	0.083 (F)	0.15	0.083	2.5 (0.25)
59	594-42-3	perchloromethyl mercaptan	0.3 (F)	None	0.3	10 (1)
60	624-83-9	methyl isocyanate	0.067 (F)	0.25	0.067	3 (3)
61	630-08-0	carbon monoxide	83 (F)	350	83	1200 (120)
62	814-68-6	acryloyl chloride	None	None	0.24	None
63	1336-21-6	ammonium hydroxide	None	None	330	None
64	2551-62-4	sulphur hexafluoride	None	None	33000	None
65	4170-30-3	crotonaldehyde	4.4 (F)	5	4.4	50 (5)

Item	CAS #	E2 Substance Name	AEGL-02[a]	ERPG-02[b]	TEEL-2[c]	IDLH[d] (1/10)
66	7439-97-6	mercury	1.7 mg/m^3 (I)	0.25 (vapour)	1.7	10 mg (Hg)/ m^3 (1)
67	7446-09-5	sulphur dioxide	0.75 (F)	3	0.75	100 (10)
68	7446-11-9	sulphur trioxide	8.7 mg/m^3 (I)	10 mg/m^3	8.7	None
69	7550-45-0	titanium tetrachloride	1.0 (I)	20 mg/m^3	1	None
70	7616-94-6	perchloryl fluoride	4.0 (F)	None	4	100 (10)
71	7637-07-2	boron trifluoride	29 mg/m^3 (F)	30 mg/m^3	29	25 (2.5)
72	7647-01-0	hydrogen chloride, anhydrous	22 (F)	20	22	50 (5)
73	7647-01-0	hydrochloric acid	None	None	22	None
74	7664-39-3	hydrogen fluoride, anhydrous	24 (F)	20	24	30 (3)
75	7664-39-3	hydrofluoric acid	None	None	24	None
76	7664-41-7	ammonia, anhydrous	160 (F)	150	160	300 (30)
77	7664-41-7	ammonia solution	None	None	160	None
78	7697-37-2	Nitric acid	24 (F)	10	24	25 (2.5)
79	7719-09-7	thionyl chloride	2.4 (I)	2	2.4	None
80	7719-12-2	phosphorus trichloride	2.0 (F)	3	2	25 (2.5)
81	7723-14-0	phosphorus	11 mg/m^3 (P)	None	3	5 mg/m^3 (0.5)
82	7726-95-6	Bromine	0.24 (F)	0.5	0.24	3 (0.3)
83	7782-41-4	Fluorine	5.0 (F)	5	0.17	25 (2.5)
84	7782-50-5	chlorine	2.0 (F)	3	2	10 (1)
85	7783-06-4	hydrogen sulphide	27 (F)	30	27	100 (10)
86	7783-07-5	hydrogen selenide	0.11 (F)	0.2	0.11	1 (0.1)
87	7783-60-0	sulphur tetrafluoride	None	None	0.1	None
88	7784-34-1	arsenous trichloride	None	None	10	None
89	7784-42-1	arsine	0.17 (F)	0.5	0.17	3 (0.3)
90	7790-94-5	Chlorosulfuric acid	4.4 mg/m^3 (I)	10 mg/m^3	4.4 mg/m^3	None
91	7803-51-2	phosphine	2.0 (F)	0.5	2	50 (5)
92	7803-52-3	stibine	1.5 (I)	0.5	1.5	5 (0.5)
93	8014-95-7	sulphuric acid, fuming	8.7 mg/m^3 (I)	10 mg/m^3	8.7 mg/m^3	None

Item	CAS #	E2 Substance Name	AEGL-02[a]	ERPG-02[b]	TEEL-2[c]	IDLH[d] (1/10)
94	10025-87-3	phosphorus oxychloride	None	None	0.48	None
95	10035-10-6	hydrogen bromide	40 (F)	None	40	30 (0.3)
96	10035-10-6	hydrobromic acid	None	None	40	None
97	10049-04-4	chlorine dioxide	1.1 (F)	0.5	1.1	5 (5)
98	10102-43-9	nitric oxide	None	None	12	100 (10)
99	10102-44-0	nitrogen dioxide	12 (F)	15	12	20 (2)
100	10294-34-5	boron trichloride	29 mg/m^3 (F)	None	71	None
101	13463-39-3	nickel carbonyl	0.036 (F)	None	0.036	2 (0.2)
102	13463-40-6	iron pentacarbonyl	0.060 (F)	None	0.06	0.4 (0.04)
103	19287-45-7	diborane	1.0 (F)	1	1	15 (1.5)
104	20816-12-0	osmium tetroxide	0.0084 (I)	None	0.0084	1 mg (Os)/m^3 (0.1)
105	26471-62-5	toluene diisocyanate	None	None	0.083	None

[a] AEGL-02, Acute Exposure Guideline Levels, U.S. Environmental Protection Agency, 2017; (F) = final; (I) = interim; (P) = proposed; 60 minutes; ppm unless otherwise stated. https://www.epa.gov/aegl

[b] ERPG-02, Emergency Response Planning Guidelines, 2016; ppm unless otherwise stated. aiha.org

[c] TEEL-2, Temporary Emergency Exposure Limits, U.S Department of Energy, 2016; 60 minutes; ppm unless otherwise stated. https://www.energy.gov/

[d] IDLH, Immediately Dangerous to Life or Health, The National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, 2019; ppm unless otherwise stated. https://www.cdc.gov/niosh/idlh/intridl4.html

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