Mine Methane Capture Project Protocol

Active Coal Mines: Destruction of CH_4 from Drainage Systems and Ventilation Air Methane

Protocol Version

[Effective Date]

Notes on the draft protocol:

This protocol adaptation is originally based on Quebec's (QC) Protocol 4 for Drainage projects at active underground and surface coal mines. The QC protocol has been reformatted into the common protocol template we are using for all protocols in this adaptation process. The Climate Action Reserve has combined this protocol with elements of Quebec's Protocol 5 (VAM) throughout this draft, as well as implemented proposed revisions. Highlighting indicates content that needs additional review. Red text indicates content that is subject to change based on the Ontario offset regulation which is still in development.

The Climate Action Reserve recommends including the abandoned mine methane (AMM) project type, currently included in the California protocol, if sufficient data is available from provincial mine permitting agencies (still TBD).

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Abbreviations and Acronyms

CO_2	Carbon dioxide
CH_4	Methane
GHG	Greenhouse gas
GJ/h	Gigajoule per hour
K	Kelvin
Kg	Kilogram
kPa	Kilopascal
L	Litres
LNG	Liquid Natural Gas
Mg	Mega gram (1,000,000 grams or one tonne, or “t”)
MDDELCC	Ministère du Développment durable, de l’Environnement et de la Lutte contre les changements climatiques du Québec (Quebec Ministry of Sustainable Development, Environment, and Fight Against Climate Change)
MOECC	Ontario Ministry of Environment and Climate Change
m^3	Cubic metres
t	Metric ton (or tonne)
N_2O	Nitrous oxide
NG	Natural gas
SSR	Source, sink, and reservoir
USEPA	United States Environmental Protection Agency

1 Introduction

The purpose of the mine methane capture and destruction protocol is to quantify greenhouse gas emissions reductions associated with any project designed to reduce GHG emissions by destroying CH_4 from active coal mines that would have otherwise been vented to the atmosphere from degasification systems.

Project Developers that install mine methane capture and destruction technologies use this document to register GHG emission reductions with the Ontario Cap and Trade Program[1] and the Quebec Cap and Trade System.[2] This protocol provides eligibility rules, methods to calculate reductions, performance-monitoring instructions, and procedures for reporting project information. This protocol is designed to ensure the complete, consistent, transparent, accurate, and conservative quantification and verification of GHG emission reductions associated with a mine methane capture and destruction project.[3]

For the purposes of this protocol, the term “Regulation” is used to refer to the following:

1. For projects to be registered with the Ontario Cap and Trade Program, located at coal mines outside of the Province of Quebec, the term “Regulation” shall refer to the Ontario Regulation concerning The Cap and Trade Program, made under the Climate Change Mitigation and Low-Carbon Economy Act;
2. For projects to be registered with the Quebec Cap and Trade Program, located at coal mines within the Province of Quebec, the term “Regulation” shall refer to the Quebec Regulation respecting a cap-and-trade system for greenhouse gas emission allowances, made under the Environment Quality Act.

For the purposes of this protocol, the term “Ministry” is used to refer to the following:

1. For projects to be registered with the Ontario Cap and Trade Program, located at coal mines outside of the Province of Quebec, the term “Ministry” shall refer to the Ontario Ministry of Environment and Climate Change (MOECC);
2. For projects to be registered with the Quebec Cap and Trade Program, located at coal mines within the Province of Quebec, the term “Ministry” shall refer to the Quebec Ministry of Sustainable Development, Environment, and Fight Against Climate Change (MDDELCC).

[1] As created by the Climate Change Mitigation and Low-Carbon Economy Act, 2016, Ontario Regulation 144/16, “The Cap and Trade Program.”
[2] As created by the Environmental Quality Act, Chapter Q-2, r. 46.1, “Regulation Respecting a Cap and Trade System for Greenhouse Gas Emission Allowances.”
[3] See the WRI/WBCSD GHG Protocol for Project Accounting (Part I, Chapter 4) for a description of GHG reduction project accounting principles.

2 The GHG Reduction Project

2.1 Project Definition

For the purpose of this protocol, the term “project” is equivalent to the term “offset initiative” in the Ontario Regulation.

For the purpose of this protocol, the GHG reduction project is defined as the use of an eligible device to capture and destroy CH_4 from:

- a CH_4 drainage system at an active underground or surface coal mine in Canada, except a mountaintop removal mine (Active Drainage)
- the ventilation system of an active underground coal mine in Canada (Ventilation Air Methane)

The project must enable the capture and destruction of CH_4 that, before the project, was emitted to the atmosphere. The CH_4 must be captured within the mine boundaries based on the current mine map and no more than 50 m below the mined seam and, in the case of an underground mine, up to 150 m above that seam. The project must not use CO_2, steam or any other fluid or gas to enhance CH_4 drainage. For Ventilation Air Methane projects, the methane must be destroyed on the site of the mine where it was captured using a destruction device.

Commented [TL1]: In CA COP, more specific guidance/requirements for this map.

The CH_4 must be destroyed on the site of the mine where it was captured using an eligible destruction device. Eligible destruction devices for all project types are enclosed flares, open flares, combustion engines, boilers, turbines, microturbines, CH_4 liquefaction units, and fuel cells. Emission reductions following pipeline injection of CH_4 are considered as common practice in the operation of an underground mine and are eligible only for a surface mine.

Commented [MH2]: Need default DE for these two if we include them. Question for SH: Are these common for mine methane?

For the purposes of this protocol,

(1) “room and pillar” means a method of underground mining in which approximately half of the coal is left in place as “pillars” to support the roof of the active mining area while “rooms” of coal are extracted;

(2) “coal” means all solid fuels classified as anthracite, bituminous, subbituminous, or lignite under ASTM D388, entitled Standard Classification of Coals by Rank;

(3) “mine gas” means the untreated gas extracted from within a mine through a CH_4 drainage system that often contains various levels of other components such as nitrogen, oxygen, CO_2 and hydrogen sulfide;

(4) “mine CH_4” means the CH_4 portion of the mine gas contained in coal seams and surrounding strata that is released as a result of mining operations;

(5) “drainage system” means a system installed in a mine to drain CH_4 from coal seams.

(6) “ventilation air” means air from a mine ventilation system;

(7) “ventilation air CH_4” means the CH_4 contained in ventilation air.

Commented [TL3]: Section to just include most critical terms. Others will be included in the Glossary (Section 9).

2.2 The Project Developer

The term "Project Developer" is defined within the Regulations as follows:

1. For the Ontario Regulation, the equivalent term is "Offset Initiative Operator";[4]
2. For the Quebec Regulation, the equivalent term is "Project Promoter."

[4] In certain circumstances, the Ontario Regulation may allow for an Offset Initiative Sponsor to fulfill duties that this protocol assigns to the Project Developer.

3 Eligibility Rules

Projects must fully satisfy the following eligibility rules in order to register offset credits. The criteria only apply to projects that meet the definition of a GHG reduction project (Section 2.1).

Eligibility Rule I:	Location	⟶	*Canadian provinces and territories*
Eligibility Rule II:	Project Start Date	⟶	*Per the guidance of the Regulation*
Eligibility Rule III:	Additionality	⟶	*Meet performance standard*

3.1 Location

Commented [MH4]: Add details on mine types, specifically that mines located on crown lands are eligible.

The project must be implemented at an active underground or surface mine in Canada.

3.2 Project Start Date

The project start date of a mine methane project is defined as the date of commencement of continuous CH_4 destruction following the completion of a start-up and/or testing period, which is not to exceed six (6) months.[5] A mine methane project may be operational regardless of whether sufficient monitoring data are available to report emission reductions. Project Developers shall refer to the Regulation to determine the eligibility of their start date, including deadlines related to submittal of applications to the Ministry.

3.3 Project Crediting Period

Project Developers shall refer to the Regulation for guidance regarding the definition, length, and rules related to project crediting periods.

3.4 Additionality

The project is considered to go beyond current practice when it meets the conditions in the Regulation. Reductions in GHG emissions must be additional and result from a project that is voluntary, that is that it is not being carried out, at the time of registration or renewal, in response to a legislative or regulatory provision, a permit or other type of authorization, an order made under an Act or regulation, or a court decision. The requirements of additionality are assessed through the Performance Standard Test in Section 3.4.1.

3.4.1 Performance Standard Test

Projects pass the Performance Standard Test by meeting a performance threshold, i.e., a standard of performance applicable to all mine methane capture and destruction projects, established on an ex-ante basis by this protocol.

There are numerous possible management options and end uses for coal mine methane, ranging from venting, to destruction by flares, to injection of the methane into natural gas pipelines. The Performance Standard Test employed by this protocol is based on a national assessment of "common practice" for managing coal mine methane. The performance standard

[5] The start-up period begins on the first day of mine methane destruction in the project system.

defines those end uses that have been determined to exceed common practice and therefore generates additional GHG reductions.

Drainage projects pass the Performance Standard Test if they destroy CMM through any end-use management option other than injection into a natural gas pipeline for off-site consumption (e.g., flare, power generation, heat generation, producing CNG/LNG for vehicle use, etc.).

Commented [TL5]: This is not considered additional in the US, since many drainage projects DO inject into pipelines. Are there any instances of coal mine methane being injected into pipelines in Canada? (We know there is some coalbed methane injection, but no waste mine methane, as far as we can tell).

All VAM projects pass the Performance Standard Test. Such projects may include, but are not limited to, the following end uses for VAM:

- Thermal flow reversal reactors with or without catalysts
- Volatile organic compound concentrators
- Carbureted gas turbines
- Lean-fueled turbines with catalytic combustors that compress the air/methane mixture and then combust it in a catalytic combustor
- Hybrid coal- and ventilation air-fueled gas turbine technology
- Lean-fueled catalytic microturbine technology
- Combustion air for commercial engine and turbine technologies or a coal-fired steam power plant

3.4.2 The Legal Requirement Test

All projects are subject to a Legal Requirement Test to ensure that the GHG reductions achieved by a project would not otherwise have occurred due to federal, state, or local regulations, or other legally binding mandates. At the initial application for registration, the Project Developer must attest that the above is true. In addition, the project's Surveillance plan (Section 6) must include procedures that the Project Developer will follow to ascertain and demonstrate that the project at all times passes the Legal Requirement Test.

3.4.2.1 Federal Regulations

Coal mine methane emissions are not subject to regulation at the federal level in Canada.

3.4.2.2 Provincial, Territorial, and State Regulations

At this time, no Canadian provinces or territories, nor the US states (e.g., California) with which they may link their cap-and-trade programs, have individual regulations related to the control of methane emissions at coal mines. As noted above, the project's Surveillance plan (Section 6) must include procedures that the Project Developer will follow to ascertain and demonstrate that the project at all times passes the Legal Requirement Test. This includes monitoring the applicable provincial regulations to ensure no new regulations may be put in place which would make the project ineligible.

3.5 Regulatory Compliance

As a final eligibility requirement, Project Developers must attest that project activities do not cause material violations of applicable laws (e.g., air, water quality, safety, etc.). Project Developers are required to disclose in writing to the verifier any and all instances of legal violations – material or otherwise – caused by the project activities.

A violation should be considered to be "caused" by project activities if it can be reasonably argued that the violation would not have occurred in the absence of the project activities. If there is any question of causality, the Project Developer shall disclose the violation to the verifier.

If it is determined that project activities have caused a material violation, then credits will not be issued for GHG reductions that occurred during the period(s) when the violation occurred. Individual violations due to administrative or reporting issues, or due to "acts of nature," are not considered material and will not affect crediting. However, recurrent administrative violations directly related to project activities may affect crediting. Verifiers must determine if recurrent violations rise to the level of materiality. If the verifier is unable to assess the materiality of the violation, then the verifier shall consult with the Ministry.

Commented [MH6]: Removed reference to verifier, made it more general to avoid implication that verifier determines whether credits can be issued

4 The GHG Assessment Boundary

The GHG Assessment Boundary delineates the GHG sources, sinks, and reservoirs (SSRs) that must be assessed by Project Developers in order to determine the net change in emissions caused by a mine methane project.[6]

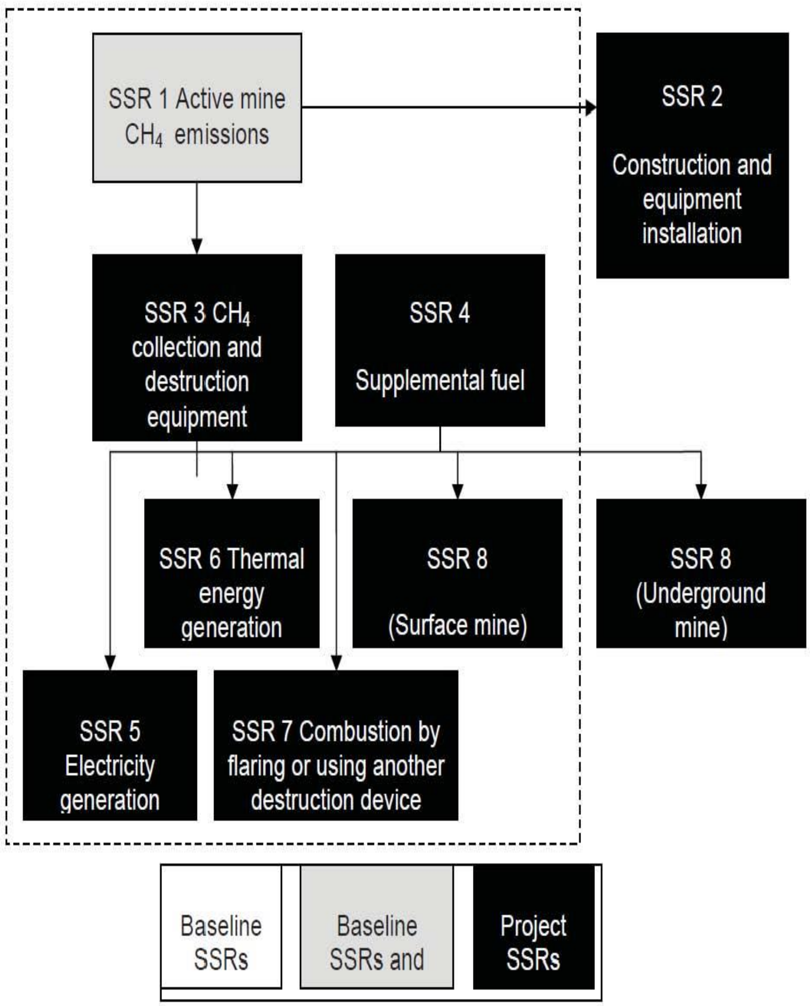
This protocol does not account for carbon dioxide emission reductions associated with displacing grid-delivered electricity or fossil fuel use.

Figure 4.1 illustrates all relevant GHG SSRs associated with drainage project activities and delineates the GHG Assessment Boundary.

Table 4.1 provides greater detail on each SSR and justification for the inclusion or exclusion of certain SSRs and gases from the GHG Assessment Boundary.

[6] The definition and assessment of SSRs is consistent with ISO 14064-2 guidance.

Figure 4.1. ~~Flowchart for the reduction project process~~ GHG Assessment Boundary for Active Underground and Active Surface Mines



Commented [MH7]: Updates to Diagram still necessary. Also need to add new assessment boundary diagrams for VAM (and AMM, if included)

Remove supplemental fuel, which is not clearly defined, and replace with Fossil fuel for transportation of mine gas to destruction device after SSR 3, add liquefaction, compression and storage of CNG/LNG as well as vehicle operation and (potentially) displacement of fossil fuels or electricity (see Figure 4.2 in COP)

Redo in order to correct spacing errors, e.g., SSR 8s should both say “Pipeline injection”

Remove white “baseline SSR” box in legend

Table 4.1. Description of all Sources, Sinks, and Reservoirs

SSR	Source Description	GHG	Relevant to Baseline (B) or Project (P)	Included or Excluded	Justification/Explanation
1	CH_4 emissions from mining activities	CH_4	B, P	Included	Main emission source of methane from active mines. A GHG project will directly affect these emissions. Only the change in mine methane emissions release will be taken into account, by monitoring the methane used or destroyed by the project
2	Emissions from construction and/or installation of new equipment	CO_2	P	Excluded	Excluded for simplification. This emission source is assumed to be very small.
		CH_4			Excluded for simplification. This emission source is assumed to be very small.
		N_2O			Excluded for simplification. This emission source is assumed to be very small.
3	Emissions resulting from fossil fuels consumed to operate the CH_4 drainage system	CO_2	P	Included	If any additional equipment is required by the project beyond what is required in the baseline, energy consumption from additional equipment shall be accounted for. Energy used by equipment installed for the safety of the mine shall be excluded.
		CH_4		Excluded	Excluded for simplification. This emission source is assumed to be very small.
		N_2O		Excluded	Excluded for simplification. This emission source is assumed to be very small.
4	Emissions from the use of supplemental fossil fuels	CO_2	P	Included	If any additional equipment is required by the project beyond what is required in the baseline, energy consumption from additional equipment shall be accounted for.
		CH_4		Excluded	Excluded for simplification. This emission source is assumed to be very small.
		N_2O		Excluded	Excluded for simplification. This emission source is assumed to be very small.
5	Emissions from CH_4 destruction for electricity generation	CO_2	P	Included	If mine methane is used for on-site power generation, project will result in increased CO_2 emissions from the destruction of methane to generate power. This source is also included where mine methane is sent to a non-qualifying device for electricity generation.
		N_2O		Excluded	Excluded for simplification. This emission source is assumed to be very small.

SSR	Source Description	GHG	Relevant to Baseline (B) or Project (P)	Included or Excluded	Justification/Explanation
	Emissions of uncombusted CH_4	CH_4	P	Included	If mine methane is used for on-site power generation, project will result in increased CH_4 emissions from incomplete combustion. This source is also included where mine methane is sent to a non-qualifying device for electricity generation.
6	Emissions from CH_4 destruction for heat generation	CO_2	P	Included	If mine methane is used for on-site thermal energy generation, project will result in increased CO_2 emissions from the destruction of methane to generate energy. This source is also included where mine methane is sent to a non-qualifying device to generate energy.
		N_2O		Excluded	Excluded for simplification. This emission source is assumed to be very small.
	Emissions of uncombusted CH_4	CH_4	P	Included	If mine methane is used for on-site thermal energy generation, project will result in increased CH_4 emissions from incomplete combustion. This source is also included where mine methane is sent to a non-qualifying device to generate energy.
7	Emissions from CH_4 destruction using a flare or other device	CO_2	P	Included	If mine methane is sent to a flare, project will result in increased CO_2 emissions from the destruction of methane in flare. This source is also included where mine methane is sent to a non-qualifying device for flaring.
		N_2O		Excluded	Excluded for simplification. This emission source is assumed to be very small.
	Emissions of uncombusted CH_4	CH_4	P	Included	If mine methane is sent to a flare, project will result in increased CH_4 emissions from incomplete combustion. This source is also included where mine methane is sent to a non-qualifying device for flaring.
8 (Active underground mine)	Pipeline injection	CO_2 CH_4 N_2O	P	Excluded	The project is unlikely to affect quantities of methane delivered to commercial pipelines at underground mines, and will therefore not affect fugitive pipeline emissions.
8 (Surface mine and abandoned underground mine)	Emissions resulting from the combustion of CH_4 injected into a pipeline	CO_2	P	Included	If surface mine methane is injected into a pipeline, project will result in increased CO_2 emissions from the destruction of methane at the end use.
		N_2O		Excluded	Excluded for simplification. This emission source is assumed to be very small.

SSR	Source Description	GHG	Relevant to Baseline (B) or Project (P)	Included or Excluded	Justification/Explanation
	Emissions of uncombusted CH_4 injected into a pipeline	CH_4	P	Included	If surface mine methane is injected into a pipeline, project will result in increased CH_4 emissions from incomplete combustion.
9	Emissions attributable to energy consumed to operate mine ventilation system	CO_2	B, P	Excluded	Operation of mine ventilation system will not be affected by the project.
		CH_4			
		N_2O			
10	Emissions attributable to energy consumed to operate equipment to capture and destroy VAM	CO_2	P	Included	The VAM collection system will result in increased combustion emissions due to energy consumption from equipment used to capture and destroy VAM.
		CH_4		Excluded	Excluded for simplification. This emission source is assumed to be very small.
		N_2O		Excluded	Excluded for simplification. This emission source is assumed to be very small.
11	Emissions from the destruction of VAM	CO_2	P	Included	VAM project will result in increased CO_2 emissions from the oxidation of methane in ventilation air.
		N_2O		Excluded	Excluded for simplification. This emission source is assumed to be very small.
	Emissions of uncombusted VAM	CH_4		Included	VAM project will result in CH_4 emissions from non-oxidized CH_4 from the ventilation air stream.

5 Quantifying GHG Emission Reductions

GHG emission reductions from a coal mine methane project are quantified by comparing actual project emissions to baseline emissions at the mine. Baseline emissions are an estimate of the GHG emissions from sources within the GHG Assessment Boundary that would have occurred in the absence of the coal mine methane project. Project emissions are actual GHG emissions that occur at sources within the GHG Assessment Boundary. Project emissions must be subtracted from the baseline emissions to quantify the project's total net GHG emission reductions.

5.1 Quantifying GHG Emission Reductions from Active Drainage Projects

The Project Developer must calculate the quantity of GHG emission reductions attributable to the project using Equation 5.1.

Equation 5.1. GHG Emission Reductions

$$ER = BE - PE$$

Where, Units

ER	=	GHG emission reductions attributable to the project during the project reporting period, in metric tonnes CO_2 equivalent	tCO_2e
BE	=	Emissions under the baseline scenario during the project reporting period, calculated using Equation 5.3, in metric tonnes CO_2 equivalent	tCO_2e
PE	=	Project emissions during the project reporting period, calculated using Equation 5.5, in metric tonnes CO_2 equivalent	tCO_2e

When the flow meter does not correct for the temperature and pressure of the mine gas at standard conditions, the Project Developer must measure mine pressure and temperature separately and correct the flow values using Equation 5.2. The Project Developer must use the corrected flow values in all the equations of this protocol.

Equation 5.2. Adjusting CMG Flow for Temperature and Pressure

$$MG_{i,t} = MG_{uncorrected} \times \frac{293.15}{T} \times \frac{P}{101.325}$$

Where,			Units
$MG_{i,t}$	=	Volume of mine gas sent to destruction device *i* in time interval *t*, in cubic metres at standard conditions	m^3/unit time
i	=	Destruction device	
t	=	Time interval shown in the table in Table 6.1 for which CH_4 flow and content measurements are aggregated	
$MG_{uncorrected}$	=	Uncorrected volume of mine gas sent to destruction device *i* in time interval *t*, in cubic metres	m^3/unit time
293.15	=	Reference temperature, in Kelvin	Kelvin
T	=	Measured temperature of mine gas for the given time period, in Kelvin (°C + 273.15)	Kelvin (°C + 273.15)
P	=	Pressure of the mine gas for the given time period, in kilopascals	kilopascals
101.325	=	Standard pressure, in kilopascals	kilopascals

5.1.1 Quantifying Baseline Emissions from Active Drainage Projects

In the baseline scenario, CH_4 sent to a destruction device during the project reporting period, except CH_4 captured by a pre-mining surface well used to extract CH_4, must be taken into account.

In the case of a surface well used to extract CH_4 before a mining operation, CH_4 emissions from past periods are considered only during a project reporting period when the well is mined through, in other words when one of the following situations occurs:

(1) the well is physically bisected by mining activities;

(2) the well produces elevated amounts of atmospheric gases so that the concentration of nitrogen in the mine gas increases by 5 compared to baseline concentrations according to a gas analysis using a gas chromatograph completed by an ISO 17025 accredited laboratory.

To ensure that the elevated nitrogen concentrations are not solely the result of a leak in the well, the oxygen concentration must not have increased by the same proportion as the nitrogen concentration;

(3) in the case of an underground mine, the working face passes less than 150 m below the well;

(4) in the case of an underground mine, the room and pillar method is used and the block of coal that will be left unmined as a pillar is less than 150 m directly below the well.

The Project Operator must calculate GHG emissions in the baseline scenario using Equation 5.3:

Equation 5.3. Calculating Baseline Emissions

$$BE = \left[\sum_{t=1}^{n}[Q_i] \times 0.667 \times 0.001 \times 21\right] + BE_{MD}$$

Where, Units

BE	=	Baseline scenario emissions during the project reporting period, in metric tonnes CO_2 equivalent	tCO_2e
n	=	Number of destruction devices	
i	=	Destruction device	
Q_i	=	Total quantity of CH_4 sent to destruction device *i* during the project reporting period, calculated using Equation 5.4, in cubic metres of CH_4 at standard conditions	m^3 CH_4
0.667	=	Density of CH_4, in kilograms of CH_4 per cubic metre of CH_4 at standard conditions	kg CH_4/m^3 CH_4
0.001	=	Conversion factor, kilograms to metric tonnes	
21	=	Global Warming Potential of CH_4	
BE_{MD}	=	Baseline scenario emissions during the project reporting period, from any pre-project destruction of methane, in metric tonnes CO_2	tCO_2

Equation 5.4. Baseline Methane Released to Atmosphere

$$Qi = \sum_{t=1}^{n}\left[\left(MG_{i,t} - PPMG_{i,t}\right) \times C_{CH4,t}\right]$$

Where, Units

Q_i	=	Total quantity of CH_4 sent to destruction device *i* during the project reporting period, in cubic metres of CH_4 at standard conditions	m^3 CH_4
n	=	Number of time intervals during the project reporting period	
t	=	Time interval shown in the table in Table 6.1 for which CH_4 flow and content measurements for the mine gas are aggregated	

$MG_{i,t}$	=	Volume of mine gas sent to destruction device *i* in time interval *t*, in cubic metres at standard conditions, except mine gas from a surface well that is not yet mined through. Despite the foregoing, if the surface well is mined through during the project reporting period, the mine gas sent to a destruction device during the current reporting period and in previous years must be included	m^3
$PPMG_{i,t}$	=	Volume of mine gas that would have been sent to a pre-project destruction device *i* in time interval *t*, in cubic metres at standard conditions	m^3
$C_{CH4,t}$	=	Average CH_4 content in the mine gas sent to a destruction device during time interval *t*, in cubic metres of CH_4 per cubic metre of mine gas	m^3 CH_4/

5.1.2 Quantifying Project Emissions from Active Drainage Projects

Project emissions are actual GHG emissions that occur within the GHG Assessment Boundary as a result of the project activity. Project emissions must be quantified every reporting period on an ex post basis. The Project Developer must calculate the GHG project emissions using Equations 5.5 to 5.8. The CO_2 emissions attributable to the destruction of CH_4 from a pre-mining surface well used to extract CH_4 during a current project reporting period, calculated using Equation 5.7, must be included even if the well has not yet been mined through.

Equation 5.5. Calculating Project Emissions

$$PE = FF_{CO2} + DM_{CO2} + UM_{CH4}$$

Where,			<u>Units</u>
PE	=	Project emissions during the project reporting period, in metric tonnes CO_2 equivalent	tCO_2e
FF_{CO2}	=	Total CO_2 emissions attributable to the consumption of fossil fuel to capture and destroy mine CH_4 during the project reporting period, calculated using Equation 5.6, in metric tonnes CO_2 equivalent	tCO_2e
DM_{CO2}	=	Total CO_2 attributable to the destruction of CH_4 during the project reporting period, calculated using Equation 5.7, in metric tonnes CO_2 equivalent	tCO_2e
UM_{CH4}	=	CH_4 emissions attributable to uncombusted CH_4 during a project reporting period, calculated using Equation 5.8, in metric tonnes CO_2 equivalent	tCO_2e

Equation 5.6. Project Emissions from Fossil Fuels

$$FF_{CO2} = \frac{\sum_{j=1}^{n}\left(FF_{PR,j} \times EF_{CF,j}\right)}{1,000}$$

Where,			<u>Units</u>
FF_{CO2}	=	Total CO_2 attributable to the consumption of fossil fuel to capture and destroy mine CH4 during the project reporting period, in metric tonnes CO2 equivalent	tCO_2e
n	=	Number of types of fossil fuel	
j	=	Type of fossil fuel	

$FF_{PR,j}$	=	Total quantity of fossil fuel *j* consumed, expressed - in kilograms, in the case of fuels whose quantity is expressed as a mass - in cubic metres at standard conditions, in the case of fuels whose quantity is expressed as a volume of gas - in litres, in the case of fuels whose quantity is expressed as a volume of liquid	kg/m^3/l
$EF_{CF,j}$	=	CO_2 emission factor for fossil fuel *j* specified in the Regulation - in kilograms of CO_2 per kilogram, in the case of fuels whose quantity is expressed as a mass - in kilograms of CO_2 per cubic metre at standard conditions, in the case of fuels whose quantity is expressed as a volume of gas - in kilograms of CO_2 per litre, in the case of fuels whose quantity is expressed as a volume of liquid	kg/m^3/l
1,000	=	Conversion factor, metric tonnes to kilograms	

Equation 5.7. Project Emissions from Destruction of Captured Methane

$$DM_{CO2} = \sum_{t=1}^{n} [Q_i \times DE_i] \times 1.556 \times 0.001$$

Where,			Units
DM_{CO2}	=	Project emissions during the project reporting period, in metric tonnes CO_2 equivalent	tCO_2e
n	=	Number of destruction devices	
i	=	Destruction device	
Q_i	=	Total quantity of CH_4 sent to destruction device *i* during the project reporting period, calculated using Equation 5.4, in cubic metres of CH_4 at standard conditions	tCO_2e
DE_i	=	Default CH_4 destruction efficiency of destruction device *i*, determined in accordance with Appendix A	
1.556	=	CO_2 emission factor attributable to the combustion of CH_4, in kilograms of CO_2 per cubic metre of CH_4 combusted	kg CO_2/m^3 CH_4
0.001	=	Conversion factor, kilograms to metric tonnes	

Equation 5.8. Project Emissions from Uncombusted Methane

$$UM_{CH4} = \sum_{t=1}^{n} [Q_i \times (1 - DE_i)] \times 0.667 \times 0.001 \times 21$$

Where,			Units
UM_{CH4}	=	CH_4 emissions attributable to uncombusted CH_4 during the project reporting period, in metric tonnes CO_2 equivalent	tCO_2e
n	=	Number of destruction devices	
i	=	Destruction device	
Q_i	=	Total quantity of CH_4 sent to destruction device *i* during the project reporting period, calculated using Equation 5.4, in cubic metres of CH_4 at standard conditions	m^3
DE_i	=	Default CH_4 destruction efficiency of destruction device *i*, determined in accordance with Appendix A	kg/m^3/l

0.667	=	Density of CH_4, in kilograms of CH_4 per cubic metre of CH_4 at standard conditions	kg CH_4/m^3 CH_4
0.001	=	Conversion factor, kilograms to metric tonnes	
21	=	Global Warming Potential factor of CH_4	

5.2 Quantifying GHG Emission Reductions from Ventilation Air Methane Projects

Commented [MH8]: Equations from QC protocol don't appear to include calculation of VAM based on average flow rate, time, methane density, and correction to std conditions – recommend adding appropriate equations from Reserve or California protocol

The Project Developer must calculate the quantity of GHG emission reductions attributable to the project using Equation 5.9:

Equation 5.9. GHG Emission Reductions

$$ER = BE - PE$$

Where,			Units
ER	=	GHG emission reductions attributable to the project during the project reporting period, in metric tonnes CO_2 equivalent	tCO_2e
BE	=	Emissions under the baseline scenario during the project reporting period, calculated using Equation 5.10, in metric tonnes CO_2 equivalent	tCO_2e
PE	=	Project emissions during the project reporting period, calculated using Equation 5.11, in metric tonnes CO_2 equivalent	tCO_2e

5.2.1 Quantifying Baseline Emissions from Ventilation Air Methane Projects

The Project Developer must calculate GHG emissions in the baseline scenario using Equation 5.10:

Equation 5.10. Calculating Baseline Methane Emissions

$$BE = \left[\sum_{t=1}^{n} (VA_{Et} - VA_{PP}) \times C_{CH4,t} \times 0.667 \times 0.001 \times 21\right] + BE_{MD}$$

Where,			Units
BE	=	Baseline scenario emissions during the project reporting period, in metric tonnes CO_2 equivalent	tCO_2e
n	=	Number of time intervals during the project reporting period	
t	=	Time interval shown in the table in Table 6.1 for which flow and content measurements of ventilation air CH_4 are aggregated	
VA_{Et}	=	Volume of ventilation air sent to destruction device during time interval *t*, in cubic metres at standard conditions	m^3/unit time
VA_{PP}	=	Volume of ventilation air that would have been sent to pre-project destruction device, during time interval *t*, in cubic metres at standard conditions	m^3/unit time

$C_{CH4,t}$	=	Average CH_4 content in ventilation air before entering destruction device during time interval *t*, in cubic metres of CH_4 per cubic metre of ventilation air	m^3 CH_4/m^3
0.667	=	Density of CH_4, in kilograms of CH_4 per cubic metre of CH_4 at standard conditions	kg CH_4/m^3 CH_4
0.001	=	Conversion factor, kilograms to metric tonnes	
21	=	Global Warming Potential of CH_4	
BE_{MD}	=	Baseline scenario emissions during the project reporting period, from any pre-project destruction of methane, in metric tonnes CO_2	tCO_2e

If a mass flow meter is used to monitor gas flow instead of a volumetric flow meter, the volume and density terms must be replaced by the monitored mass value in kilograms. The CH_4 content must be in mass percent.

5.2.2 Quantifying Project Emissions from Ventilation Air Methane Projects

The Project Developer must calculate the GHG project emissions using Equations 5.11 to 5.15:

Equation 5.11. Calculating Project Emissions

$$PE = FF_{CO2} + DM_{CO2} + UM_{CH4}$$

Where,			Units
PE	=	Project emissions during a project reporting period, in metric tonnes CO_2 equivalent	tCO_2e
FF_{CO2}	=	Total CO_2 attributable to the consumption of fossil fuel to capture and destroy ventilation air CH_4 during a project reporting period, calculated using Equation 5.12, in metric tonnes CO_2 equivalent	tCO_2e
DM_{CO2}	=	Total CO_2 attributable to the destruction of CH_4 during a project reporting period, calculated using Equation 5.14, in metric tonnes CO_2 equivalent	tCO_2e
UM_{CH4}	=	CH_4 emissions attributable to uncombusted CH_4 during a project reporting period, calculated using Equation 5.15, in metric tonnes CO_2 equivalent	tCO_2e

Equation 5.12. Project Emissions from Fossil Fuels

$$FF_{CO2} = \frac{\sum_{j=1}^{n}\left(FF_{PR,j} \times EF_{CF,j}\right)}{1,000}$$

Where,			Units
FF_{CO2}	=	Total CO_2 attributable to the consumption of fossil fuel to capture and destroy ventilation air CH_4 during a project reporting period, in metric tonnes CO_2 equivalent	tCO_2e
n	=	Number of types of fossil fuel	
j	=	Type of fossil fuel	

$FF_{PR,j}$	=	Annual quantity of fossil fuel *j* consumed, expressed - in kilograms, in the case of fuels whose quantity is expressed as a mass - in cubic metres at standard conditions, in the case of fuels whose quantity is expressed as a volume of gas - in litres, in the case of fuels whose quantity is expressed as a volume of liquid	kg/m^3/l
$EF_{CF,j}$	=	CO_2 emission factor for fossil fuel *j* specified in tables 1-3 to 1-8 of QC.1.7 in Schedule A.2 to the Regulation respecting mandatory reporting of certain emissions of contaminants into the atmosphere (chapter Q-2, r. 15), expressed - in kilograms of CO_2 per kilogram, in the case of fuels whose quantity is expressed as a mass - in kilograms of CO_2 per cubic metre at standard conditions, in the case of fuels whose quantity is expressed as a volume of gas - in kilograms of CO_2 per litre, in the case of fuels whose quantity is expressed as a volume of liquid	kg/m^3/l
1,000	=	Conversion factor, metric tonnes to kilograms	

If the volume of ventilation air leaving the destruction device is not measured as specified in Table 6.1, it must be calculated using Equation 5.13:

Equation 5.13. Ventilation Air Leaving the Destruction Device

$$\boldsymbol{VA_S = VA_E + CA}$$

Where,			Units
VA_S	=	Volume of ventilation air leaving the destruction device during the project reporting period, in cubic metres at standard conditions	m^3
VA_E	=	Volume of ventilation air sent to a destruction device during the project reporting period, in cubic metres at standard conditions	m^3
CA	=	Volume of cooling air added after the point of metering for the volume of ventilation air sent to the destruction device (VA_E), in cubic metres at standard conditions, or a value of 0 if no cooling air is added	m^3

Equation 5.14. Project Emissions from Destruction of Captured Methane

$$\boldsymbol{DM_{CO2} = [(VA_E \times C_{CH4}) - (VA_S \times C_{dest-CH4})] \times 1.556 \times 0.001}$$

Where,			Units
DM_{CO2}	=	Total CO_2 attributable to the destruction of CH_4 during a project reporting period, in metric tonnes CO_2 equivalent	tCO_2e
VA_E	=	Volume of ventilation air sent to a destruction device during the project reporting period, in cubic metres at standard conditions	m^3
VA_S	=	Volume of ventilation air leaving the destruction device during the project reporting period, in cubic metres at standard conditions	m^3
C_{CH4}	=	Average CH_4 content in ventilation air before entering destruction device during the project reporting period, in cubic metres of CH_4 per cubic metre of gas	m^3 CH_4/m^3

$C_{dest\text{-}CH4}$	=	Average CH_4 content in ventilation air leaving the destruction device during the project reporting period, in cubic metres of CH_4 per cubic metre of gas	m^3 CH_4/m^3
1.556	=	CO_2 emission factor attributable to the combustion of CH_4, in kilograms of CO_2 per cubic metre of CH_4 combusted	kg CO_2/m^3 CH_4
0.001	=	Conversion factor, kilograms to metric tonnes	

Equation 5.15. Project Emissions from Uncombusted Methane

$$UM_{CH4} = VA_S \times T_{dest-CH4} \times 0.667 \times 0.001 \times 21$$

Where,			Units
UM_{CH4}	=	CH_4 emissions attributable to uncombusted CH_4 during a project reporting period, in metric tonnes CO_2 equivalent	tCO_2e
VA_S	=	Volume of ventilation air leaving the destruction device during the project reporting period, in cubic metres at standard conditions	m^3
$T_{dest\text{-}CH4}$	=	Average CH_4 content in ventilation air leaving the destruction device during the project reporting period, in cubic metres of CH_4 per cubic metre of gas	m^3 CH_4/m^3
0.667	=	Density of CH_4, in kilograms of CH_4 per cubic metre of CH_4 at standard conditions	kg CH_4/m^3 CH_4
0.001	=	Conversion factor, kilograms to metric tonnes	
21	=	Global Warming Potential factor of CH_4	

If a mass flow meter is used to monitor gas flow instead of a volumetric flow meter, the volume and density terms must be replaced by the monitored mass value in kilograms. The CH_4 content must be in mass percent.

6 Project ~~Surveillance~~Monitoring

Commented [MH9]: Recommend changing to "monitoring" throughout

6.1 Data Collection

The Project Developer is responsible for collecting the information required for project monitoring.

The Project Developer must show that the data collected are actual and that rigorous supervision and record-keeping procedures are applied at the project site.

6.2 ~~Surveillance~~ Monitoring Plan

The monitoring plan must specify the methods used to collect and record the data required for all the relevant parameters in Table 6.1.

At a minimum, the surveillance plan must include the following:

1. Methods used to collect and record the data required for all the relevant parameters in Table 6.1;
2. Frequency of data acquisition;
3. Record keeping plan (see Section 7.2 for minimum record keeping requirements)
4. Frequency of instrument cleaning, inspection and calibration activities, and of the verification of instrument calibration accuracy; and
5. The role and qualifications of the person responsible for each monitoring activity, as well as the quality assurance and quality control measures taken to ensure that data acquisition and instrument calibration are carried out consistently and with precision; and
6. A detailed diagram of the LFG capture and treatment or destruction system, including the placement of all measurement instrument and equipment that affect included SSRs; and
7. Procedures which will be followed to ascertain and demonstrate that the project at all times meets the additionality requirements of the Regulation.

6.3 Monitoring Requirements

Project Developers are responsible for monitoring the performance of the project and ensuring that the operation of all project-related equipment is consistent with the manufacturer's recommendations. Methane emission reductions from mine gas capture and control systems must be monitored with measurement equipment that directly meters:

1. The flow of mine gas delivered to each destruction device[7], measured continuously and recorded every 15 minutes or totalized and recorded at least daily, adjusted for

[7] A single meter may be used for multiple, identical destruction devices. In this instance, methane destruction in these units will be eligible only if both units are monitored to be operational, unless evidence is available to document that the design of the device is such that methane may not pass through when it is not operational.

temperature and pressure;

2. The fraction of CH_4 in the mine gas delivered to each destruction device, measured continuously and recorded every 15 minutes and averaged at least daily.

All flow data collected must be corrected for temperature and pressure at 15° C and 1 atm. The temperature and pressure of the mine gas must be measured continuously. No separate monitoring of temperature and pressure is necessary when using flow meters that automatically correct for temperature and pressure, expressing mine gas volumes in normalized cubic meters.

Figure 6.1 represents the suggested arrangement of destruction system metering equipment.

The operating status of the mine gas destruction device must be monitored and recorded at least hourly. GHG reductions will not be accounted for during periods in which the destruction device is not operational. For flares, operation is defined as thermocouple readings above 260°C. For all other destruction devices, the means of demonstration shall be determined by the project operator, subject to manufacturer guidance, and subject to verifier review.

6.3.1 Arrangement of Metering Equipment

For drainage projects, the mine gas from each drainage system (i.e., surface pre-mining boreholes, horizontal pre-mining boreholes, or post-mining boreholes) must be monitored separately prior to interconnection with other sources. The volumetric gas flow, methane concentration, temperature, and pressure shall be monitored and recorded separately for each drainage system.

In addition, the flow of gas to each destruction device must be monitored separately for each destruction device, except under certain conditions. Specifically, if all destruction devices are of identical efficiency and verified to be operational throughout the reporting period, a single flow meter may be used to monitor gas flow to all destruction devices. Otherwise, the destruction efficiency of the least efficient destruction device shall be used as the destruction efficiency for all destruction devices monitored by this meter.

If a project using a single meter to monitor gas flow to multiple destruction devices has any periods when not all destruction devices downstream of a single flow meter are operational, methane destruction from the set of downstream devices during these periods will only be eligible provided that the verifier can confirm all of the following requirements and conditions are met:

a. The destruction efficiency of the least efficient downstream destruction device in operation shall be used as the destruction efficiency for all destruction devices downstream of the single meter; and
b. All devices are either equipped with valves on the input gas line that close automatically if the device becomes non-operational (requiring no manual intervention), or designed in such a manner that it is physically impossible for gas to pass through while the device is non-operational; and
c. For any period during which one or more downstream destruction devices are not operational, it must be documented that the remaining operational devices have the capacity to destroy the maximum gas flow recorded during the period.

Commented [MH10]: Allow weekly methane % monitoring with a 10% discount?

Commented [MH11]: Should elaborate – is there a T threshold for thermocouples in flares? (We have suggested 260 C, which is similar to Reserve/CA requirements)

Do devices that have safety valves that prevent the flow of MG when non-operational (engines) need to monitoring operational activity?

6.4 ~~Measurement instruments~~ Instrument Quality Assurance and Quality Control (QA/QC)

Commented [TL12]: QA/QC requirements in CA protocol are far more frequent. Unclear if CA's frequency is worth the additional cost. Seeking feedback from Stakeholders

The Project Developer must ensure that all mine gas flow meters and CH_4 analyzers are:

1. Documented to be in calibration at the time of installation at the project; and
2. Cleaned and inspected as specified in the project's surveillance plan and at the minimum cleaning and inspection frequency specified by the manufacturer, with all cleaning and inspection activities documented by mine site personnel. If the manufacturer does not specify a minimum frequency of cleaning and inspection, then meters must be cleaned and inspected at least quarterly;
3. Not more than 2 months before or after the project reporting period end date, either
   a) Checked for accuracy by a qualified and independent person, either using a portable instrument, such as a pitot tube, or manufacturer's specifications, and ensure that the percentage drift is recorded; or
   b) Calibrated by the manufacturer, or by a third person certified for that purpose by the manufacturer; and
4. Calibrated by the manufacturer, or by a third-party certified for that purpose by the manufacturer, according to the manufacturer's specifications or every 5 years, whichever is more frequent.

A calibration certificate or a verification report on calibration accuracy must be produced and included in the project report. The verification provided for in the Regulation must include confirmation that the person is qualified to verify calibration accuracy.

Flow meters and/or methane analyzers which are installed temporarily (not portable devices) must be documented to be in calibration at the time of installation. If the device is used for 60 days or more, the device must be field checked for calibration accuracy prior to its removal from the system.

Flow meter calibrations must be documented to show that the meter was calibrated to a range of flow rates corresponding to the flow rates expected for the drainage system. CH_4 analyzer calibrations must be documented to show that the calibration was carried out to a range of temperature and pressure conditions corresponding to the range of conditions measured for the drainage system.

The verification of flow meter and analyzer calibration accuracy must show that the instruments provide a reading of volumetric flow or CH_4 content that is within a +/-5% accuracy threshold.

When a verification of the calibration accuracy of a device shows a shift outside the ± 5% accuracy threshold, but the manufacturer specifies a cleaning procedure for calibration checks, the device may be cleaned and rechecked. If the device is still out of the allowable threshold, the device must be calibrated by the manufacturer or by a third person certified for that purpose by the manufacturer. In addition, for the entire period from the last calibration that confirmed accuracy within the ± 5% threshold until such time as the piece of equipment is correctly calibrated, all the data from the piece of equipment must be corrected according to the following procedure:

(1) when the calibration indicates an under-reporting of flow rates or CH_4 content, the operator must use the measured values without correction;

(2) when the calibration indicates an over-reporting of flow rates or CH_4 content, the operator must apply to the measured values the greatest calibration drift recorded at the time of calibration.

For devices which are cleaned and rechecked, with the second check showing a return to calibration accuracy, the device does not need further calibration, but the data must be adjusted per the procedure outlined above.

The last calibration confirming accuracy within the ± 5% threshold must not have taken place more than 2 months before the end date for the project reporting period. No offset credit may be issued for a project reporting period when the calibration or verification of the calibration accuracy of the required instruments has not been correctly carried out and documented.

6.5 Missing Data

In situations where the flow rate or methane concentration monitoring equipment is missing data, the Project Developer shall apply the data substitution methodology provided in Appendix B. If for any reason the destruction device monitoring equipment is inoperable (for example, the thermal coupler on the flare), then no emission reductions can be registered for that device for the period of inoperability.

6.6 Monitoring Parameters

Prescribed monitoring parameters necessary to calculate baseline and project emissions are provided in Table 6.1.

Table 6.1. Mine Methane Project ~~Surveillance~~ Monitoring Plan

Eq. #	Parameter	Description	Data Unit	Calculated (c) Measured (m) Reference (r) Operating Records (o)	Measurement Frequency	Comment
	Operating status of destruction device	N/A	Degree Celsius or other, depending on the device	m	Hourly	Required for each destruction device. For flares, operation is defined as thermocouple readings above 260°C
	Uncorrected volume of mine gas sent to destruction device *i*, in time interval *t*	$MG_{uncorrected}$	Cubic metre per unit time	m	Only when flow data are not adjusted at standard conditions	Used only in cases where the flow meter does not automatically correct to 16°C and 101.325 kPa

Eq. #	Parameter	Description	Data Unit	Calculated (c) Measured (m) Reference (r) Operating Records (o)	Measurement Frequency	Comment
	Corrected volume of mine gas sent to destruction device *i*, in time interval *t*	$MG_{i,t}$	Cubic metre per unit time at standard conditions	m/c	Continuous and recorded at least every 15 minutes or totalized and recorded at least daily and adjusted for temperature and pressure	Measured continuously by a flow meter and recorded at least once every 15 minutes. Data to be aggregated by time interval *t* (this parameter is calculated in cases where the metered flow must be corrected for temperature and pressure)
	Total quantity of CH_4 sent to destruction device *i* during the project reporting period	Q_i	Cubic metre of CH_4 at standard conditions	c	Daily	Calculated daily
	Time interval for which mine gas CH_4 flow and content measurements are aggregated	t	Day, hour, or minute	m	Continuous or daily	Projects may use the interval used by their continuous CH_4 concentration data acquisition system, provided it is not more than 1 day for the continuous monitoring of CH_4 content
	Average CH_4 fraction of the mine gas sent to destruction device in time interval *t*	$C_{CH4,t}$	Cubic metre of CH_4 at standard conditions per cubic metre of mine gas at standard conditions	m	Continuous and recorded at least every 15 minutes	Measured by continuous gas analyzer
	Total fossil fuels consumed by the mine gas capture and destruction system during the project reporting period, by type of fuel *j*	$FF_{PR,j}$	Kilogram (solid) Cubic metre at standard conditions (gas) Litre (liquid)	c	Every reporting period	Calculated from monthly record of fossil fuel purchased and consumed
	Total electricity consumed by the mine gas capture and destruction system during the project reporting period		Megawatt-Hour	c	Every reporting period	Obtained from either onsite metering or utility purchase records. Required to determine CO_2 emissions from use of electricity to operate the project activity

Eq. #	Parameter	Description	Data Unit	Calculated (c) Measured (m) Reference (r) Operating Records (o)	Measurement Frequency	Comment
	Total heat consumed by the mine gas capture and destruction system during the project reporting period		Volume	o	Every reporting period	Obtained from purchase records. Required to determine CO_2 emissions from use of additional heat to operate the project activity
	Mine gas or ventilation air temperature	T	°C	m	Continuous	No separate monitoring of temperature is necessary when using flow meters that automatically adjust flow volumes for temperature and pressure, expressing gas volumes in normalized kPa
	Mine gas or ventilation air pressure	P	kPa	m	Continuous	No separate monitoring of pressure is necessary when using flow meters that automatically measure adjust flow volumes for temperature and pressure, expressing gas volumes in normalized kPa
	Volume of ventilation air sent to destruction device	VA_E	Cubic metre at standard conditions	m, c	Continuous and recorded at least every 2 minutes	Readings taken at least every 2 minutes to calculate average hourly flow, adjusted for T and P
	Volume of cooling air added	CA	Cubic metre at standard conditions	m, c	Continuous and recorded at least every 2 minutes	Readings taken at least every 2 minutes to calculate average hourly flow, adjusted for T and P
	Volume of ventilation air leaving the destruction device	VA_S	Cubic metre at standard conditions	m, c	Continuous and recorded at least every 2 minutes	Readings taken at least every 2 minutes to calculate average hourly flow, adjusted for T and P
	Methane concentration in ventilation air sent to destruction device	C_{CH4}	Cubic metre of CH_4 per cubic metre of gas at standard conditions	m	Continuous and recorded at least every 2 minutes	Readings taken at least every 2 minutes and used to calculate average methane concentration per hour
	Methane concentration in ventilation air leaving the destruction device	$C_{Dest\text{-}CH4}$	Cubic metre of CH_4 per cubic metre of gas at standard conditions	m	Continuous and recorded at least every 2 minutes	Readings taken at least every 2 minutes (either average over 2 minutes or instantaneous) and used to calculate average methane concentration per hour

7 Reporting Parameters

This section provides requirements and guidance on reporting rules and procedures. A priority of the Ministry is to facilitate consistent and transparent information disclosure among Project Developers. Project Developers shall conduct regular project reporting according the guidance in the Regulation.

7.1 First Project Report

In addition to the information required under the [Reference to the Regulation], the first project report must include the following information:

1. in the case of an underground mine, the mining method employed, such as room and pillar or longwall;
2. annual coal production, in metric tonnes;
3. the year of initial mine operation;
4. the scheduled year of mine closure, if known;
5. a diagram of the mine site that includes
   a. the location of existing and planned wells and boreholes, specifying whether they were used for pre-mining or post-mining drainage, and whether they are part of the project;
   b. the location of the equipment that will be used to treat or destroy the mine CH_4.

7.2 Record Keeping

For purposes of independent verification and historical documentation, Project Developers are required to keep all information outlined in this protocol for a period of 7 years starting on the date of the end of the final reporting period. Information on data procedures and data monitoring must be managed in a way that guarantees the integrity, exhaustiveness, accuracy and validity of the data.

The Project Developer must keep the following documents and information:

1. the information and data required under the surveillance plan, including all GHG calculations and their related data inputs;
2. information on each flow meter, CH_4 analyzer and destruction device used, including type, model number, serial number and manufacturer's maintenance and calibration procedures;
3. the calibration date, time and results for CH_4 analyzers and flow meters, and the corrective measures applied if a piece of equipment fails to meet the requirements of this Regulation;
4. the maintenance records for capture, destruction and monitoring systems;
5. operating records showing annual coal production.

Commented [MH13]: Sections 7, 8, and 9 are new sections from CAR template that are not present in QC protocol

Commented [MH14]: Section removed in LFG draft protocol – do we want to keep this section? Or will it be included full in the Regulation?

Commented [md15]: Here, the term drainage is used in the French version too, not sure why dégazage was used elsewhere.

Commented [TL16]: Is this necessary? May be considered proprietary? Consider other options for demonstrating mine status (Not required in CA protocol; perhaps this data point can be one option?)

7.3 Reporting Period and Verification Cycle

Project Developers must report GHG reductions resulting from project activities during each reporting period. Reporting periods shall be 12 months in length. Guidance regarding the deadlines for verification of each reporting period can be found in the Regulation.

Except for the initial reporting period, projects which generate fewer than 25,000 tonnes of emission reductions in a calendar year may delay verification for up to a year. These projects may verify two 12-month reporting periods at the same time.

8 Verification Guidance

Only verification bodies approved by the Ministry for this project type are eligible to verify Canadian mine methane project reports. Verification bodies approved under other project protocol types are not permitted to verify mine methane projects.

8.1 Standard of Verification

The Ministry's standard of verification for mine methane projects is the Canada Mine Methane Capture & Destruction Project Protocol (this document) and the Regulation. To verify a mine methane project report, verification bodies apply the guidance in the Regulation and this section of the protocol to the standards described in Sections 2 through 7 of this protocol.

Verification bodies are expected to use their professional judgment to confirm that protocol requirements have been met in instances where the protocol does not provide (sufficiently) prescriptive guidance. For more information on the Ministry's verification process and professional judgment, please see the Regulation.

8.2 ~~Surveillance~~ Monitoring Plan

Verification bodies shall confirm that the monitoring plan covers all aspects of monitoring and reporting contained in this protocol and specifies how data for all relevant parameters in Table 6.1 are collected and recorded.

8.3 Verifying Project Eligibility

Verification bodies must affirm a mine methane project's eligibility according to the rules described in this protocol. The table below outlines the eligibility criteria for a mine methane project. This table does not represent all criteria for determining eligibility comprehensively; verification bodies must also look to Section 3 and the verification items list in Table 8.2.

Table 8.1 Summary of Eligibility Criteria

Eligibility Rule	Eligibility Criteria	Frequency of Rule Application
Start Date	Per guidance in the Regulation	Once during first verification
Location	Canada	Once during first verification
Performance Standard	Installation of a qualifying destruction device where not required by law (see Section 3.4.1 for other requirements)	Once during first verification
Legal Requirement Test	Specific to each province (see Section 3.4.2 for more information)	Every verification
Regulatory Compliance Test	Disclosure of all non-compliance events to verifier; project must be in material compliance with all applicable laws	Every verification
Exclusions	▪ Coal bed methane destruction ▪ Use of CO_2 or other fluid/gas to enhance methane drainage before mining takes place	Every verification

8.4 Core Verification Activities

Commented [MH17]: Additional language to be added to allow joint verification if multiple projects exist at single mine.

The Regulation describes the core verification activities that shall be performed by verification bodies for all project verifications. They are summarized below in the context of a mine methane project, but verification bodies must also follow the general guidance in the Regulation.

Verification is a risk assessment and data sampling effort designed to ensure that the risk of reporting error is assessed and addressed through appropriate sampling, testing, and review. The three core verification activities are:

1. Identifying emission sources, sinks, and reservoirs (SSRs)
2. Reviewing GHG management systems and estimation methodologies
3. Verifying emission reduction estimates

Identifying emission sources, sinks, and reservoirs
The verification body reviews for completeness the sources, sinks, and reservoirs identified for a project, such as, *inter alia*, mine methane emissions, system energy use, fuel consumption, and combustion and destruction from various qualifying and non-qualifying destruction devices.

Reviewing GHG management systems and estimation methodologies
The verification body reviews and assesses the appropriateness of the methodologies and management systems that the mine methane Project Developer uses to gather data and calculate baseline and project emissions.

Verifying emission reduction estimates
The verification body further investigates areas that have the greatest potential for material misstatements and then confirms whether or not material misstatements have occurred. This involves site visits to the project facility (or facilities if the project includes multiple facilities) to ensure the systems on the ground correspond to and are consistent with data provided to the verification body. In addition, the verification body recalculates a representative sample of the performance or emissions data for comparison with data reported by the Project Developer in order to double-check the calculations of GHG emission reductions.

8.5 Mine Methane Project Verification Items

The following tables provide lists of items that a verification body needs to address while verifying a mine methane project. The tables include references to the section in the protocol where requirements are further described. The table also identifies items for which a verification body is expected to apply professional judgment during the verification process. Verification bodies are expected to use their professional judgment to confirm that protocol requirements have been met in instances where the protocol does not provide (sufficiently) prescriptive guidance.

Note: These tables shall not be viewed as a comprehensive list or plan for verification activities, but rather guidance on areas specific to mine methane projects that must be addressed during verification.

8.5.1 Project Eligibility and Credit Issuance

Table 8.2 lists the criteria for reasonable assurance with respect to eligibility and credit issuance for mine methane projects. These requirements determine if a project is eligible to register credits for the reporting period. If any one requirement is not met, either the project may be determined ineligible or the GHG reductions from the reporting period (or sub-set of the reporting period) may be ineligible for issuance of credits, as specified in Sections 2, 3, and 6.

Table 8.2 Eligibility Verification Items

Protocol Section	Eligibility Qualification Item	Apply Professional Judgment?
3.4.1	Verify that the project meets the appropriate Performance Standard Test for the project type per Section 3.4.1	No
3.4.3	Verify that the project activities comply with applicable laws by reviewing any instances of non-compliance provided by the Project Developer and performing a risk-based assessment	Yes
4	Confirm all baseline destruction devices have been properly accounted for within project's GHG Assessment Boundary	No
6	Verify that monitoring meets the requirements of the protocol	No
6	Verify that the project surveillance plan contains procedures for ascertaining and demonstrating that the project passes the Legal Requirement Test at all times	Yes
6	Verify that the mine gas and/or VAM destruction system operated in a manner consistent with the design specifications	Yes
6	Verify that there is an individual responsible for managing and reporting GHG emissions, and that individual properly trained and qualified to perform this function	Yes
6.2	Verify that all gas flow meters and methane analyzers adhered to the inspection, cleaning, and calibration schedule specified in the protocol. If they do not, verify whether any non-conformances should be considered material.	Yes
6.2	If any piece of equipment failed a calibration check, verify that data from that equipment was scaled according to the failed calibration procedure for the appropriate time period	No
6.3	If used, verify that data substitution methodology was properly applied	No
7	Verify that appropriate documents are created to support and/or substantiate activities related to GHG emission reporting activities, and that such documentation is retained appropriately	Yes

8.5.2 Quantification of GHG Emission Reductions

Table 8.3 lists the items that verification bodies shall include in their risk assessment and re-calculation of the project's GHG emission reductions. These quantification items inform any determination as to whether there are material and/or immaterial misstatements in the project's GHG emission reduction calculations. If there are material misstatements, the calculations must be revised before credits are issued.

Table 8.3. Quantification Verification Items

Protocol Section	Quantification Item	Apply Professional Judgment?
4	Verify that SSRs included in the GHG Assessment Boundary correspond to those required by the protocol and those represented in the project	No

Protocol Section	Quantification Item	Apply Professional Judgment?
5	Verify that the Project Developer correctly accounted for baseline methane destruction in the baseline scenario	No
5	Verify that the Project Developer correctly monitored, quantified and aggregated the amount of mine methane collected and destroyed by mine gas or VAM destruction system	No
5	Verify that the Project Developer correctly quantified and aggregated electricity use	Yes
5	Verify that the Project Developer correctly quantified and aggregated fossil fuel use	Yes
5	Verify that the Project Developer correctly quantified and aggregated heat consumption	Yes
5	Verify that the Project Developer applied the correct emission factors for fossil fuel combustion and grid-delivered electricity	No
5	Verify that the Project Developer applied the correct methane destruction efficiencies	No
Appendix A	If the Project Developer used source test data in place of the default destruction efficiencies (Appendix A), verify accuracy and appropriateness of data and calculations	Yes

8.5.3 Risk Assessment

Verification bodies will review the following items in Table 8.4 to guide and prioritize their assessment of data used in determining eligibility and quantifying GHG emission reductions.

Table 8.4. Risk Assessment Verification Items

Protocol Section	Item that Informs Risk Assessment	Apply Professional Judgment?
	Verify that the surveillance plan is sufficiently rigorous to support the requirements of the protocol and proper operation of the project	Yes
	Verify that appropriate monitoring equipment is in place to meet the requirements of the protocol	No
	Verify that equipment calibrations have been carried out to satisfy the requirements of the protocol	No
	Verify that the individual or team responsible for managing and reporting project activities are qualified to perform this function	Yes
	Verify that appropriate training was provided to personnel assigned to greenhouse gas reporting duties	Yes
	Verify that all contractors are qualified for managing and reporting greenhouse gas emissions if relied upon by the Project Developer. Verify that there is internal oversight to assure the quality of the contractor's work	Yes
	Verify that the methane destruction equipment was operated and maintained according to manufacturer specifications	Yes
	Verify that all required records have been retained by the Project Developer	No

8.6 Completing Verification

The Regulation provides detailed information and instructions for verification bodies to finalize the verification process. It describes completing a Verification Report, preparing a Verification Opinion, submitting the necessary documents to the Ministry, and notifying the Ministry of the project's verified status.

9 Glossary of Terms

Commented [MH18]: Mainly from Reserve's CMM protocol V1.1. Will need to be updated to include Ontario (or Canada-wide) mine statuses, and other terms.

Abandoned mine	A mine where all mining activity including mine development and mineral production have ceased, mine personnel are not present in the mine workings, and mine ventilation fans are no longer operative.[8] In the U.S., mines are declared "abandoned" from the date when ventilation is discontinued.[9] This mine type is not eligible under this protocol.
Active mine	Active mines include mine works that are actively ventilated by the mine operator.
Additionality	Project activities that are above and beyond "business as usual" operation, exceed the baseline characterization, and are not mandated by regulation.
Baseline emissions	Baseline emissions represent the GHG emissions within the GHG Assessment Boundary that would have occurred in the absence of the GHG reduction project.
Carbon dioxide (CO_2)	The most common of the six primary greenhouse gases, consisting of a single carbon atom and two oxygen atoms.
CO_2 equivalent (CO_2e)	The quantity of a given GHG multiplied by its total global warming potential. This is the standard unit for comparing the degree of warming which can be caused by different GHGs.
Coal bed methane (CBM)	A generic term for methane originating in coal seams that is drained from virgin coal seams and surrounding strata. CBM is unrelated to mining activities.
Coal mine methane (CMM)	Methane contained in coal and surrounding strata that is released because of mining activity. For the purposes of this protocol, CMM also refers to the methane gas that is released because of mining activity at Category III gassy underground trona mines.
Direct emissions	GHG emissions from sources that are owned or controlled by the reporting entity.
Drainage system	A term used to encompass the entirety of the equipment that is used to drain the gas from underground and collect it at a common point, such as a vacuum pumping station. In this protocol, methane drainage systems include surface pre-mining, horizontal pre-mining, and post-mining.
Effective Date	The date of adoption of this protocol by the MOECC or the MDDELCC.

[8] UN Economic and Social Council, Economic Commission for Europe, Committee on Sustainable Energy, Glossary of Coal Mine Methane Terms and Definitions, July 2008.
[9] MSHA Program Policy Manual Volume V, January 2006, p.120.

Eligible end use	For the purposes of this protocol, all end uses that result in the destruction/oxidation of methane except for injection into natural gas pipeline for underground mines.
Emission factor (EF)	A unique value for determining an amount of a GHG emitted for a given quantity of activity data (e.g., metric tons of carbon dioxide emitted per barrel of fossil fuel burned).
Emission reduction	1 metric tonne CO_2 equivalent reduced, as compared to a baseline level of emissions
Environment and Climate Change Canada	Governmental organization responsible for accurate and transparent monitoring, reporting and verification of Canada's greenhouse gas emissions and removals.
Fossil fuel	A fuel, such as coal, oil, and natural gas, produced by the decomposition of ancient (fossilized) plants and animals.
Gob	Also referred to as goaf, it is the collapsed area of strata produced by the removal of coal and artificial supports behind a working coalface. Strata above and below the gob are de-stressed and fractured by the mining activity.
Greenhouse gas (GHG)	Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs), or perfluorocarbons (PFCs).
GHG reservoir	A physical unit or component of the biosphere, geosphere, or hydrosphere with the capability to store or accumulate a GHG that has been removed from the atmosphere by a GHG sink or a GHG captured from a GHG source.
GHG sink	A physical unit or process that removes GHG from the atmosphere.
GHG source	A physical unit or process that releases GHG into the atmosphere.
Global Warming Potential (GWP)	The ratio of radiative forcing (degree of warming to the atmosphere) that would result from the emission of one unit of a given GHG compared to one unit of CO_2.
Indirect emissions	Reductions in GHG emissions that occur at a location other than where the reduction activity is implemented, and/or at sources not owned or controlled by project participants.
Longwall mine	An underground mining type that uses at least one longwall panel during coal excavation.
Metric ton (t, tonne)	A common international measurement for the quantity of GHG emissions, equivalent to about 2204.623 pounds or 1.1 short tons.
Methane (CH_4)	A potent GHG with a high global warming potential, consisting of a single carbon atom and four hydrogen atoms.
Mine	An area of land and all structures, facilities, machinery tools, equipment, shafts, slopes, tunnels, excavations, and other property, real or personal, placed upon, under, or above the surface of such

	land by any person, used in, or to be used in, or resulting from, the work of extracting minerals. The mine boundaries are defined by the mine area as permitted by the province in which the mine is located.
Mine gas	Gas from drainage systems before any processing or enrichment that often contains various levels of other components (e.g., nitrogen, oxygen carbon dioxide, hydrogen sulfide, NMHC, etc.).
Mine methane	Methane contained in coal and surrounding strata that is released because of mining activity.
Mined through	When the linear distance between the endpoint of the borehole and the working face that will pass nearest the endpoint of the borehole has reached an absolute minimum. Coal mine methane from surface pre-mining boreholes shall not be quantified in the baseline until the endpoint of the borehole is mined through.
Ministry	Ontario Ministry of the Environment and Climate Change (MOECC) or Quebec Ministry of Sustainable Development, Environment, and Fight Against Climate Change (MDDELC)
MMBtu	One million British thermal units.
Non-qualifying destruction device	A methane destruction device that does not meet one or more of the eligibility rules as described in Section 3 (e.g., operational start date, regulatory requirement, injection into natural gas pipeline) and is located at the same mine where eligible project activities are taking place.
Oxidizer	For the purposes of this protocol, the term oxidizer refers to technology for destruction of ventilation air methane with or without utilization of thermal energy and/or with or without a catalyst.
Project diagram	A diagram of the mine that illustrates the location, quantity, and type of boreholes, ventilations shafts, eligible destruction devices and non-qualifying destruction devices within a project's GHG Assessment Boundary.
Project baseline	A "business as usual" GHG emission assessment against which GHG emission reductions from a specific GHG reduction activity are measured.
Project emissions	Project emissions are actual GHG emissions that occur within the GHG Assessment Boundary as a result of project activities. Project emissions are calculated at a minimum on an annual, *ex-post* basis.
Project operator	An entity that undertakes a GHG project, as identified in Section 2.1 of this protocol.
Qualifying destruction device	Eligible treatment or destruction devices include enclosed flares, open flares, combustion engines, boilers, turbines, microturbines, natural gas pipeline injection, fuel cells, and CH_4 liquefaction units. Additional types of devices may be approved by the Ministry.
Reporting period	Specific time period of project operation for which the project

	operator has calculated and reported emission reductions and is seeking verification and issuance of credits. The reporting period must be no longer than 12 months.
Room and pillar mine	An underground mining type that uses square or rectangular pillars of coal during excavation, laid out in a checkerboard fashion. Pillars typically range in size from 60 feet by 60 feet to 100 feet by 100 feet and rooms are typically 20 feet wide and a few thousand feet long
Ventilation air methane (VAM)	Coal mine methane that is mixed with the ventilation air in the mine that is circulated in sufficient quantity to dilute methane to low concentrations for safety reasons (typically below 1 percent).
Ventilation system	A system that is used to control the concentration of methane and other deleterious gases within mine working areas. Ventilation systems consist of powerful fans that move large volumes of air through the mine workings to dilute methane concentrations. All underground coal mines in Canada are required to develop and maintain ventilation systems.
Verification organization	An organization that is accredited under ISO 14065 by a member of the International Accreditation Forum in Canada or the United States according to an ISO 17011 program.
Year	For the purposes of this protocol, year refers to a 12-month period of the project's crediting period, not a calendar year.

Appendix A Destruction Efficiencies for Destruction Devices

Table A.1. Destruction Efficiencies for Destruction Devices

Treatment or Destruction Device	Efficiency
Open Flare	0.96
Enclosed Flare	0.995
Internal Combustion Engine	0.936
Boiler	0.98
Microturbine or Large Gas Turbine	0.995
Boiler Following Upgrade and Injection into a Pipeline	0.96
CH_4 Liquefaction Unit	0.95

If a device not listed here is approved for use by the Ministry, the destruction efficiency shall be determined through on-site emissions testing or monitoring, unless otherwise directed by the Ministry.

Commented [TL19]: This section will be updated to be consistent across all protocols. (This may be something that is ultimately included in the Regulation, in which case references to Destruction Efficiency (DE) could simply reference the regulation

Commented [TL20]: Recommend adding "upgrade and use of gas as CNG/LNG fuel" (DE = 0.95)

Commented [TL21]: Recommend distinguishing between lean burn and rich burn internal combustion engines (0.936 vs. 0.995), as is done in CA and CAR protocols

Commented [TL22]: Reconsider DE for pipeline injection (0.981 in California protocol, 0.98 in Reserve protocol), priority on harmonizing destruction efficiencies across all protocols.

Appendix B Missing Data – Substitution Methods

The replacement methods below may be used only:

1. For CH_4 content or mine gas flow rate parameters;
2. For missing data on mine gas flow rates that are discrete, non-chronic and due to unforeseen circumstances;
3. When the proper functioning of the treatment or destruction device can be shown by thermocouple readings at the flare or other device;
4. When data on mine gas flow rate only, or CH_4 content only, are missing;
5. To replace data on mine gas flow rates when a continuous analyzer is used to measure CH_4 content and when it is shown that CH_4 content was consistent with normal operations for the time when the data are missing; and
6. To replace data on CH_4 content when it is shown that the mine gas flow rate was consistent with normal operations for the time when the data are missing.

No offset credit may be issued for periods when the replacement methods cannot be used.

Table B.1. Missing Data – Replacement Methods

Missing Data Period	Replacement Method
Less than 6 hours	Use the average of the 4 hours immediately before and following the missing data period
6 to less than 24 hours	Use the 90% upper or lower confidence limit of the 72 hours prior to and after the missing data period, whichever results in greater conservativeness
1 to 7 days	Use the 95% upper or lower confidence limit of the 72 hours prior to and after the missing data period, whichever results in greater conservativeness
More than 7 days	No data may be replaced and no reduction may be credited