

Toxic process gas safety in water and wastewater treatment facilities

Guide to risk identification and controls for employers

About this resource

This fillable self-assessment tool is for employers using toxic process gases (TPGs) — specifically chlorine gas, anhydrous ammonia, or sulfur dioxide — for water treatment, water distribution, and/or wastewater treatment in B.C. This document is not intended to address ozone, which is another TPG found in water treatment, water distribution, and wastewater treatment.

Review the questions in each section to better understand the hazard, the risk, and whether your facility has effective controls in place to protect workers from TPG exposure.

Disclaimer for use

Please be aware that not all requirements in the Occupational Health and Safety (OHS) Regulation related to TPGs are included. This guide is simply a tool to help you understand risk, reduce risk, and decrease the likelihood of potential violations of the *Workers Compensation Act* and OHS Regulation. This is not a compliance checklist and should not be used as such.

Information is also available on our [Managing risk](#) page on worksafebc.com.

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General characteristics of chlorine gas, anhydrous ammonia, and sulfur dioxide

Chlorine gas (CAS# 7782-50-5)

- Disinfectant
- Sharp, pungent odour
- Heavier than air
- Corrosive to skin, eyes, and respiratory tract
- Oxidizer
- Time-weighted average (TWA): 0.5 ppm
- Short-term exposure limit (STEL): 1 ppm
- Immediately dangerous to life and health (IDLH): 10 ppm

Anhydrous ammonia (CAS# 7664-41-7)

- Pungent odour
- Lighter than air, but can become heavier than air in high-humidity environments
- Corrosive to skin, eyes, and respiratory tract
- Flammable
- Hygroscopic (readily attracts and holds water molecules)
- Time-weighted average (TWA): 25 ppm
- Short-term exposure limit (STEL): 35 ppm
- Immediately dangerous to life and health (IDLH): 300 ppm

Sulfur dioxide (CAS# 7446-09-5)

- Neutralizes chlorination
- Pungent odour
- Heavier than air
- Corrosive to skin, eyes, and respiratory tract
- Time-weighted average (TWA): 2 ppm
- Short-term exposure limit (STEL): 5 ppm
- Immediately dangerous to life and health (IDLH): 100 ppm

Part A: Assessing your risk and controls

Answer the following questions to assess the toxic process gases (TPGs) risk and controls in your facility. If you identify a deficiency, indicate the action(s) required to correct it, including the person assigned and the due date.

Risk identification

Which TPGs (chlorine, anhydrous ammonia, and/or sulfur dioxide) are present on site?
Response/comments

Action(s) to take, including person assigned and due date

How much of each TPG is present on site?
Response/comments

Action(s) to take, including person assigned and due date

Monitoring and alarms

Are there continuously operating fixed gas monitors inside the TPG enclosure?
Response/comments

Action(s) to take, including person assigned and due date

Where inside are the fixed gas monitors located?
Response/comments

Action(s) to take, including person assigned and due date

Is there a readout or display that allows a worker to check the measured concentration before entering the enclosure?

Yes No

Response/comments	
Is there a TPG monitoring and alarm system covering all indoor locations where TPGs are present inside piping or other equipment (i.e., in the same room or space where a loss of containment could occur)? <input type="checkbox"/> Yes <input type="checkbox"/> No Response/comments	If not, which areas lack monitors? Response/comments
Where applicable, if a pressure relief device engages because of an emergency or malfunction, will operators be notified? Response/comments	
Action(s) to take, including person assigned and due date	

Ventilation

Can a release of TPGs be safely exhausted to the outdoors from a TPG enclosure using a ventilation system (i.e., discharged outside without putting workers or other people at risk and without potentially drawing the TPG back into the building)? <input type="checkbox"/> Yes <input type="checkbox"/> No Response/comments
Was the ventilation system designed, installed, and maintained using established engineering principles? <input type="checkbox"/> Yes <input type="checkbox"/> No Response/comments
Are TPG enclosures equipped with emergency ventilation that can be safely activated (e.g., without entry into the enclosure) in emergency situations such as a TPG leak? <input type="checkbox"/> Yes <input type="checkbox"/> No Response/comments

Are TPG enclosure ventilation systems vapour-proof, dedicated, and resistant to corrosion by the TPGs they carry?

Yes No

Response/comments

Do the TPG enclosures have ventilation systems with fans located outside the building to keep the duct work and the enclosures under negative pressure?

Yes No

Response/comments

Risk mitigation

In the event of an emergency or accidental release, can connected cylinders or tonners be isolated to stop the flow of TPG either remotely from a safe location or automatically by an alarm system?

Yes No

Response/comments

If the TPG system is equipped with pressure relief or similar device:

- Do these devices exhaust safely to the outdoors?
- Are operators alerted if pressure relief devices engage because of an emergency or malfunction?

Yes No

Response/comments

Does the TPG piping system meet the following requirements?

- The system is constructed of materials designed to be resistant to corrosion caused by the gas it carries.
- It is constructed to withstand the pressures it is subjected to (e.g., it is safely routed, supported, and protected from impact damage, shock, and vibration).
- It is equipped with isolation, pressure venting, or bleed valves designed to purge the lines safely of residual gases before maintenance or servicing procedures.

Yes No

Response/comments

Are there appropriate, functioning emergency washing facilities that include the following:

- A tempered shower?
- A tempered eyewash station (15–30°C for 15 minutes) located within 6 metres (20 feet) of the hazard, while outside of the enclosure?

Yes No

Response/comments

Service and maintenance

Have critical components associated with TPG-handling equipment been identified?

- Have servicing and maintenance activities and frequencies been determined?
- Are servicing and maintenance frequencies being followed?
- Are service and maintenance completed by adequately trained people?

Note: Critical components may include equipment and piping containing TPGs, controls to prevent loss of containment, and/or controls to mitigate harm in case of loss of containment.

Yes No

Response/comments

How are the TPG ventilation systems monitored to detect failure of critical components of the system (e.g., fans, motors, air velocity)?

Note: Monitoring could be automated or be conducted through regular manual inspections.

Yes No

Response/comments

Are TPG monitors calibrated at least annually or according to the manufacturer's instructions, whichever is more often?

Yes No

Response/comments

Are TPG monitors and alarms tested monthly?

Yes No

Response/comments

Other employers and/or prime contractor

Have all third-party workers on site (including contractors) been oriented and trained to the site, including emergency procedures?

Yes No

Response/comments

If third-party workers are performing work on the TPG system(s), are they following the appropriate written procedures for the task, per the employer's exposure control plan?

Yes No

Response/comments

Is the work by third-party workers being done safely?

Yes No

Response/comments

Labels and signage

Are all critical components of equipment and machinery handling TPGs clearly identified (labelled)?

Yes No

Response/comments

Can the functions of all TPG control devices be readily determined (e.g., with the help of labels or signage)?

Yes No

Response/comments

Are all TPG pipes labelled to identify their contents?

Yes No

Response/comments

Personal protective equipment (PPE)

Is the personal protective equipment provided to workers adequate depending on the hazardous conditions (e.g., airborne concentration, nature of release) that could be present to protect against exposure through respiration, eyes, and skin?

Note: for chlorine, see the PPE section in the latest version of WorkSafeBC's publication, [Safe Work Practices for Chlorine](#).

Yes No

Response/comments

Do workers carry or wear appropriate respirators during tasks that will or may involve exposure?

Yes No

Response/comments

Do workers carry or wear appropriate respirators for the purpose of escaping from the TPG enclosure?

Yes No

Response/comments

Training and supervision

What process is in place to:

- Make sure all applicable workers are effectively trained on relevant procedures, plans, and documents (including those found in the exposure control plan and emergency plan)?
- Make sure workers are following all relevant procedures, plans, and documents?

Response/comments

Action(s) to take, including person assigned and due date

Part B: Assessing your exposure control plan

Use the following questions to assess whether your ECP meets the intent of the OHS Regulation requirements. If your ECP does not include an element listed below, identify the action(s) required to correct the deficiency, the person assigned to do so, and the due date.

Statement of purpose

A brief description of what the ECP is designed to do (e.g., protect workers from exposure to toxic process gases on site)

Does your ECP include this element?

Yes No

Action(s) to take, including person assigned and due date

Responsibilities

A list of assigned responsibilities relating to the ECP (which may include specific employer representatives, supervisors, workers, joint health and safety committee, third parties, etc.)

Does your ECP include this element?

Yes No

Action(s) to take, including person assigned and due date

TPGs identification

For all TPGs on site, a description of the risk that includes:

- Amount of TPG present
- Location(s) of the TPG
- Hazardous properties of the TPG
- Any other relevant details

Does your ECP include this element?

Yes No

Action(s) to take, including person assigned and due date

Risk assessment

An assessment of the risk that identifies how workers might be exposed:

- The locations, workers' positions, work activities, and specific ways in which workers might be exposed via inhalation, contact, or ingestion
- The expected extent of the exposure
- The likelihood that this exposure could happen

Does your ECP include this element?

Yes No

Action(s) to take, including person assigned and due date

Risk control

A description of measures in place to control the risk of exposure associated with the identified locations, workers' positions, work activities, and specific ways in which workers might be exposed

Does your ECP include this element?

Yes No

Action(s) to take, including person assigned and due date

Education and training

A description that addresses the following questions:

- Which workers must be educated and trained?
- What does this education and training include?
- When do workers receive training?
- How often are workers tested or retrained?
- How will workers demonstrate they are competent in and understand the content?

Does your ECP include this element?

Yes No

Action(s) to take, including person assigned and due date

Written work procedures

Clear, step-by-step written work procedures (if performed by the employer's workers) for controlling the risk of TPG exposure during activities such as:

- Entering the TPG enclosure
- Changing cylinders
- Other servicing and maintenance activities that may have risk of exposure to TPGs

Does your ECP include this element?

Yes No

Action(s) to take, including person assigned and due date

Hygiene facilities and decontamination procedures

Adequate hygiene facilities and decontamination procedures, including emergency washing stations to address eye, skin, and respiratory exposure

Does your ECP include this element?

Yes No

Action(s) to take, including person assigned and due date

Documentation

Adequate documentation of procedures, including maintenance and testing records, equipment manuals, training records, and calibration and other records of inspection

Does your ECP include this element?

Yes No

Action(s) to take, including person assigned and due date

Annual review

Annual review of the ECP in consultation with the joint committee or a worker representative to ensure the following:

- The ECP continues to be adequate for worker health and safety, and reflects the current workplace conditions.
- The ECP is fully implemented.

Does your ECP include this element?

Yes No

Action(s) to take, including person assigned and due date

Implementation of ECP

Consider the following questions to help you assess whether your ECP is in practice and maintained.

Is your written ECP as described above up to date?
Response/comments

Action(s) to take, including person assigned and due date

Has it been fully implemented (controls in place, relevant workers educated and trained, procedures followed, etc.)?
Response/comments

Action(s) to take, including person assigned and due date

Part C: Assessing your emergency plan

Employers are required to have an emergency plan in place. Answer the following questions to assess whether your emergency plan meets the intent of the OHS Regulation requirements. If your emergency plan does not include an element listed below, identify the action(s) required to correct the deficiency, the person assigned and the due date.

Inventory

An inventory that identifies:

- All hazardous substances that may endanger workers in an emergency, including the quantity, location(s), and nature of the hazard
- Location of safety data sheets (SDSs)

Does your emergency plan include this element?

Yes No

Action(s) to take, including person assigned and due date

Risk assessment

Risk assessment that addresses the following questions:

- What risks associated with TPGs may be on site, whether routine or emergency (risks posed by hazardous substances from accidental release, fire, or other such emergency)?
- What is the nature of the hazard (i.e., what are relevant health and physical hazards to workers in an emergency, and how severe could an emergency be)?
- Could emergency conditions arise at adjacent workplaces that may affect this workplace?
- Who would be at risk in an emergency?

- Does the risk assessment provide a clear explanation of the thought process behind the risk evaluation?
- What specific circumstances, events, failures, or errors could lead to an emergency?
- What root causes or contributing factors could lead to these specific circumstances, events, failures, or errors?
- What controls are in place to prevent and mitigate an emergency?
- What emergency conditions (e.g., maximum concentration of TPGs) are beyond what you could or would respond to without the assistance of third-party emergency responders? If an incident is beyond the site's capabilities, who will you rely upon?
- Have you confirmed that third-party emergency responders are capable, willing, and available to respond to a TPG emergency?

See also questions in [OHS guideline G5.99](#).

Does your emergency plan include this element?

Yes No

Action(s) to take, including person assigned and due date

Procedures — Emergency evacuation

Emergency evacuation procedures that address the following questions:

- What specific circumstances trigger an evacuation? (Be more specific than "a release of TPG.")
- How will workers (including third parties) and the first aid attendant be notified of an emergency and the need to evacuate?
- Where are the muster points?
- How will appropriate muster point(s) be chosen when an emergency happens?
 - Have alternative muster points been identified? How will you confirm that workers have been safely evacuated?
 - What happens if you determine that not all affected workers have reached the muster point?

Does your emergency plan include this element?

Yes No

Action(s) to take, including person assigned and due date

Procedures — Notification

Notification procedures that address the following questions:

- When and how will you notify adjacent employers and residences that may be affected if the risk of exposure extends beyond the workplace?
- When and how will you notify emergency responders?
- When and how will you notify relevant agencies (e.g., WorkSafeBC, Technical Safety BC, Emergency Management BC)?
- Who handles these notifications? If that person is absent, who is the backup?

Does your emergency plan include this element?

Yes No

Action(s) to take, including person assigned and due date

Procedures — Internal and external emergency responders

Emergency response procedures that address the following questions:

- Who will investigate and/or bring an emergency under control, and under what circumstances?
- Do procedures address all the different emergencies that could occur (e.g., loss of containment from TPG system, loss of containment from pressure relief devices)?

- Do the procedures explain how an emergency will be investigated and brought under control?
- How and when would the following occur?
 - Shutdown of the TPG supply from cylinders
 - Activating the enclosure's emergency ventilation system following loss of containment
 - Control emergency ventilation system
 - Other anticipated measures to respond to the incident
- How will workers responding to the emergency be protected (including personal protective equipment and monitoring equipment)?
- What equipment is available for responding to an emergency, and where is it located? What is done periodically to make sure this equipment is in good working condition?
- How will a TPG release be brought under control?
- How will you clean up (if possible) after bringing the situation under control?
- What testing will be done to determine that responders can safely enter the facility? How will this testing be done?
- Who will determine that the workplace can be safely reoccupied, and how will they determine this?
- If relying on third-party emergency responders, have you confirmed:
 - That they are available and willing to respond in the scope and capacity that you have identified to them?
 - That they are capable of responding (including having procedures, training, and appropriate personal protective equipment)?
 - If there are any limitations on their ability to respond?
 - Their expected response time?

Does your emergency plan include this element?

Yes No

Action(s) to take, including person assigned and due date

Training

A provision that addresses the following questions:

- Who gets what training?
- What does this training cover?
- When and how often does a worker receive this training?
- How will workers demonstrate they are competent in and understand the training content?

Does your emergency plan include this element?

Yes No

Action(s) to take, including person assigned and due date

Drills

A provision that addresses the following questions:

- How often will evacuation drills happen?
- How often will emergency response drills (to bring emergency conditions under control) happen?

Note: Evacuation drills must be conducted annually. Emergency response drills should be held regularly. WorkSafeBC generally considers the minimum frequency to be once a year, but a prevention officer may decide that more frequent drills are necessary.

Does your emergency plan include this element?

Yes No

Action(s) to take, including person assigned and due date

Annual review

Annual review of the emergency plan in consultation with the joint committee or a worker representative to ensure the following:

- The emergency plan continues to ensure worker health and safety, and reflects the workplace conditions.
- The emergency plan is fully implemented.

Does your emergency plan include this element?

Yes No

Action(s) to take, including person assigned and due date

Implementation of emergency plan

- Is your emergency plan for potential TPG releases, fires, and explosions (as described above) up to date?
- Is it fully implemented (controls in place, relevant workers trained, drills performed, etc.)?
- When was the last:
 - Evacuation drill?
 - Emergency response drill?
- Have adjustments been made to the emergency plan, as applicable, based on lessons learned (e.g., from the results of emergency response drills)?

Response/comments

Action(s) to take, including person assigned and due date

Appendix: Relevant OHS Regulation requirements

See the following sections of the OHS Regulation for more information about requirements relating to toxic process gases (TPGs) in the workplace.

Requirement	OHS Regulation
Workplace Hazardous Materials Information System (WHMIS)	5.3 to 5.18
Exposure control plan	5.54
Emergency washing facilities	5.85 to 5.96
Emergency plan (including written elements covered by sections 5.98 to 5.102, and requiring an annual review)	5.97
Inventory identifying all hazardous substances	5.98
Assessment of the risks posed by hazardous substances from accidental release, fire, or other such emergency	5.99
Written procedures to evacuate workers and, as appropriate, notify emergency responders, adjacent workplaces, residences that might be affected, and provincial and municipal agencies	5.100
Spill cleanup and re-entry procedures	5.101
Emergency procedure training	5.102(a)
Emergency procedure drills	5.102(b)
Risk assessment for TPGs (can be done in conjunction with section 5.99)	6.118
Exposure control plan must meet the requirements of section 5.54	6.119
Written work procedures regarding safe handling of TPGs	6.120(1)
Emergency procedures for safe evacuation and rescue of workers established and tested on a regular basis	6.120(2)
Written work and emergency procedures are readily available	6.120(3)
Training: Workers are capable of safely operating equipment and machinery	6.121
Where practicable, separate enclosure for TPG handling	6.122
Safe testing for enclosure(s) before entry by authorized workers	6.123
TPGs vented outdoors safely	6.124(a)
Emergency ventilation for containment and control	6.125
Shutdown device for emergency or accidental release	6.126
Appropriate personal protective equipment available and used by workers	6.127
Fixed gas monitors connected to alarms at designated sites	6.128(1), (2)
Fixed gas monitors tested monthly and calibrated annually	6.128(3)
Pressure relief valves or similar devices safely direct gas outdoors	6.129(1)
Pressure relief alarm or other reporting system engaged if pressure relief valve engages or malfunctions	6.129(2)
Controls involving TPGs all clearly identified with the control function described	6.130
Piping system appropriately constructed, tested, and equipped with systems to safely purge lines	6.131
Appropriate servicing and maintenance of equipment and machinery	6.132