California Environmental Protection Agency

AIR RESOURCES BOARD

Compliance Offset Protocol
Mine Methane Capture Projects

Capturing and Destroying Methane From
U.S. Coal and Trona Mines

Adopted: April 25, 2014

Note: *All text is new. As permitted by title 2, California Code of Regulations, section 8, for ease of review, underline to indicate adoption has been omitted.*

(This page left intentionally blank)

Chapter 1. Purpose and Definitions

1.1. Purpose

(a) The purpose of the Compliance Offset Protocol Mine Methane Capture Projects (protocol) is to quantify greenhouse gas emission reductions associated with the capture and destruction of methane that would otherwise be vented into the atmosphere as a result of mining operations at active underground and surface coal and trona mines and abandoned underground coal mines.

(b) AB 32 exempts quantification methodologies from the Administrative Procedure Act (APA);[1] however those elements of the protocol are still regulatory. The exemption allows future updates to the quantification methodologies to be made through a public review and Board adoption process but without the need for rulemaking documents. Each protocol identifies sections that are considered quantification methodologies and exempt from APA requirements. Any changes to the non-quantification elements of the offset protocols would be considered a regulatory update subject to the full regulatory development process. Those sections that are considered to be a quantification methodology are clearly indicated in the title of the chapter or subchapter if only a portion of that chapter is considered part of the quantification methodology of the protocol.

1.2. Definitions

(a) For the purposes of this protocol, the following definitions apply:

(1) "Abandoned Underground Mine" means a mine where all mining activity including mine development and mineral production has ceased, mine personnel are not present in the mine workings, and mine ventilation fans are no longer operative. A mine must be classified by the Mine Safety and Health Administration (MSHA) as abandoned or abandoned and sealed in order to be eligible for an abandoned mine methane recovery activity.

(2) "Abandoned Mine Methane" or "AMM" means methane released from an abandoned mine.

[1] Health and Safety Code section 38571

(3) “Accuracy” is defined in section 95102 of the Mandatory Reporting Regulation.

(4) “Active Surface Mine” means a permitted mine in which the mineral lies near the surface and can be extracted by removing the covering layers of rock and soil. A mine must be classified by the Mine Safety and Health Administration (MSHA) as active, intermittent, or temporarily idle in order to be eligible for an active surface mine methane drainage activity.

(5) “Active Underground Mine” means a permitted mine usually located several hundred feet below the earth’s surface. A mine must be classified by the Mine Safety and Health Administration (MSHA) as active, intermittent, or temporarily idle in order to be eligible for an active underground mine methane drainage or ventilation air methane activity.

(6) “Basin” is defined in section 95102 of the Mandatory Reporting Regulation.

(7) “Borehole” means a hole made with a drill, augur, or other tool into a coal seam or surrounding strata from which mine gas is extracted.

(8) “Cap-and-Trade Regulation” or “Regulation” means ARB’s regulation establishing the California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms as set forth in title 17, California Code of Regulations, chapter 1, subchapter 10, article 5 (commencing with section 95800).

(9) “Coal” is defined in section 95102 of the Mandatory Reporting Regulation.

(10) “Coal Bed Methane” or “CBM” or “Virgin Coal Bed Methane” means methane-rich natural gas drained from coal seams and surrounding strata not disturbed by mining. The extraction, capture, and destruction of virgin coal bed methane are unrelated to mining activities and are not eligible under this protocol.

(11) “Emission Factor” is defined in section 95102 of the Mandatory Reporting Regulation.

(12) “Enclosed Flare” means a flare that is situated in an enclosure for the purposes of safety and accurate measurement of gas combustion. For purposes of this protocol, an enclosed flare is considered a flare.

(13) “End-use Management Option” means a method of methane destruction deemed either eligible or ineligible for the purpose crediting under this protocol.

(14) “Flare” is defined in section 95102 of the Mandatory Reporting Regulation.

(15) “Flooded Mine” or “Flooded Section” means a mine, or section thereof, that is flooded (i.e., filled with water) as a result of the turning off of pumps at time of abandonment and has no detectable freely venting methane emissions. Mines that either pump water due to regulatory or legal requirements or have detectable free standing water shall not be considered flooded provided that they still freely vent methane.

(16) “Flow Meter” is defined in section 95102 of the Mandatory Reporting Regulation.

(17) “Gas Treatment” means applying techniques to extracted mine gas such as dehydration, gas separation, and the removal of non-methane components to prepare the mine gas for an end-use management option, including pipeline injection.

(18) “Gob” means the part of the mine from which the mineral and artificial supports have been removed and the roof allowed to fall in. Gob is also known as “Goaf.”

(19) “Initial start-up period” means the period between qualifying destruction device installation and project commencement. After the installation of the qualifying destruction device, the Offset Project Operator or Authorized Project Designee may run, tune, and test the system to ensure its operational quality. An initial start-up period must not exceed 9 months.

(20) “Longwall” means a method of underground mining where a mechanical shearer is pulled back and forth across a coal face and loosened coal falls onto a conveyor for removal from the mine.

(21) “Mandatory Reporting Regulation” or “MRR” means ARB’s regulation establishing the Mandatory Reporting of Greenhouse Gas Emissions set forth in title 17, California Code of Regulations Chapter 1, Subchapter 10, article 2 (commencing with section 95100).

(22) “Methane Drainage System” or “Drainage System” means a system that drains methane from coal or trona seams and/or surrounding rock strata and transports it to a common collection point. Methane drainage systems may comprise multiple methane sources.

(23) “Methane Source” means a methane source type (i.e., ventilation shafts, pre-mining surface wells, pre-mining in-mine boreholes, post-mining gob wells, existing coal bed methane wells that would otherwise be shut-in and abandoned, abandoned wells that are reactivated, and converted dewatering wells) in the aggregate. In this protocol, “methane source” does not refer to any specific ventilation shaft, borehole, or well, but instead refers to all the ventilation shafts, boreholes, and wells of the same type collectively.

(24) “Mine Gas” or “MG” means the untreated gas extracted from within a mine through a methane drainage system that often contains various levels of other components (e.g., nitrogen, oxygen, carbon dioxide, hydrogen sulfide, and nonmethane hyrdocarbons) in addition to methane.

(25) “Mine Methane” or “MM” means methane contained in mineral deposits and surrounding strata that is released as a result of mining operations; the methane portion of mine gas.

(26) “Mine Operator” means any owner, lessee, or other person who operates, controls, or supervises a coal or other mine or any independent contractor performing services or construction at such mine. For purposes of this protocol, the Mine Operator is the operating entity listed on the state well drilling permit, or a state operating permit for wells where no drilling permit is issued by the state.

(27) “Mine Safety and Health Administration” or “MSHA” means the U.S. federal agency that regulates mine health and safety.

(28) “Mining Activities” means working an area or panel of coal or trona that has been developed and equipped to facilitate mineral extraction and is shown on a mining plan.

(29) “Mountaintop Removal Mining” means a method of surface mining involving the removal of the covering layers of rock and soil at or near the top of a mountain to expose coal seams. Projects which occur at mines that employ mountaintop removal mining are not eligible under this protocol.

(30) “Natural Gas Seep” means an area where natural gas is emitted from overburden and outcrops that connect the mine to the atmosphere.

(31) “Natural Gas Pipeline” or “Pipeline” means a high pressure pipeline transporting saleable quality natural gas offsite to distribution, metering, or regulating stations or directly to customers.

(32) “Non-Qualifying Destruction Device” or “Non-Qualifying Device” means a destruction device that is either operational at the mine prior to offset project commencement, except as specified in section 2.4(b), or used to combust mine methane via an ineligible end-use management option per section 3.4. A destruction device that is operational at the mine prior to offset project commencement is considered a non-qualifying destruction device even if retrofitted thereafter. Methane destroyed by a non-qualifying device must be monitored for quantification of both the baseline and project scenarios.

(33) “Offset Project Expansion” means the addition of a new methane source or new destruction device to an existing MMC project. A methane source is deemed new if it is either drilled after offset project commencement or connected to a destruction device after offset project commencement. A destruction device is deemed new if it becomes operational after offset project commencement. Under certain circumstances, described in chapter 2, the addition of new methane sources or new destruction devices may qualify as a new MMC project or an offset project expansion. In those cases, an Offset Project Operator may choose how to define the

addition. Offset project expansion, unlike the establishment of a new MMC project, will not result in a new offset project commencement date or crediting period. Offset project expansion, unlike the establishment of a new MMC project, allows the Offset Project Operator to submit a single Offset Project Data Report (OPDR) and undergo a single verification for the reporting period.

(34) "Open-pit" means a method of surface mining where coal is exposed by removing the overlying rock. This is also known as open-cut or opencast mining.

(35) "Pre-mining In-mine Boreholes" means a borehole drilled into an unmined seam from within the mine to drain methane from the seam ahead of the advancement of mining. This is also known as horizontal pre-mining boreholes.

(36) "Pre-mining Surface Wells" means a well drilled into an unmined seam from the surface to drain methane from the seam and surrounding strata, often months or years in advance of mining. This is also known as surface pre-mining boreholes, surface-to-seam boreholes, and surface-drilled directional boreholes.

(37) "Post-mining Gob Well" or "Gob Well" means a well used to extract or vent methane from the gob. Gob wells may be drilled from the surface or within the mine.

(38) "Project Activity" means a change in mine methane management that leads to a reduction in GHG emissions in comparison to the baseline management and GHG emissions.

(39) "Qualifying Destruction Device" or "Qualifying Device" means a destruction device that was not operational at the mine prior to offset project commencement, except as specified in section 2.4(b), and that was not used to combust mine methane via an ineligible end-use management option per section 3.4. Methane destroyed by a qualifying device must be monitored for quantification of both the baseline and project scenarios.

(40) “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.

(41) “Sealed,” in reference to an abandoned underground mine, means that existing wells and ventilation shafts are sealed, to some degree, with earthen or concrete seals inhibiting the flow of mine gas into the atmosphere. For purposes of determining baseline emissions under this protocol, the status of an abandoned underground mine (i.e., sealed or venting) must be obtained, if available, from a state agency with information on abandoned coal mines. If status is unavailable, an abandoned underground mine is considered sealed if any known entrance into the mine (e.g., portals, ventilation shafts, and methane drainage wells) has been sealed at any time prior to the project commencement date.

(42) “Shut-in” means to close, temporarily, a well capable of production.

(43) “Standard Conditions” or “Standard Temperature and Pressure” or “STP" means, for the purposes of this protocol, 60 degrees Fahrenheit and 14.7 pounds per square inch absolute (1 atm).

(44) “Standard Cubic Foot” or “scf” means, for the purposes of this protocol, a measure of quantity of gas, equal to a cubic foot of volume at 60 degrees Fahrenheit and 14.7 pounds per square inch (1 atm) of pressure.

(45) “Strata,” plural of stratum, means the layers of sedimentary rock surrounding a coal seam.

(46) “Surface Mine Methane” or “SMM” means methane contained in mineral deposits and surrounding strata that is released as a result of surface mining operations.

(47) “Thermal Energy” means the thermal output produced by a combustion source used directly as part of a manufacturing process, industrial/commercial process, or heating/cooling application, but not used to produce electricity.

(48) “Trona” means a water-bearing sodium carbonate compound mineral that is mined and processed into soda ash or bicarbonate of soda.

(49) “Uncertainty” is defined in section 95102 of the Mandatory Reporting Regulation.

(50) “Uncertainty Deduction” means an adjustment applied to the emission reductions achieved by an abandoned mine methane recovery activity to account for uncertainty related to the use of emission rate decline curves. The purpose of an uncertainty deduction is to ensure that credited emission reductions remain conservative.

(51) “Ventilation Air” or “VA” means the gas emitted from the ventilation system of a mine which originates across the mine workings and contains low concentrations of methane.

(52) “Ventilation Air Methane” or “VAM” means methane contained in ventilation air.

(53) “Ventilation Air Methane Collection System” or “VAM Collection System” means a system that captures the ventilation air methane from the ventilation system.

(54) “Ventilation Shaft” means a vertical passage used to move fresh air underground and/or to remove methane and other gases from an underground mine.

(55) “Ventilation System” means a system of fans that provides a flow of air to underground workings of a mine for the purpose of sufficiently diluting and removing methane and other noxious gases.

(56) “Venting,” in reference to an abandoned underground mine, means that existing wells and ventilation shafts are left unsealed, allowing air into the mine and methane to escape freely to the atmosphere. For purposes of determining baseline emissions under this protocol, the status of an abandoned underground mine, sealed or venting, must be obtained from a state agency with information on abandoned coal mines. If status is unavailable, an abandoned underground mine is considered venting if no known entrance into the mine (e.g., portals, ventilation shafts, and methane drainage wells) has been sealed at any time prior to the project commencement date.

(57) “Well” means a well drilled for extraction of natural gas from a coal seam, surrounding strata, or mine.

(b) For terms not defined in section 1.2(a), the definitions in section 95802 of the Cap-and-Trade Regulation (Regulation) apply.

(c) For purposes of this protocol, the following acronyms apply:

(1) “AAPG” means American Association of Petroleum Geologists.

(2) “AB 32” means Assembly Bill 32, the Global Warming Solutions Act of 2006.

(3) “acf” means actual cubic feet.

(4) “acfm” means actual cubic feet per minute.

(5) “AMM” means abandoned mine methane.

(6) “APA” means Administrative Procedure Act.

(7) “ARB” means the California Air Resources Board.

(8) “ASTM” means the American Society of Testing and Materials.

(9) “atm” means atmosphere in reference to a unit of pressure.

(10) “Btu” means British thermal unit.

(11) “CBM” means coal bed methane.

(12) “CH_4” means methane.

(13) “CO_2” means carbon dioxide.

(14) “CO_2e” means carbon dioxide equivalent.

(15) “d” means day.

(16) “F” means Fahrenheit.

(17) “GHG” means greenhouse gas.

(18) “GWP” means global warming potential.

(19) “h” means hour.

(20) “kg” means kilogram.

(21) “lb” means pound.

(22) “m” means minute.

(23) “MG” means mine gas.

(24) “MM” means mine methane.

(25) “MMBtu” means million British thermal units.

(26) “MMC” means mine methane capture.

(27) “MRR” means Mandatory Reporting Regulation; the Regulation for the Mandatory Reporting of Greenhouse Gas Emissions.

(28) “Mscf” means thousand standard cubic feet.

(29) “Mscf/d” means thousand standard cubic feet per day.

(30) “MSHA” means Mine Safety and Health Administration.

(31) “MT” means metric ton.

(32) “MWh” means megawatt hour.

(33) “N_2O” means nitrous oxide.

(34) “OPDR” means Offset Project Development Report.

(35) “R” means Rankine.

(36) “scf” means standard cubic foot.

(37) “scf/d” means standard cubic feet per day.

(38) “scfm” means standard cubic feet per minute.

(39) “SMM” mean surface mine methane.

(40) “SSR” means GHG sources, sinks, and reservoirs.

(41) “STP” means standard temperature and pressure.

(42) “QA/QC” means quality assurance and quality control.

(43) “VA” means ventilation air.

(44) “VAM” means ventilation air methane.

Chapter 2. Eligible Activities – Quantification Methodology

This protocol includes four mine methane capture activities designed to reduce GHG emissions that result from the mining process at active underground mines, active surface mines, and abandoned underground mines. The following types of mine methane capture activities are eligible:

2.1. Active Underground Mine Ventilation Air Methane Activities

This protocol applies to MMC projects that install a VAM collection system and qualifying device to destroy the methane in VA otherwise vented into the atmosphere through the return air shaft(s) as a result of underground coal or trona mining operations.

(a) Methane sources eligible for VAM activities include:

(1) Ventilation systems; and

(2) Methane drainage systems from which mine gas is extracted and used to supplement VA. Only the mine methane sent with ventilation air to a destruction device is eligible.

(b) In order to be considered a qualifying device for the purpose of this protocol, the device must not have been operational at the mine prior to offset project commencement.

(c) At active underground mines, an Offset Project Operator or Authorized Project Designee may operate both VAM and methane drainage activities as a single offset project all sharing the earliest commencement date. Alternatively, the Offset Project Operator or Authorized Project Designee may elect to operate separate offset projects for each activity with unique commencement dates.

(d) If a newly constructed ventilation shaft is connected to an existing or new qualifying destruction device after offset project commencement, the Offset Project Operator may either classify it as an offset project expansion or list the addition as a new MMC project.

(e) If an existing ventilation shaft that was not connected to a destruction device at time of offset project commencement is connected to an existing or new qualifying destruction device after offset project commencement, the Offset Project Operator may either classify it as an offset project expansion or list the addition as a new MMC project.

(f) If a new qualifying destruction device is added to a ventilation shaft currently connected to an existing qualifying destruction device this addition of the new qualifying destruction device is considered an offset project expansion.

(g) Ventilation air methane from any ventilation shaft connected to a non-qualifying destruction device at any point during the year prior to offset project commencement is not eligible for crediting.

2.2. Active Underground Mine Methane Drainage Activities

This protocol applies to MMC projects that install equipment to capture and destroy methane extracted through a methane drainage system that would otherwise be vented into the atmosphere as a result of underground coal or trona mining operations.

(a) Methane drainage systems must consist of one, or a combination of, the following methane sources that drain methane from the mineral seam, surrounding strata, or underground workings of the mine before, during, and/or after mining:

  (1) Pre-mining surface wells;

  (2) Pre-mining in-mine boreholes; and

  (3) Post-mining gob wells.

(b) In order to be considered a qualifying device for the purpose of this protocol, a methane destruction device for an active underground mine methane drainage activity must not have been operational at the mine prior to offset project commencement and must represent an end-use management option other than natural gas pipeline injection.

(c) At active underground mines, an Offset Project Operator or Authorized Project Designee may operate both VAM and methane drainage activities as a single project all sharing the earliest commencement date. Alternatively, the Offset Project Operator or Authorized Project Designee may elect to operate separate projects for each activity with unique commencement dates.

(d) If a newly drilled well/borehole is connected to an existing or new qualifying destruction device after offset project commencement, the Offset Project Operator may either classify it as an offset project expansion or list the addition as a new MMC project.

(e) If an existing well/borehole that was not connected to a destruction device at time of offset project commencement is connected to an existing or new qualifying destruction device after offset project commencement, the Offset Project Operator may either classify it as an offset project expansion or list the addition as a new MMC project.

(f) If a new qualifying destruction device is connected to a well/borehole currently connected to an existing qualifying destruction device, this addition of the new qualifying destruction device is considered an offset project expansion.

(g) Mine methane from any well or borehole connected to a non-qualifying destruction device at any point during the year prior to offset project commencement is not eligible for crediting.

(h) To be eligible for crediting under this protocol, MMC projects at active underground mines must not:

(1) Account for virgin CBM extracted from coal seams outside the extents of the mine according to the mine plan or from outside the methane source boundaries as described in section 3.5; or

(2) Use CO_2, steam, or any other fluid/gas to enhance mine methane drainage.

2.3. Active Surface Mine Methane Drainage Activities

This protocol applies to MMC projects that install equipment to capture and destroy methane extracted through a methane drainage system that would otherwise be vented into the atmosphere as a result of surface coal or trona mining operations.

(a) Methane drainage systems must consist of one, or a combination, of the following methane sources that drain methane from the coal seam or surrounding strata before and/or during mining:

(1) Pre-mining surface wells;

(2) Pre-mining in-mine boreholes;

(3) Existing CBM wells that would otherwise be shut-in and abandoned as a result of encroaching mining;

(4) Abandoned wells that are reactivated; and

(5) Converted dewatering wells.

(b) In order to be considered a qualifying device for the purpose of this protocol, a methane destruction device for an active surface mine methane drainage activity must not have been operational at the mine prior to offset project commencement.

(c) If a newly drilled well/borehole is connected to an existing or new qualifying destruction device after offset project commencement, the Offset Project Operator may either classify it as an offset project expansion or list the addition as a new MMC project.

(d) If an existing well/borehole that was not connected to a destruction device at time of offset project commencement is connected to an existing or new qualifying destruction device after offset project commencement, the Offset Project Operator may either classify it as an offset project expansion or list the addition as a new MMC project.

(e) If a new qualifying destruction device is connected to a well/borehole currently connected to an existing qualifying destruction device, this addition of the new qualifying destruction device is considered an offset project expansion.

(f) SMM from any well or borehole connected to a non-qualifying destruction device at any point during the year prior to offset project commencement is not eligible for crediting.

(g) To be eligible for crediting under this protocol, MMC projects at active surface mines must not:

(1) Account for virgin CBM extracted from wells outside the extents of the mine according to the mine plan or from outside the methane source boundaries as described in section 3.5;

(2) Use CO_2, steam, or any other fluid/gas to enhance mine methane drainage; or

(3) Occur at mines that employ mountaintop removal mining methods.

2.4. Abandoned Underground Mine Methane Recovery Activities

This protocol applies to MMC projects that install equipment to capture and destroy methane extracted through a methane drainage system that would otherwise be vented into the atmosphere as a result of previous underground coal mining operations.

(a) Methane drainage systems must consist of one, or a combination of, the following methane sources:

(1) Pre-mining surface wells drilled into the mine during active mining operations;

(2) Pre-mining in-mine boreholes drilled into the mine during active mining operations;

(3) Post-mining gob wells drilled into the mine during active mining operations; and

(4) Surface wells drilled after the cessation of active mining operations.

(b) In order to be considered a qualifying device for the purpose of this protocol, a methane destruction device for an abandoned underground mine methane recovery activity must not have been operational at the mine prior to offset project commencement unless the mine was previously engaged in active underground methane drainage activities and the methane destruction device was considered a qualifying destruction device for those activities.

(c) Abandoned underground mine methane recovery activities at multiple mines with multiple mine operators may report and verify together as a single project per the requirements of section 95977 of the Regulation if they meet the following criteria:

(1) A single Offset Project Operator is identified and emission reductions achieved by the project will be credited to that Offset Project Operator.

(2) The methane recovered from the mines is metered at a centralized point prior to being sent to a destruction device.

(3) The Offset Project Operator meets all monitoring, reporting, and verification requirements in chapters 6, 7, and 8.

(4) Offset projects at all mines are in compliance with regulations per section 3.8. If any mine is found to be out of compliance, no emission reductions will be credited to the project for the reporting period even if achieved by one of the other mines found to be in compliance.

(d) In the event that there are vertically separated mines overlying and underlying other mines, wells completed in one mine can be used to capture methane in overlying or underlying mines provided the wells are within the maximum vertical extent of each mine per section 3.5(d)(4).

(e) If a newly drilled well/borehole is connected to an existing or new qualifying destruction device after offset project commencement, the Offset Project

Operator may either classify it as an offset project expansion or list the addition as a new MMC project.

(f) If an existing well/borehole that was not connected to a destruction device at time of offset project commencement is connected to an existing or new qualifying destruction device after offset project commencement, the Offset Project Operator may either classify it as an offset project expansion or list the addition as a new MMC project.

(g) If a new qualifying destruction device is connected to a well/borehole currently connected to an existing qualifying destruction device, this addition of the new qualifying destruction device is considered an offset project expansion.

(h) AMM from any well or borehole connected to a non-qualifying destruction device at any point during the year prior to offset project commencement is not eligible for crediting.

(i) To be eligible for crediting under this protocol, MMC projects at abandoned underground mines must not:

(1) Account for virgin CBM from wells outside the extents of the mine according to the final mine map(s) or from outside the methane source boundaries described in section 3.5;

(2) Use CO_2, steam, or any other fluid/gas to enhance mine methane drainage; or

(3) Occur at flooded mines or in flooded sections of mines.

Chapter 3. Eligibility

In addition to the offset project eligibility criteria and regulatory program requirements set forth in subarticle 13 of the Regulation, mine methane capture offset projects must adhere to the eligibility requirements below.

3.1. General Eligibility Requirements

(a) Offset projects that use this protocol must:

(1) Involve the installation and operation of a device, or set of devices, associated with the capture and destruction of mine methane;

(2) Capture mine methane that would otherwise be emitted to the atmosphere; and

(3) Destroy the captured mine methane through an eligible end-use management option per section 3.4.

(b) Offset Project Operators or Authorized Project Designees that use this protocol must:

(1) Provide the listing information required by section 95975 of the Regulation and section 7.1;

(2) Monitor GHG emission sources within the offset project boundary as delineated in chapter 4 per the requirements of chapter 6;

(3) Quantify GHG emission reductions per chapter 5;

(4) Prepare and submit OPDRs for each reporting period that include the information requirements in section 7.2; and

(5) Obtain offset verification services from an ARB-accredited offset verification body in accordance with section 95977 of the Regulation and chapter 8.

3.2. Location

(a) Only projects located in the United States are eligible under this protocol.

(b) Offset projects situated on the following categories of land are only eligible under this protocol if they meet the requirements of this protocol and the Regulation, including the waiver of sovereign immunity requirements of section 95975(l) of the Regulation:

(1) Land that is owned by, or subject to an ownership or possessory interest of a Tribe;

(2) Land that is “Indian lands” of a Tribe, as defined by 25 U.S.C. §81(a)(1); or

(3) Land that is owned by any person, entity, or Tribe, within the external borders of such Indian lands.

(c) Projects must take place at either:

(1) An active underground or surface mine permitted for coal or trona mining by an appropriate state or federal agency and classified by MSHA as active, intermittent, or temporarily idle; or

(2) An abandoned underground coal mine classified by MSHA as abandoned or abandoned and sealed.

(d) Mines located on federal lands are eligible for implementation of MMC projects.

3.3. Offset Project Operator or Authorized Project Designee

(a) The Offset Project Operator or Authorized Project Designee is responsible for project listing, monitoring, reporting, and verification.

(b) The Offset Project Operator or Authorized Project Designee must submit the information required by subarticle 13 of the Regulation and in chapter 7.

(c) The Offset Project Operator must have legal authority to implement the offset project.

(d) The Offset Project Operator must be:

(1) The mine operator as defined in section 1.2(a)(26); or

(2) The entity that owns or leases the equipment used to capture or destroy mine methane.

3.4. Additionality

Offset projects must meet the additionality requirements set out in section 95973(a)(2) of the Regulation, in addition to the requirements in this protocol. Eligible offsets must be generated by projects that yield additional GHG reductions that exceed any GHG reductions otherwise required by law or regulation or any GHG reduction that would otherwise occur in a conservative business-as-usual scenario. These requirements are assessed through the Legal Requirement Test in section 3.4.1 and the Performance Standard Evaluation in section 3.4.2.

3.4.1. Legal Requirement Test

(a) Emission reductions achieved by an MMC project must exceed those required by any law, regulation, or legally binding mandate as required in sections 95973(a)(2)(A) and 95975(n) of the Regulation.

(b) The following legal requirement test applies to all MMC projects:

(1) If no law, regulation, or legally binding mandate requiring the destruction of methane at the mine at which the project is located exists, all emission reductions resulting from the capture and destruction of mine methane are

considered to not be legally required, and therefore eligible for crediting under this protocol.

(2) If any law, regulation, or legally binding mandate requiring the destruction of methane at the mine at which the project is located exists, only emission reductions resulting from the capture and destruction of mine methane that are in excess of what is required to comply with those laws, regulations, and/or legally binding mandates are eligible for crediting under this protocol.

3.4.2. Performance Standard Evaluation

(a) Emission reductions achieved by an MMC project must exceed those likely to occur in a conservative business-as-usual scenario.

(b) The performance standard evaluation is satisfied if the following requirements are met, on the basis of activity type:

(1) Active Underground Mine VAM Activities

(A) Destruction of VAM via any end-use management option automatically satisfies the performance standard evaluation because destruction of VAM is not common practice nor considered business-as-usual, and is therefore eligible for crediting under this protocol.

(2) Active Underground Mine Methane Drainage Activities

(A) Destruction of extracted mine methane via any end-use management option except as described in 3.4.2(b)(2)(B) automatically satisfies the performance standard evaluation because it is not common practice nor considered business-as-usual, and is therefore eligible for crediting under this protocol.

(B) Pipeline injection of mine methane extracted from methane drainage systems at active underground mines is common practice and considered business-as-usual, and therefore ineligible for crediting under this protocol.

(3) Active Surface Mine Methane Drainage Activities

(A) Destruction of extracted mine methane via any end-use management option automatically satisfies the performance standard evaluation because it is not common practice nor considered business-as-usual, and is therefore eligible for crediting under this protocol.

(4) Abandoned Underground Mine Methane Recovery Activities

(A) Destruction of extracted mine methane via any end-use management option except as described in 3.4.2(b)(4)(B) automatically satisfies the performance standard evaluation because it is not common practice nor considered business-as-usual, and is therefore eligible for crediting under this protocol.

(B) Pipeline injection of mine methane recovered at abandoned underground mines that also injected mine methane into a natural gas pipeline for off-site consumption while active is common practice and considered business-as-usual, and therefore ineligible for crediting under this protocol.

3.5. Methane Source Boundaries

(a) The methane destroyed for the purpose of reducing mine methane emissions under this protocol must be methane that would otherwise be emitted into the atmosphere during the normal course of mining activities.

(b) To ensure that virgin coal bed methane is excluded from the destroyed mine methane accounted for in this protocol, physical boundaries must be placed on the source of the methane.

(c) All methane from a mine's ventilation and drainage systems must be collected from within the mine extents according to an up-to-date mine plan.

(d) Additional physical boundaries on the basis of activity type are as follows:

(1) Active underground mine ventilation air methane activities may account for:

(A) All destroyed methane contained in VA collected from a mine ventilation system; and

(B) All destroyed mine methane contained in mine gas extracted from a methane drainage system used to supplement VA.

(2) Active underground mine methane drainage activities may account for:

(A) Destroyed mine methane contained in mine gas extracted from strata up to 150 meters above and 50 meters below a mined seam through pre-mining surface wells and pre-mining in-mine boreholes; and

(B) All destroyed mine methane contained in mine gas extracted through gob wells.

(3) Active surface mine methane drainage activities may account for destroyed surface mine methane contained in mine gas extracted from all strata above and up to 50 meters below a mined seam through pre-mining surface wells, pre-mining in-mine boreholes, existing coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining, abandoned wells that are reactivated, and converted dewatering wells.

(4) Abandoned underground mine methane recovery activities may account for:

(A) Destroyed abandoned mine methane contained in mine gas extracted from strata up to 150 meters above and 50 meters below a mined seam through pre-mining surface wells and pre-mining in-mine boreholes drilled during active mining operations;

(B) Destroyed abandoned mine methane contained in mine gas extracted from strata up to 150 meters above and 50 meters below a mine seam through newly drilled surface wells; and

(C) Destroyed abandoned mine methane contained in mine gas extracted from strata up to 150 meters above and 50 meters below a mined seam through existing post-mining gob wells.

3.6. Offset Project Commencement

(a) For this protocol, offset project commencement is defined as the date at which the offset project's mine methane capture and destruction equipment becomes

operational. Equipment is considered operational on the date at which the system begins capturing and destroying methane gas upon completion of an initial start-up period.

(b) Per section 95973(a)(2)(B) of the Regulation, compliance offset projects must have an offset project commencement date after December 31, 2006.

3.7. Project Crediting Period

The crediting period for this protocol is ten reporting periods.

3.8. Regulatory Compliance

(a) An offset project must meet the regulatory compliance requirements set forth in section 95973(b) of the Regulation.

Chapter 4. Offset Project Boundary – Quantification Methodology

The offset project boundary delineates the GHG emission SSRs that must be included or excluded when quantifying the net change in emissions associated with the installation and operation of a device, or set of devices, associated with the capture and destruction of mine methane. The following offset project boundaries apply to all MMC projects on the basis of activity type:

4.1. Active Underground Mine VAM Activities

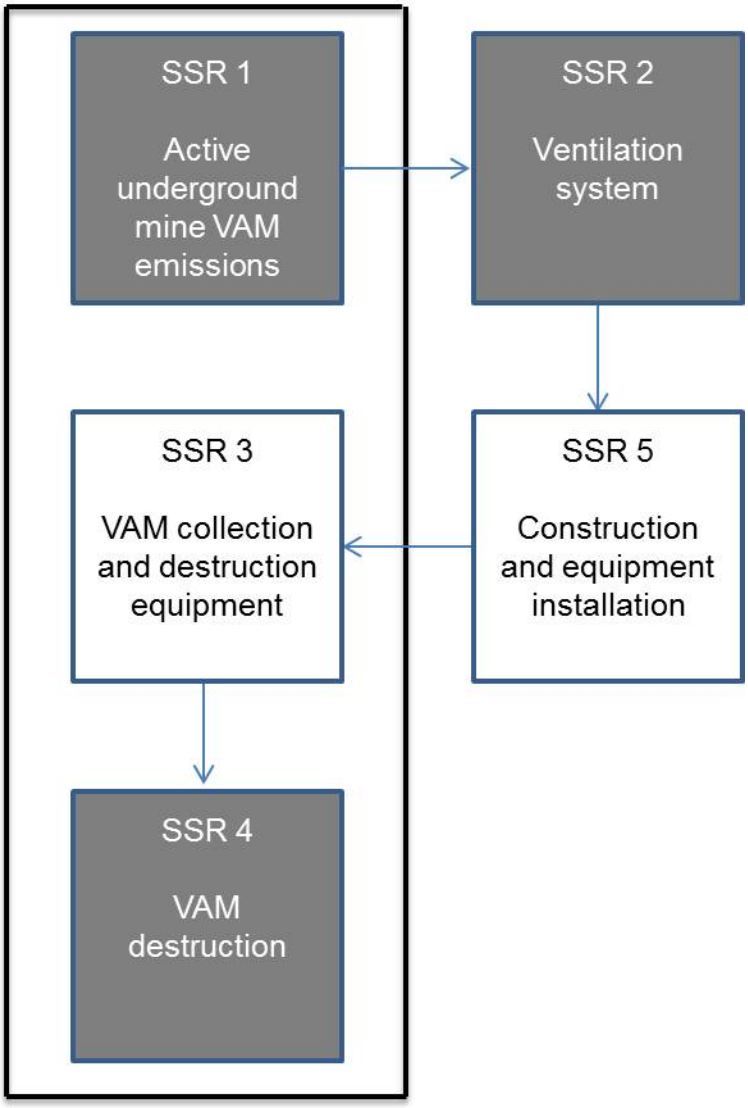
(a) Figure 4.1 illustrates the offset project boundary for active underground mine VAM activities, indicating which SSRs are included or excluded from the offset project boundary.

(1) All SSRs within the bold line are included and must be accounted for under this protocol.

(2) SSRs in shaded boxes are relevant to the baseline and project emissions.

(3) SSRs in unshaded boxes are relevant only to the project emissions.

Figure 4.1. Illustration of the offset project boundary for active underground mine VAM activities



(b) Table 4.1 lists the SSRs for active underground mine VAM activities, indicating which gases are included or excluded from the offset project boundary.

Table 4.1. List of the greenhouse gas sinks, sources, and reservoirs for active underground mine VAM activities

SSR	Description	GHG	Baseline (B) or Project (P)	Included/ Excluded
1	Emissions from the venting of VAM through mine ventilation system	CH_4	B, P	Included
2	Emissions resulting from energy consumed to operate mine ventilation system	CO_2	n/a	Excluded
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded
3	Emissions resulting from energy consumed to operate additional equipment used to capture or destroy VAM	CO_2	P	Included
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded
4	Emissions resulting from VAM destruction	CO_2	B, P	Included
		N_2O	n/a	Excluded
	Emissions of uncombusted methane	CH_4	B, P	Included
5	Emissions from construction and/or installation of new equipment	CO_2	n/a	Excluded
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded
	Fugitive emissions from construction	CH_4	n/a	Excluded

4.2. Active Underground Mine Methane Drainage Activities

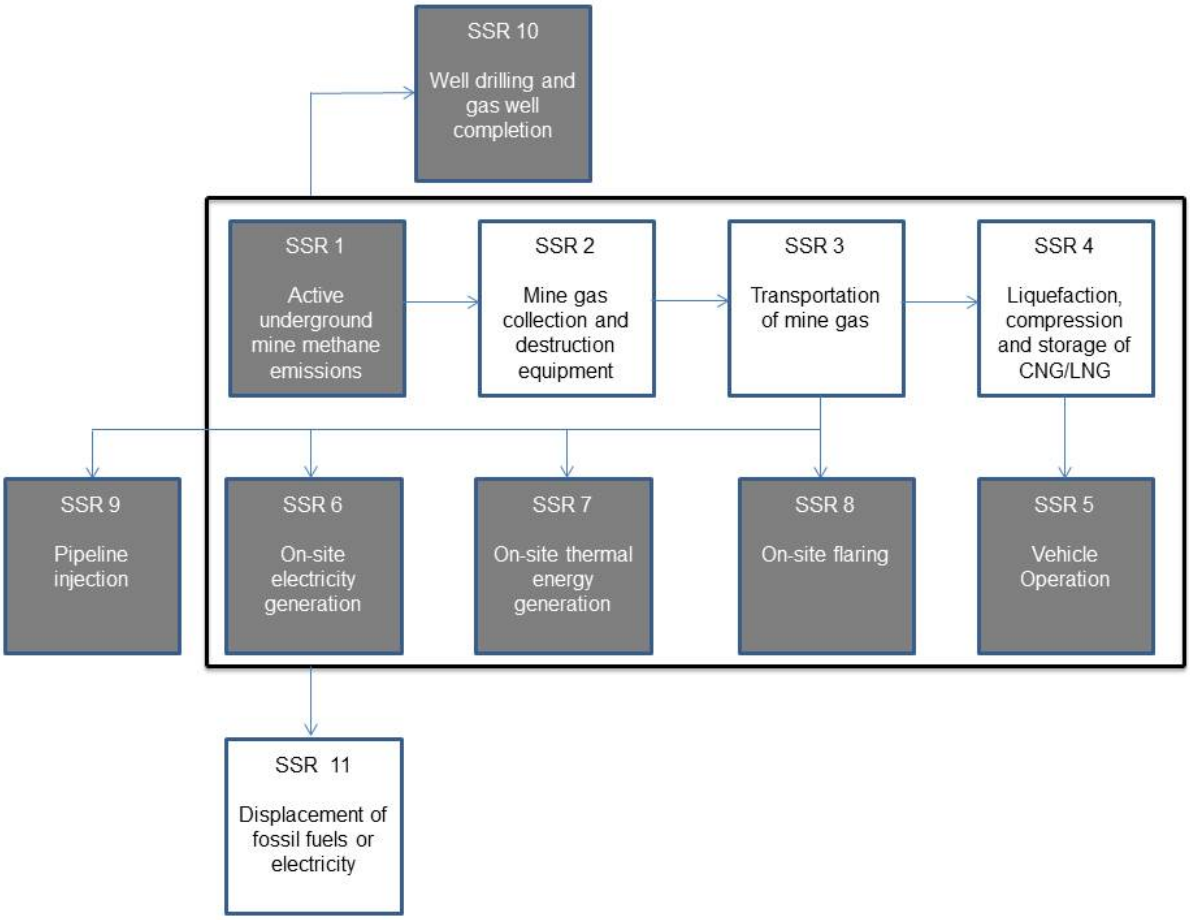
(a) Figure 4.2 illustrates the offset project boundary for active underground mine methane drainage activities, indicating which SSRs are included or excluded from the offset project boundary.

(1) All SSRs within the bold line are included and must be accounted for under this protocol.

(2) SSRs in shaded boxes are relevant to the baseline and project emissions.

(3) SSRs in unshaded boxes are relevant only to the project emissions.

Figure 4.2. Illustration of the offset project boundary for active underground mine methane drainage activities



(b) Table 4.2 lists the identified SSRs for active underground mine methane drainage activities, indicating which gases are included or excluded from the offset project boundary.

Table 4.2. List of identified greenhouse gas sinks, sources, and reservoirs for active underground mine methane drainage activities

SSR	Description	GHG	Relevant to Baseline (B) or Project (P)	Included/ Excluded
1	Emissions from the venting of mine methane extracted through methane drainage system	CH_4	B, P	Included
2	Emissions resulting from energy consumed to operate additional equipment used to capture, treat, or destroy drained mine gas	CO_2	P	Included
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded
	Fugitive emissions from operation of additional equipment used to capture, treat, or destroy drained mine gas	CH_4	n/a	Excluded
3	Emissions resulting from additional energy consumed to transport mine gas to treatment or destruction equipment	CO_2	P	Included
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded
	Fugitive emissions from the on-site transportation of mine gas	CH_4	n/a	Excluded
4	Emissions resulting from energy consumed to operate additional equipment used to liquefy, compress, or store methane for vehicle use.	CO_2	P	Included
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded
	Fugitive emissions from operation of additional equipment used to liquefy, compress, or store methane for vehicle use	CH_4	n/a	Excluded
5	Emissions resulting from methane combustion during vehicle operation	CO_2	B, P	Included
		N_2O	n/a	Excluded
	Emissions resulting from incomplete methane combustion during vehicle operation	CH_4	B, P	Included
6	Emissions resulting from methane combustion during on-site electricity generation	CO_2	B, P	Included
		N_2O	n/a	Excluded
	Emissions resulting from incomplete methane combustion during on-site electricity generation	CH_4	B, P	Included

7	Emissions resulting from methane combustion during on-site thermal energy generation	CO_2	B, P	Included
		N_2O	n/a	Excluded
	Emissions resulting from incomplete methane combustion during on-site thermal energy generation	CH_4	B, P	Included
8	Emissions resulting from methane combustion during on-site flaring	CO_2	B, P	Included
		N_2O	n/a	Excluded
	Emissions resulting from incomplete methane combustion during flaring	CH_4	B, P	Included
9	Emissions resulting from methane combustion resulting from pipeline injection	CO_2	n/a	Excluded
		N_2O	n/a	Excluded
	Emissions resulting from the incomplete methane combustion resulting from pipeline injection	CH_4	n/a	Excluded
10	Emissions from well drilling and gas well completion	CO_2	n/a	Excluded
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded
	Fugitive emissions from well drilling and gas well completion	CH_4	n/a	Excluded
11	Emission reductions resulting from the displacement of fossil fuels or electricity	CO_2	n/a	Excluded
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded

4.3. Active Surface Mine Methane Drainage Activities

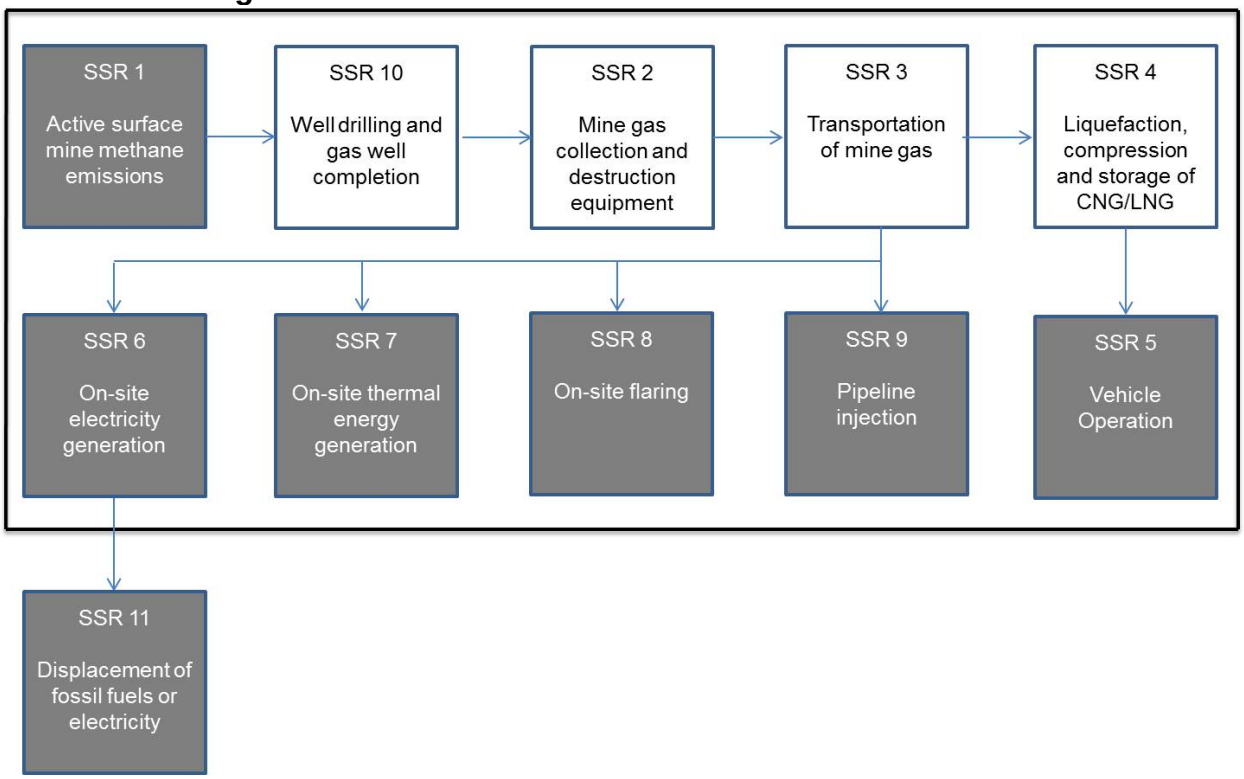
(a) Figure 4.3 illustrates the offset project boundary for active surface mine methane drainage activities, indicating which SSRs are included or excluded from the offset project boundary.

(1) All SSRs within the bold line are included and must be accounted for under this protocol.

(2) SSRs in shaded boxes are relevant to the baseline and project emissions.

(3) SSRs in unshaded boxes are relevant only to the project emissions.

Figure 4.3. Illustration of the offset project boundary for active surface mine methane drainage activities



(b) Table 4.3 lists the SSRs for active surface mine methane drainage activities, indicating which gases are included or excluded from the offset project boundary.

Table 4.3. List of the greenhouse gas sinks, sources, and reservoirs for active surface mine methane drainage activities

SSR	Description	GHG	Relevant to Baseline (B) or Project (P)	Included/ Excluded
1	Emissions from the venting of mine methane during the mining process	CH_4	B, P	Included
2	Emissions resulting from energy consumed to operate additional equipment used to capture, treat, or destroy drained mine gas	CO_2	P	Included
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded
	Fugitive emissions from operation of additional equipment used to capture, treat, or destroy drained mine gas	CH_4	n/a	Excluded
3	Emissions resulting from additional energy consumed to transport mine gas to treatment or destruction equipment	CO_2	P	Included
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded
	Fugitive emissions from the on-site transportation of mine gas	CH_4	n/a	Excluded

4	Emissions resulting from energy consumed to operate additional equipment used to liquefy, compress, or store methane for vehicle use.	CO_2	P	Included
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded
	Fugitive emissions from operation of additional equipment used to liquefy, compress, or store methane for vehicle use	CH_4	n/a	Excluded
5	Emissions resulting from methane combustion during vehicle operation	CO_2	B, P	Included
		N_2O	n/a	Excluded
	Emissions resulting from incomplete methane combustion during vehicle operation	CH_4	B, P	Included
6	Emissions resulting from methane combustion during on-site electricity generation	CO_2	B, P	Included
		N_2O	n/a	Excluded
	Emissions resulting from incomplete methane combustion during on-site electricity generation	CH_4	B, P	Included
7	Emissions resulting from methane combustion during on-site thermal energy generation	CO_2	B, P	Included
		N_2O	n/a	Excluded
	Emissions resulting from incomplete methane combustion during on-site thermal energy generation	CH_4	B, P	Included
8	Emissions resulting from methane combustion during on-site flaring	CO_2	B, P	Included
		N_2O	n/a	Excluded
	Emissions resulting from incomplete methane combustion during flaring	CH_4	B, P	Included
9	Emissions resulting from methane combustion resulting from pipeline injection	CO_2	B, P	Included
		N_2O	n/a	Excluded
	Emissions resulting from the incomplete methane combustion resulting from pipeline injection	CH_4	B, P	Included
10	Emissions from additional well drilling and well gas completion	CO_2	P	Included
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded
	Fugitive emissions from additional well drilling and gas well completion	CH_4	n/a	Excluded
11	Emission reductions resulting from the displacement of fossil fuels or electricity	CO_2	n/a	Excluded
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded

4.4. Abandoned Underground Mine Methane Recovery Activities

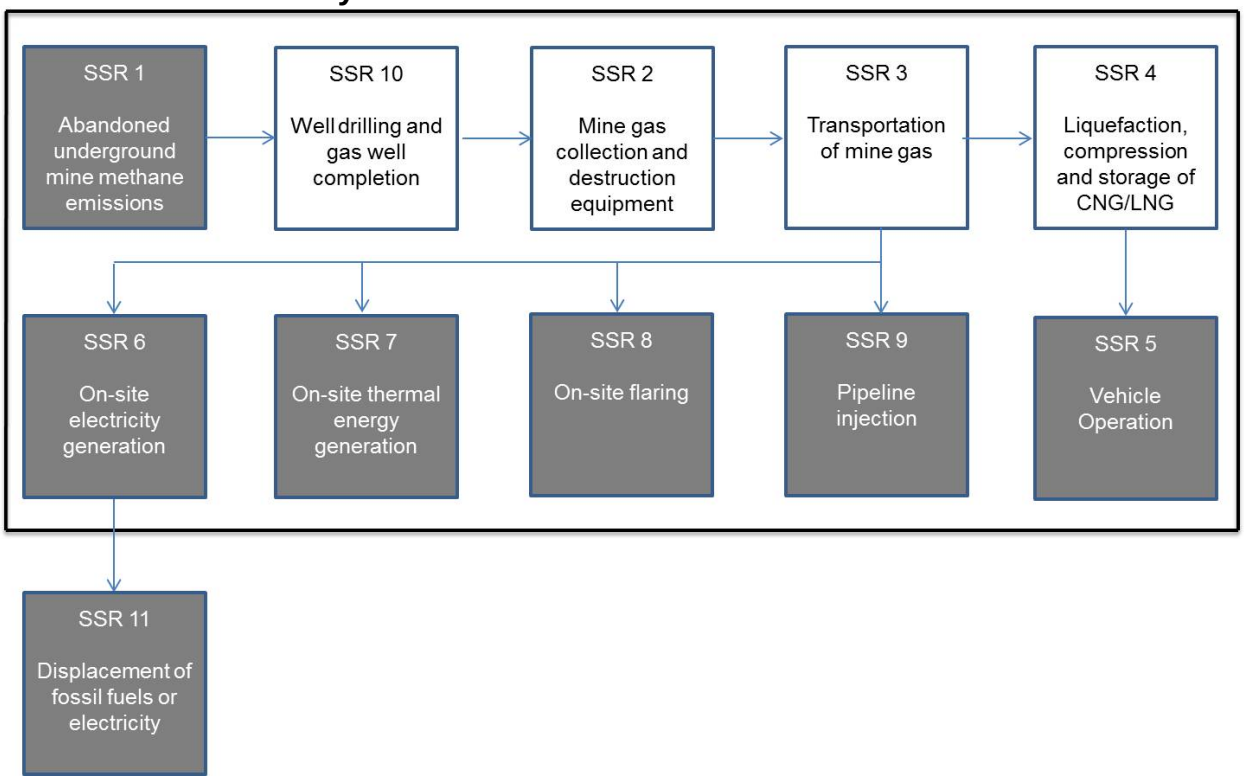
(a) Figure 4.4 illustrates the offset project boundary for abandoned underground mine methane recovery activities, indicating which SSRs are included or excluded from the offset project boundary.

(1) All SSRs within the bold line are included and must be accounted for under this protocol.

(2) SSRs in shaded boxes are relevant to the baseline and project emissions.

(3) SSRs in unshaded boxes are relevant only to the project emissions.

Figure 4.4. Illustration of the offset project boundary for abandoned underground mine methane recovery activities



(b) Table 4.4 lists the SSRs for abandoned underground mine methane recovery activities, indicating which gases are included or excluded from the offset project boundary.

Table 4.4. List of the greenhouse gas sinks, sources, and reservoirs for abandoned underground mine methane recovery activities

SSR	Description	GHG	Relevant to Baseline (B) or Project (P)	Included/ Excluded
1	Emissions of mine methane liberated after the conclusion of mining operations	CH_4	B, P	Included
2	Emissions resulting from energy consumed to operate additional equipment used to capture, treat, or destroy drained mine gas	CO_2	P	Included
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded
	Fugitive emissions from operation of additional equipment used to capture, treat, or destroy drained mine gas	CH_4	n/a	Excluded
3	Emissions resulting from additional energy consumed to transport mine gas to treatment or destruction equipment	CO_2	P	Included
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded
	Fugitive emissions from the on-site transportation of mine gas	CH_4	n/a	Excluded
4	Emissions resulting from energy consumed to operate equipment used to liquefy, compress, or store methane for vehicle use.	CO_2	P	Included
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded
	Fugitive emissions from operation of equipment used to liquefy, compress, or store methane for vehicle use	CH_4	n/a	Excluded
5	Emissions resulting from methane combustion during vehicle operation	CO_2	B, P	Included
		N_2O	n/a	Excluded
	Emissions resulting from incomplete methane combustion during vehicle operation	CH_4	B, P	Included
6	Emissions resulting from methane combustion during on-site electricity generation	CO_2	B, P	Included
		N_2O	n/a	Excluded
	Emissions resulting from incomplete methane combustion during on-site electricity generation	CH_4	B, P	Included
7	Emissions resulting from methane combustion during on-site thermal energy generation	CO_2	B, P	Included
		N_2O	n/a	Excluded
	Emissions resulting from incomplete methane combustion during on-site electricity generation	CH_4	B, P	Included
8	Emissions resulting from methane combustion during on-site flaring	CO_2	B, P	Included
		N_2O	n/a	Excluded
	Emissions resulting from	CH_4	B, P	Included

	incomplete methane combustion during flaring			
9	Emissions resulting from methane combustion resulting from pipeline injection Emissions resulting from the incomplete methane combustion resulting from pipeline injection	CO_2	B, P	Included
		N_2O	n/a	Excluded
		CH_4	B, P	Included
10	Emissions from additional well drilling and well gas completion	CO_2	B, P	Included
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded
	Fugitive emissions from additional well drilling and gas well completion	CH_4	n/a	Excluded
11	Emission reductions resulting from the displacement of fossil fuels or electricity	CO_2	n/a	Excluded
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded

Chapter 5. Quantifying GHG Emission Reductions – Quantification Methodology

(a) GHG emission reductions from an MMC project are quantified by comparing actual project emissions to project baseline emissions at the mine.

(b) Offset Project Operators and Authorized Project Designees must use the activity type-specific calculation methods provided in this protocol to determine baseline and project GHG emissions.

(c) GHG emission reductions must be quantified over a consecutive twelve month period. The length of time over which GHG emission reductions are quantified is called the “reporting period.”

(d) Measurements used to quantify GHG emission reductions must be quantified using flow rates and methane densities adjusted to standard conditions of 60°F and 14.7 pounds per square inch (1 atm).

(e) Depending on the methane analyzer technology used, methane concentration readings may or may not need to be adjusted for temperature and pressure. If readings require adjustment, then such adjustments must be performed.

(f) Global warming potential values must be determined consistent with the definition of Carbon Dioxide Equivalent in MRR section 95102(a).

5.1. Active Underground Mine Ventilation Air Methane Activities

(a) GHG emission reductions for a reporting period (ER) must be quantified by subtracting the project emissions for that reporting period (PE) from the baseline emissions for that reporting period (BE) using equation 5.1.

Equation 5.1: GHG Emission Reductions

$ER = BE - PE$

Where,

ER	=	Emission reductions achieved by the project during the reporting period (MT CO_2e)
BE	=	Baseline emissions during the reporting period (MT CO_2e)
PE	=	Project emissions during the reporting period (MT CO_2e)

5.1.1. Quantifying Baseline Emissions

(a) Baseline emissions for a reporting period (BE) must be estimated by summing the baseline emissions for all SSRs identified as included in the baseline in table 4.1 and by using equation 5.2.

Equation 5.2: Baseline Emissions

$BE = BE_{MD} + BE_{MR}$

Where,

BE	=	Baseline emissions during the reporting period (MT CO_2e)
BE_{MD}	=	Baseline emissions from destruction of methane during the reporting period (MT CO_2e)
BE_{MR}	=	Baseline emissions from release of methane into the atmosphere during the reporting period (MT CO_2e)

(b) Baseline emissions from the destruction of methane (BE_{MD}) must be quantified using equation 5.3.

(c) BE_{MD} must include the estimated CO_2 emissions from the destruction of VAM by non-qualifying devices.

(d) If there is no destruction of methane in the baseline, then $BE_{MD} = 0$.

Equation 5.3: Baseline Emissions from Destruction of Methane

$BE_{MD} = \sum_{i} MD_{B,i} \times CEF_{CH4}$

Where,

BE_{MD}	=	Baseline emissions from destruction of methane during the reporting period (MT CO_2e)
i	=	Use of methane (oxidation or alternative end-use) by non-qualifying destruction devices
$MD_{B,i}$	=	Methane that would have been destroyed through use i by non-qualifying devices during the reporting period (MT CH_4)
CEF_{CH4}	=	CO_2 emission factor for combusted methane (2.744 MT CO_2e/MT CH_4)

(e) The amount of methane that would have been destroyed by non-qualifying destruction devices ($MD_{B,i}$) must be quantified using equation 5.4.

(f) For the purpose of baseline quantification, only non-qualifying destruction devices that were operating during the year prior to offset project commencement should be taken into account.

(g) The volume or mass of VA that would have been sent to a non-qualifying device for destruction during the reporting period in the baseline must be determined by calculating and comparing:

(1) The volume or mass of VA sent to non-qualifying destruction devices during the current reporting period, adjusted for temperature and pressure using equation 5.11, if applicable;

(2) The volume or mass of VA sent to non-qualifying destruction devices during the three-year period prior to offset project commencement (or during the length of time the devices are operational, if less than three years), adjusted for temperature and pressure using equation 5.11, if applicable, and averaged according to the length of the reporting period; and

(3) The volume or mass of VA sent to non-qualifying destruction devices during the time period a law, regulation, or legally binding mandate, in place for less than three years prior to offset project commencement, was in effect, adjusted for temperature and pressure using equation 5.11, if applicable, and averaged according to the length of the reporting period.

(h) The largest of the three quantities determined in sections 5.1.1(g)(1)-(3) must be used for the volume of ventilation air that would have been sent to a non-

qualifying device for destruction through use i during the reporting period in the baseline scenario ($VA_{B,i}$) in equations 5.4 and 5.5.

(i) If using a quantity for $VA_{B,i}$ determined by section 5.1.1(g)(1), data for ventilation air flow rate ($VA_{flow,t}$), methane concentration of ventilation air ($C_{CH4,t}$), methane concentration of exhaust gas ($C_{CH4,exhaust,t}$), average flow rate of cooling air ($CA_{flow,i,y}$), hours of destruction device operation (y), volume of mine gas sent for destruction with ventilation air ($MG_{SUPP,i}$), and methane concentration of mine gas ($C_{CH4,MG}$) must be monitored for the non-qualifying destruction devices and used in equations 5.4 and 5.5.

(j) If using a quantity for $VA_{B,i}$ determined by section 5.1.1(g)(2) or 5.1.1(g)(3), historical data for ventilation air flow rate ($VA_{flow,t}$), methane concentration of ventilation air ($C_{CH4,t}$), methane concentration of exhaust gas ($C_{CH4,exhaust,t}$), average flow rate of cooling air ($CA_{flow,i,y}$), hours of operation (y), volume of mine gas sent for destruction with ventilation air ($MG_{SUPP,i}$), and methane concentration of mine gas ($C_{CH4,MG}$) must be used in equations 5.4 and 5.5, if available.

(k) If using a quantity for $VA_{B,i}$ determined by section 5.1.1(g)(2) or 5.1.1(g)(3), and historical data for ventilation air flow rate ($VA_{flow,t}$), methane concentration of ventilation air ($C_{CH4,t}$), methane concentration of exhaust gas ($C_{CH4,exhaust,t}$), average flow rate of cooling air ($CA_{flow,i,y}$), and mine gas methane concentration ($C_{CH4,MG}$) are not available, the highest single-hour average flow rates and methane concentrations during the reporting period must be used in place of historical data.

(l) If using a quantity for $VA_{B,i}$ determined by section 5.1.1(g)(2) or 5.1.1(g)(3), and historical data for hours of operation (y) is not available, the highest number of operational hours for any qualifying or non-qualifying destruction device during the reporting period must be used in place of historical data.

(m) If using a quantity for $VA_{B,i}$ determined by section 5.1.1(g)(2) or 5.1.1(g)(3), and historical data for volume of mine gas sent for destruction with ventilation air ($MG_{SUPP,i}$) is not available, the largest volume of mine gas sent to any qualifying or non-qualifying destruction device during the reporting period must be used in place of historical data.

(n) If cooling air was added to the destruction device after the point of metering for VA, this must be accounted for with term $CA_{flow,i,y}$ in equation 5.4. If no cooling air was added, then $CA_{flow,i,y} = 0$.

(o) If the flow rate of cooling air was metered, then the average metered data flow rate must be used for the flow rate. If the flow rate was not metered, the maximum capacity of the cooling air intake system must be used for the flow rate.

Equation 5.4: Methane Destroyed in Baseline

$MD_{B,i} = (VA_{B,i} \times C_{CH4} \times 0.0423 \times 0.000454 - BE_{NO,i})$

Where,

$MD_{B,i}$	=	Methane that would have been destroyed through use i by non-qualifying devices during the reporting period; calculated separately for each destruction device (MT CH_4)
i	=	Use of methane (oxidation or alternative end-use) by non-qualifying destruction devices
$VA_{B,i}$	=	Volume of ventilation air that would have been sent to non-qualifying devices for destruction through use i during the reporting period (scf)
C_{CH4}	=	Weighted average of measured methane concentration of captured ventilation air that would have been sent to non-qualifying destruction devices during the reporting period (scf CH_4/scf)
0.0423	=	Standard density of methane (lb CH_4/scf CH_4)
0.000454	=	MT CH_4/lb CH_4
$BE_{NO,i}$	=	Baseline emissions of non-oxidized methane that would have been emitted as a result of incomplete oxidation of the ventilation air stream during the reporting period (MT CH_4)

With:

$$C_{CH4} = \frac{\sum_t (VA_{flow,t} \times C_{CH4,t})}{\sum_t VA_{flow,t}}$$

Where,

$C_{CH4,t}$	=	Hourly average methane concentration of ventilation air sent to a destruction device (scf CH_4/scf)
$VA_{flow,t}$	=	Hourly average flow rate of ventilation air sent to a destruction device (scfm)

And:

$BE_{NO,i} = (VA_{B,i} + \sum_{y} CA_{flow,i,y} \times 60) \times C_{CH4,exhaust,i} \times 0.0423 \times 0.000454$

Where,

y	=	Hours during which the destruction device would have been operational during reporting period (h)
$CA_{flow,i,y}$	=	Hourly average flow rate of cooling air that would have been sent to a destruction device after the metering point of the ventilation air stream during period y (scfm)
60	=	Number of minutes in an hour
$C_{CH4,exhaust,i}$	=	Weighted average of measured methane concentration of exhaust gas that would have been emitted from the destruction device during the reporting period (scf CH_4/scf)

With:

$$C_{CH4,exhaust,i} = \frac{\sum_y \left[\left(\frac{VA_{B,i}}{y} + CA_{flow,i,y} \times 60\right) \times C_{CH4,exhaust,y}\right]}{\sum_y \left(\frac{VA_{B,i}}{y} + CA_{flow,i,y} \times 60\right)}$$

Where,

$C_{CH4,exhaust,y}$	=	Hourly average methane concentration of exhaust gas (scf CH_4/scf)

Methane concentrations and flow rates must be recorded every two minutes with averages calculated at least hourly. If the Offset Project Operator or Authorized Project Designee monitors and records data at a higher frequency, this data may be used within appropriate variables of the above equations to reflect the higher frequency of data collection.

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 and the methane concentration must be in mass percent.

(p) Baseline emissions from the release of methane (BE_{MR}) must be quantified using equation 5.5.

(q) BE_{MR} must account for the total amount of methane actually destroyed by all qualifying and non-qualifying devices during the reporting period.

(r) VAM project activities may supplement VA with mine gas (MG) extracted from a methane drainage system to either increase or help balance the methane concentration of VA flowing into the destruction device. If MG is used to supplement VA, the MG destroyed by the project during the reporting period

must be accounted for using equation 5.5, either as $MG_{SUPP,i}$ if VA flow and MG flow are monitored separately, or through $VA_{P,i}$ if only the resulting enriched flow is monitored.

(s) Methane that is still vented in the project scenario is not accounted for in the project emissions or baseline emissions since it is vented in both scenarios.

Equation 5.5: Baseline Emissions from Release of Methane

$$BE_{MR} = \sum_i [(VA_{P,i} \times C_{CH4} - VA_{B,i} \times C_{CH4}) + MG_{SUPP,i} \times C_{CH4,MG}] \times 0.0423 \times 0.000454 \times GWP_{CH4}$$

Where,

BE_{MR}	=	Baseline emissions from release of methane into the atmosphere during the reporting period (MT CO_2e)
i	=	Use of methane (oxidation or alternative end-use) by all qualifying and non-qualifying destruction devices
$VA_{P,i}$	=	Volume of ventilation air sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)
$VA_{B,i}$	=	Volume of ventilation air that would have sent to non-qualifying devices for destruction through use i during the reporting period (scf)
C_{CH4}	=	Weighted average of measured methane concentration of captured ventilation air sent to qualifying and non-qualifying destruction devices during the reporting period (scf CH_4/scf)
$MG_{SUPP,i}$	=	Volume of mine gas that would have been extracted from a methane drainage system and sent with ventilation air to qualifying and non-qualifying devices for destruction during the reporting period (scf)
$C_{CH4,MG}$	=	Weighted average of measured methane concentration of captured mine gas that would have been sent with ventilation air to non-qualifying devices for destruction during the reporting period (scf CH_4/scf)
0.0423	=	Standard density of methane (lb CH_4/scf CH_4)
0.000454	=	MT CH_4/lb CH_4
GWP_{CH4}	=	Global warming potential of methane (MT CO_2e/MT CH_4)

With:

$$C_{CH4} = \frac{\sum_t (VA_{flow,t} \times C_{CH4,t})}{\sum_t VA_{flow,t}}$$

Where,

$C_{CH4,t}$ = Hourly average methane concentration of ventilation air sent to a destruction device (scf CH_4/scf)

$VA_{flow,t}$ = Hourly average flow rate of ventilation air sent to a destruction device (scfm)

And:

$$C_{CH4MG} = \frac{\sum_t (DV_{MG,t} \times C_{CH4,MG,t})}{\sum_t DV_{MG,t}}$$

Where,

$C_{CH4,MG,t}$ = Daily average methane concentration of mine gas sent with ventilation air to destruction device (scf CH_4/scf)

$DV_{MG,t}$ = Daily volume of mine gas sent with ventilation air to destruction device (scf)

Methane concentrations and flow rates must be recorded every two minutes with averages calculated at least hourly. If the Offset Project Operator or Authorized Project Designee monitors and records data at a higher frequency, this data may be used within appropriate variables of the above equations to reflect the higher frequency of data collection.

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 and the methane concentration must be in mass percent.

5.1.2. Quantifying Project Emissions

(a) Project emissions must be quantified over a consecutive twelve month period.

(b) Project emissions for a reporting period (PE) must be quantified by summing the emissions for all SSRs identified as included in the project in table 4.1 and using equation 5.6.

(c) VAM that is still vented in the project scenario is not accounted for in the project emissions or baseline emissions since it is vented in both scenarios.

Equation 5.6: Project Emissions

$PE = PE_{EC} + PE_{MD} + PE_{UM}$

Where,

PE = Project emissions during the reporting period (MT CO_2e)

PE_{EC} = Project emissions from energy consumed to capture and destroy methane during the reporting period (MT CO_2e)

PE_{MD}	=	Project emissions from destruction of methane during the reporting period (MT CO_2e)
PE_{UM}	=	Project emissions from uncombusted methane during the reporting period (MT CO_2e)

(d) If the project uses fossil fuel or grid electricity to power additional equipment required for project activities (e.g., capturing and destroying ventilation air, transporting ventilation air, etc.), the resulting CO_2 emissions from the energy consumed to capture and destroy methane (PE_{EC}) must be quantified using equation 5.7.

Equation 5.7: Project Emissions from Energy Consumed to Capture and Destroy Methane

$$PE_{EC} = (CONS_{ELEC} \times CEF_{ELEC}) + \frac{(CONS_{HEAT} \times CEF_{HEAT} + CONS_{FF} \times CEF_{FF})}{1000}$$

Where,

PE_{EC}	=	Project emissions from energy consumed to capture and destroy methane during the reporting period (MT CO_2e)
$CONS_{ELEC}$	=	Additional electricity consumption for the capture and destruction of methane during the reporting period (MWh)
CEF_{ELEC}	=	CO_2 emission factor of electricity used from appendix A (MT CO_2e/MWh)
$CONS_{HEAT}$	=	Additional heat consumption for the capture and destruction of methane during the reporting period (volume)
CEF_{HEAT}	=	CO_2 emission factor of heat used from appendix A (kg CO_2/volume)
$CONS_{FF}$	=	Additional fossil fuel consumption for the capture and destruction of methane during the reporting period (volume)
CEF_{FF}	=	CO_2 emission factor of fossil fuel used from appendix A (kg CO_2/volume)
1/1000	=	Conversion of kg to metric tons

(e) Project emissions from the destruction of methane (PE_{MD}) must be quantified using equation 5.8.

Equation 5.8: Project Emissions from Destruction of Methane

$$PE_{MD} = \sum_i MD_{P,i} \times CEF_{CH4}$$

Where,

PE_{MD}	=	Project emissions from destruction of methane during the reporting period (MT CO_2e)
i	=	Use of methane (oxidation or alternative end-use) by all qualifying and non-qualifying destruction devices
$MD_{P,i}$	=	Methane destroyed through use i by qualifying and non-qualifying devices during the reporting period (MT CH_4)
CEF_{CH4}	=	CO_2 emission factor for combusted methane (2.744 MT CO_2e/MT CH_4)

(f) The amount of methane destroyed ($MD_{P,i}$) must be quantified using equation 5.9.

(g) If MG is used to supplement VA, the MG destroyed by the project during the reporting period must be accounted for using equation 5.9 either as $MG_{SUPP,i}$, if VA flow and MG flow are monitored separately, or through $VA_{P,i}$ if only the resulting enriched flow is monitored.

(h) If cooling air was added to the destruction device after the point of metering for VA, this must be accounted for with term $CA_{flow,i,y}$ in equations 5.9 and 5.10. If no cooling air is added, then $CA_{flow,i,y} = 0$.

(i) If the flow rate of cooling air was metered, then the average metered data flow rate must be used. If the flow rate was not metered, the maximum capacity of the cooling air intake system must be used for the flow rate.

Equation 5.9: Methane Destroyed

$MD_{P,i} = (MM_{P,i} - PE_{NO,i})$

Where,

$MD_{P,i}$	=	Methane destroyed through use i by qualifying and non-qualifying devices during the reporting period; calculated separately for each destruction device (MT CH_4)
i	=	Use of methane (oxidation or alternative end-use) by all qualifying and non-qualifying destruction devices
$MM_{P,i}$	=	Measured methane sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (MT CH_4)
$PE_{NO,i}$	=	Project emissions of non-oxidized methane emitted as a result of incomplete oxidation of the ventilation air stream during the reporting period (MT CH_4)

With:

$MM_{P,i} = (VA_{P,i} \times C_{CH4} + MG_{SUPP,i} \times C_{CH4,MG}) \times 0.0423 \times 0.000454$

Where,

$VA_{P,i}$ = Volume of ventilation air sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)

C_{CH4} = Weighted average of measured methane concentration of captured ventilation air sent to qualifying and non-qualifying destruction devices during the reporting period; (scf CH_4/scf)

$MG_{SUPP,i}$ = Volume of mine gas extracted from a methane drainage system and sent with ventilation air to qualifying and non-qualifying devices for destruction during the reporting period (scf)

$C_{CH4,MG}$ = Weighted average of measured methane concentration of captured mine gas sent with ventilation air to qualifying and non-qualifying destruction devices during the reporting period (scf CH_4/scf)

0.0423 = Standard density of methane (lb CH_4/scf CH_4)

0.000454 = MT CH_4/lb CH_4

With:

$$C_{CH4} = \frac{\sum_t (VA_{flow,t} \times C_{CH4,t})}{\sum_t VA_{flow,t}}$$

Where,

$C_{CH4,t}$ = Hourly average methane concentration of ventilation air sent to a destruction device (scf CH_4/scf)

$VA_{flow,t}$ = Hourly average flow rate of ventilation air sent to a destruction device (scfm)

And:

$$C_{CH4MG} = \frac{\sum_t (DV_{MG,t} \times C_{CH4,MG,t})}{\sum_t DV_{MG,t}}$$

Where,

$C_{CH4,MG,t}$ = Daily average methane concentration of mine gas sent with ventilation air to destruction device (scf CH_4/scf)

$DV_{MG,t}$ = Daily volume of mine gas sent with ventilation air to destruction device (scf)

And:

$$PE_{NO,i} = \sum_y (VA_{flow,i,y} \times 60 + CA_{flow,i,y} \times 60) \times C_{CH4,exhaust,i} \times 0.0423 \times 0.000454$$

Where,

y	=	Hours during which destruction device was operational during reporting period (h)
$VA_{flow,i,y}$	=	Hourly average flow rate of ventilation air sent to a device for destruction through use i during the reporting period (scfm)
$CA_{flow,i,y}$	=	Hourly average flow rate of cooling air sent to a destruction device after the metering point of the ventilation air stream during period y (scfm)
60	=	Number of minutes in an hour
$C_{CH4,exhaust,i}$	=	Weighted average of measured methane concentration of exhaust gas emitted from the destruction device during the reporting period (scf CH_4/scf)

With:

$$C_{CH4,exhaust,i} = \frac{\sum_y \left[\left(VA_{flow,i,y} \times 60 \ + CA_{flow,i,y} \times 60 \right) \times \ C_{CH4,exhaust,y} \right]}{\sum_y \left(VA_{flow,i,y} \times 60 + CA_{flow,i,y} \times 60 \right)}$$

Where,

$C_{CH4,exhaust,y}$	=	Hourly average methane concentration of exhaust gas (scf CH_4/scf)

Methane concentrations and flow rates must be recorded every two minutes with averages calculated at least hourly. If the Offset Project Operator or Authorized Project Designee monitors and records data at a higher frequency, this data may be used within appropriate variables of the above equations to reflect the higher frequency of data collection.

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 and the methane concentration must be in mass percent.

(k) Project emissions from uncombusted methane (PE_{UM}) must be quantified using equation 5.10.

Equation 5.10: Project Emissions from Uncombusted Methane

$$PE_{UM} = \sum_i PE_{NO,i} \times GWP_{CH4}$$

Where,

PE_{UM}	=	Project emissions from uncombusted methane during the reporting period (MT CO_2e)
i	=	Use of methane (oxidation or alternative end-use) by all qualifying and non-qualifying destruction devices

$PE_{NO,i}$ = Project emissions of non-oxidized methane emitted as a result of incomplete oxidation of the ventilation air stream during the reporting period; calculated separately for each destruction device (MT CH_4)

GWP_{CH4} = Global warming potential of methane (MT CO_2e/MT CH_4)

With:

$$PE_{NO,i} = \sum_{y} (VA_{flow,i,y} \times 60 + CA_{flow,i,y} \times 60) \times C_{CH4,exhaust,i} \times 0.0423 \times 0.000454$$

Where,

y = Hours during which destruction device was operational during reporting period (h)

$VA_{flow,i,y}$ = Hourly average flow rate of ventilation air sent to a device for destruction through use i during the reporting period (scfm)

$CA_{flow,i,y}$ = Hourly average flow rate of cooling air sent to a destruction device after the metering point of the ventilation air stream during period y (scfm)

60 = Number of minutes in an hour

$C_{CH4,exhaust,i}$ = Weighted average of measured methane concentration of exhaust gas emitted from the destruction device during the reporting period (scf CH_4/scf)

0.0423 = Standard density of methane (lb CH_4/scf CH_4)

0.000454 = MT CH_4/lb CH_4

With:

$$C_{CH4,exhaust,i} = \frac{\sum_y \left[\left(VA_{flow,i,y} \times 60 + CA_{flow,i,y} \times 60 \right) \times C_{CH4,exhaust,y} \right]}{\sum_y \left(VA_{flow,i,y} \times 60 + CA_{flow,i,y} \times 60 \right)}$$

Where,

$C_{CH4,exhaust,\ y}$ = Hourly average methane concentration of exhaust gas (scf CH_4/scf)

Methane concentrations and flow rates must be recorded every two minutes with averages calculated at least hourly. If the Offset Project Operator or Authorized Project Designee monitors and records data at a higher frequency, this data may be used within appropriate variables of the above equations to reflect the higher frequency of data collection.

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 and the methane concentration must be in mass percent.

(l) If gas flow metering equipment provides an actual flow rate instead of a flow rate adjusted to standard conditions, apply equation 5.11 to standardize the flow rate of VA entering the destruction device.

Equation 5.11: Flow Rate or Volume Adjusted for Temperature and Pressure

$$VA_{adjusted,y} = VA_{actual,y} \times \frac{519.67}{T_{VAinflow,\ y}} \times \frac{P_{VAinflow,y}}{1}$$

Where,

$VA_{adjusted,y}$	=	Average flow rate or total volume of ventilation air sent to a destruction device during time interval y, adjusted to standard conditions (scfm or scf)
$VA_{actual,y}$	=	Measured average flow rate or total volume of ventilation air sent to a destruction device during time interval y (acfm or acf)
$T_{VAinflow,y}$	=	Measured absolute temperature of ventilation air sent to a destruction device for the time interval y, °R = °F + 459.67 (°R)
$P_{VAinflow,y}$	=	Measured absolute pressure of ventilation air sent to a destruction device for the time interval y (atm)

5.2. Active Underground Mine Methane Drainage Activities

(a) GHG emission reductions for a reporting period (ER) must be quantified by subtracting the project emissions for that reporting period (PE) from the baseline emissions for that reporting period (BE) using equation 5.12.

(b) If a mine that has historically sent MM to a natural gas pipeline ceases to do so, MM from that source (pre-mining surface wells, pre-mining in-mine boreholes, or post-mining gob wells) is ineligible for emission reduction under this protocol, even if the MM is sent to an otherwise eligible destruction device. If a mine begins to inject MM into a natural gas pipeline while the offset project is ongoing, MM from that source is ineligible for emission reductions going forward.

(c) MM that is injected into a natural gas pipeline in the project scenario is not accounted for in the project emissions or baseline emissions, since it is injected in both scenarios.

Equation 5.12: GHG Emission Reductions

$$ER = BE - PE$$

Where,

ER	=	Emission reductions achieved by the project during the reporting period (MT CO_2e)
BE	=	Baseline emissions during the reporting period (MT CO_2e)
PE	=	Project emissions during the reporting period (MT CO_2e)

5.2.1. Quantifying Baseline Emissions

(a) Baseline emissions for a reporting period (BE) must be estimated by summing the baseline emissions for all SSRs identified as included in the baseline in table 4.2 and using equation 5.13.

Equation 5.13: Baseline Emissions

$BE = BE_{MD} + BE_{MR}$

Where,

BE	=	Baseline emissions during the reporting period (MT CO_2e)
BE_{MD}	=	Baseline emissions from destruction of methane during the reporting period (MT CO_2e)
BE_{MR}	=	Baseline emissions from release of methane into the atmosphere during the reporting period (MT CO_2e)

(b) Baseline emissions from the destruction of MM (BE_{MD}) must be quantified using equation 5.14.

(c) BE_{MD} must include the estimated CO_2 emissions from the destruction of MM in non-qualifying devices.

(d) If there is no destruction of methane in the baseline, then $BE_{MD} = 0$.

Equation 5.14: Baseline Emissions from Destruction of Methane

$BE_{MD} = \sum_{i} MD_{B,i} \times CEF_{CH4}$

Where,

BE_{MD}	=	Baseline emissions from destruction of methane during the reporting period (MT CO_2e)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by non-qualifying destruction devices
$MD_{B,i}$	=	Methane that would have been destroyed through use i by non-qualifying devices during the reporting period (MT CH_4)
CEF_{CH4}	=	CO_2 emission factor for combusted methane (2.744 MT CO_2e/MT CH_4)

(e) The amount of mine methane destroyed ($MD_{B,i}$) must be quantified using equation 5.15.

(f) MG can originate from three distinct sources for active underground mine methane drainage activities: pre-mining surface wells, pre-mining in-mine boreholes, and post-mining gob wells. MG from these sources must be measured and accounted for individually per the equations in this section.

(g) For the purpose of baseline quantification, only non-qualifying destruction devices that were operating during the year prior to offset project commencement should be taken into account.

(h) For each eligible methane source, the volume or mass of MG that would have been sent to a non-qualifying device for destruction during the reporting period in the baseline must be determined by calculating and comparing:

(1) The volume or mass of MG sent to non-qualifying destruction devices during the current reporting period, adjusted for temperature and pressure using equation 5.23, if applicable;

(2) The volume or mass of MG sent to non-qualifying destruction devices during the three-year period prior to offset project commencement (or during the length of time the devices are operational, if less than three years), adjusted for temperature and pressure using equation 5.23, if applicable, and averaged according to the length of the reporting period; and

(3) The volume or mass of MG sent to non-qualifying destruction devices during the time period a law, regulation, or legally binding mandate, in place for less than three years prior to offset project commencement, was in effect, adjusted for temperature and pressure using equation 5.23, if applicable, and averaged according to the length of the reporting period.

(i) For each methane source, the largest of the three quantities determined in sections 5.2.1(h)(1)-(3) must be used for the volume of MG that would have been sent to a non-qualifying device for destruction through use i during the reporting period in the baseline scenario ($PSW_{B,i}$, $PIB_{B,i,}$ and $PGW_{B,i}$) in equations 5.15 and 5.16.

(j) If using a quantity for $PSW_{B,i}$, $PIB_{B,i,}$ or $PGW_{B,i}$ determined by section 5.2.1(h)(1), data for daily volume of mine gas (DV_t), methane concentration of mine gas ($C_{CH4,t}$), volume of mine gas sent for destruction with ventilation air ($MG_{SUPP,i}$), and methane concentration of mine gas sent for destruction with ventilation air ($C_{CH4,MG}$) must be monitored for the non-qualifying destruction devices and used in equations 5.15 and 5.16.

(k) If using a quantity for $PSW_{B,i}$, $PIB_{B,i,}$ or $PGW_{B,i}$ determined by section 5.2.1(h)(2) or 5.2.1(h)(3), historical data for daily volume of mine gas (DV_t), methane concentration of mine gas ($C_{CH4,t}$), volume of mine gas sent for destruction with ventilation air ($MG_{SUPP,i}$), and methane concentration of mine gas sent for destruction with ventilation air ($C_{CH4,MG}$) must be used in equations 5.15 and 5.16, if available.

(l) If using a quantity for $PSW_{B,i}$, $PIB_{B,i,}$ or $PGW_{B,i}$ determined by section 5.2.1(h)(2) or 5.2.1(h)(3), and historical data for daily volume of mine gas (DV_t) is not available, the highest single day volume of mine gas sent to any qualifying or non-qualifying destruction device during the reporting period must be used in place of historical data.

(m) If using a quantity for $PSW_{B,i}$, $PIB_{B,i,}$ or $PGW_{B,i}$ determined by section 5.2.1(h)(2) or 5.2.1(h)(3), and historical data for volume of mine gas sent for destruction with ventilation air ($MG_{SUPP,i}$) is not available, the largest volume of mine gas sent to any qualifying or non-qualifying destruction device during the reporting period must be used in place of historical data.

(n) If using a quantity for $PSW_{B,i}$, $PIB_{B,i,}$ or $PGW_{B,i}$ determined by section 5.2.1(h)(2) or 5.2.1(h)(3), and historical data for methane concentration of mine gas ($C_{CH4,t}$) and methane concentration of mine gas sent for destruction with ventilation air ($C_{CH4,MG}$) are not available, the highest single-hour average methane concentrations during the reporting period must be used in place of historical data.

(o) Offset Project Operators and Authorized Project Designees may choose to use default methane destruction efficiencies (DE_i) provided in appendix B or site-specific methane destruction efficiencies. Destruction technologies not listed in

appendix B must use site-specific methane destruction efficiencies. Site-specific methane destruction efficiencies that are demonstrated to the satisfaction of the Executive Officer to be equally or more accurate than the default methane destruction efficiencies may be used upon written approval by the Executive Officer.

Equation 5.15: Methane Destroyed in Baseline

$MD_{B,i} = (MM_{B,i} \times DE_i)$

Where,

$MD_{B,i}$	=	Methane that would have been destroyed through use i by non-qualifying devices during the reporting period; calculated separately for each destruction device (MT CH_4)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by non-qualifying destruction devices
$MM_{B,i}$	=	Measured methane that would have been sent to non-qualifying devices for destruction through use i during the reporting period (MT CH_4)
DE_i	=	Efficiency of methane destruction device i, either site-specific or from appendix B (%)

With:

$MM_{B,i} = (PSW_{B,i} \times C_{CH4} + PIB_{B,i} \times C_{CH\,4} + PGW_{B,i} \times C_{CH4}) \times 0.0423 \times 0.000454$

Where,

$PSW_{B,i}$	=	Volume of MG from pre-mining surface wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period (scf)
$PIB_{B,i}$	=	Volume of MG from pre-mining in-mine boreholes that would have been sent to non-qualifying devices for destruction through use i during the reporting period (scf)
$PGW_{B,i}$	=	Volume of MG from post-mining gob wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period (scf)
C_{CH4}	=	Weighted average of measured methane concentration of mine gas that would have been sent to non-qualifying destruction devices during the reporting period; calculated separately for each methane source (scf CH_4/scf)
0.0423	=	Standard density of methane (lb CH_4/scf CH_4)

0.000454 = MT CH_4/lb CH_4

With:

$$C_{CH4} = \frac{\sum_t (DV_t \times C_{CH4,t})}{\sum_t DV_t}$$

Where,

$C_{CH4,t}$ = Daily average methane concentration of mine gas sent to a destruction device (scf CH_4/scf)

DV_t = Daily volume of mine gas sent to a destruction device (scf)

Methane concentrations and flow rates must be recorded every two minutes with averages calculated at least hourly. If the Offset Project Operator or Authorized Project Designee monitors and records data at a higher frequency, this data may be used within appropriate variables of the above equations to reflect the higher frequency of data collection.

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 and the methane concentration must be in mass percent.

(p) Baseline emissions from the release of methane (BE_{MR}) must be quantified using equation 5.16.

(q) BE_{MR} must account for the total amount of methane actually destroyed by all qualifying and non-qualifying devices during the reporting period.

(r) Emissions from the release of methane through a pre-mining surface well is only accounted for in the baseline during the reporting period in which the emissions would have occurred (i.e., when the well is mined through). For the purposes of this protocol, a well at an active underground mine is considered mined through when any of the following occur:

(1) The working face intersects the borehole, as long as the endpoint of the borehole is not more than 50 meters below the mined coal seam;

(2) The working face passes directly underneath the bottom of the borehole, as long as the endpoint of the borehole is not more than 150 meters above the mined coal seam;

(3) The working face passes both underneath (not more than 150 meters below the endpoint of the borehole) and to the side of the borehole if room

and pillar mining technique is employed and the endpoint of the borehole lies above a block of coal that will be left unmined as a pillar; or

(4) The well produces elevated amounts of atmospheric gases (the percent concentration of nitrogen in MG increases by five compared to baseline levels). A full gas analysis using a gas chromatograph must be completed by an ISO 17025 accredited lab or a lab that has been certified by an accreditation body conformant with ISO 17025 to perform test methods appropriate for atmospheric gas content analysis. To ensure that elevated nitrogen levels are the result of a well being mined through and not the result of a leak in the well, the gas analysis must show that oxygen levels did not increase by the same proportion as the nitrogen levels.

(s) If using section 5.2.1(r)(1), (2), or (3) to demonstrate that a well is mined through, an up-to-date mine plan must be used to identify which wells were mined through, based on the above criteria, and therefore eligible for baseline quantification in any given reporting period.

(t) If the mine plan calls for mining past rather than through a borehole, MG from that borehole extracted from within the methane source boundaries as described in section 3.5(d)(2) is eligible for quantification in the baseline 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.

(u) If an MMC project at an active underground mine consists of both VAM and methane drainage activities, MG extracted from a methane drainage system ($MG_{SUPP,i}$) may be used to supplement VA to either increase or help balance the concentration of methane flowing into the destruction device. If MG is used to supplement VA, the MG destroyed by the project during the reporting period must be accounted for using equation 5.16 as $MG_{SUPP,i.}$

(v) MM that is still vented in the project scenario is not accounted for in the project emissions or baseline emissions, since it is vented in both scenarios.

Equation 5.16: Baseline Emissions from Release of Methane

$$BE_{MR} = \sum_{i} [(PSW_{P,i} \times C_{CH4} - PSW_{B,i,} \times C_{CH4}) + (PIB_{P,i} \times C_{CH4} - PIB_{B,i} \times C_{CH4}) + (PGW_{P,i} \times C_{CH4} - PGW_{B,i} \times C_{CH4}) - MG_{SUPP,i} \times C_{CH4,MG}] \times 0.0423 \times 0.000454 \times GWP_{CH4}$$

Where,

BE_{MR}	=	Baseline emissions from release of methane into the atmosphere during the reporting period (MT CO_2e)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by all qualifying and non-qualifying destruction devices
$PSW_{P,i}$	=	Volume of MG from pre-mining surface wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, only the eligible amount per equation 5.17 in accordance with sections 5.2.1(r), (s), and (t) must be quantified (scf)
$PSW_{B,i}$	=	Volume of MG from pre-mining surface wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period (scf)
$PIB_{P,i}$	=	Volume of MG from pre-mining in-mine boreholes sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)
$PIB_{B,i}$	=	Volume of MG from pre-mining in-mine boreholes that would have been sent to non-qualifying devices for destruction through use i during the reporting period (scf)
$PGW_{P,i}$	=	Volume of MG from post-mining gob wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)
$PGW_{B,i}$	=	Volume of MG from post-mining gob wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period (scf)
C_{CH4}	=	Weighted average of measured methane concentration of mine gas sent to qualifying and non-qualifying destruction devices during the reporting period; calculated separately for each methane source (scf CH_4/scf)
$MG_{SUPP,i}$	=	Volume of mine gas extracted from a methane drainage system and sent with ventilation air to qualifying and non-qualifying devices for destruction during the reporting period (scf)
$C_{CH4,MG}$	=	Weighted average of measured methane concentration of captured mine gas sent with ventilation air to qualifying and non-qualifying destruction devices during the reporting period (scf CH_4/scf)

0.0423 = Standard density of methane (lb CH_4/scf CH_4)

0.000454 = MT CH_4/lb CH_4

GWP_{CH4} = Global warming potential of methane (MT CO_2e/MT CH_4)

With:

$PSW_{P,i} = PSWe_i + PSWnqd_i$

Where,

$PSWe_i$ = Volume of MG from pre-mining surface wells sent to qualifying devices for destruction through use i that is eligible for quantification in the reporting period; quantified using equation 5.17 (scf)

$PSWnqd_i$ = Volume of MG from pre-mining surface wells sent to non-qualifying devices for destruction through use i during the reporting period (scf)

And:

$$C_{CH4} = \frac{\sum_t (DV_t \times C_{CH4,t})}{\sum_t DV_t}$$

Where,

$C_{CH4,t}$ = Daily average methane concentration of mine gas sent to a destruction device (scf CH_4/scf)

DV_t = Daily volume of mine gas sent to a destruction device (scf)

And:

$$C_{CH4MG} = \frac{\sum_t (DV_{MG,t} \times C_{CH4,MG,t})}{\sum_t DV_{MG,t}}$$

Where,

$C_{CH4,MG,t}$ = Daily average methane concentration of mine gas sent with ventilation air to destruction device (scf CH_4/scf)

$DV_{MG,t}$ = Daily volume of mine gas sent with ventilation air to destruction device (scf)

Methane concentrations and flow rates must be recorded every two minutes with averages calculated at least hourly. If the Offset Project Operator or Authorized Project Designee monitors and records data at a higher frequency, this data may be used within appropriate variables of the above equations to reflect the higher frequency of data collection.

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 and the methane concentration must be in mass percent.

(w) The eligible amount of MG from pre-mining surface wells destroyed by qualifying devices ($PSWe_i$) must be determined by using equation 5.17.

Equation 5.17: Eligible MG from Pre-mining Surface Boreholes

$PSWe_i = PSWe_{pre,i} + PSWe_{post,i}$

Where,

$PSWe_i$	=	Volume of MG from pre-mining surface wells sent to qualifying devices for destruction through use i that is eligible for quantification in the reporting period for use in equation 5.16. (scf)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, etc.) by qualifying destruction devices
$PSWe_{pre,i}$	=	Volume of MG sent to qualifying destruction devices, from the beginning of the crediting period through the end of the reporting period, captured from pre-mining surface wells that were mined through during the reporting period (scf)
$PSWe_{post,i}$	=	Volume of MG sent to qualifying destruction devices in the reporting period captured from pre-mining surface wells that were mined through during earlier reporting periods (scf)

5.2.2. Quantifying Project Emissions

(a) Project emissions must be quantified over a consecutive twelve month period.

(b) Project emissions for a reporting period (PE) must be quantified by summing the emissions for all SSRs identified as included in the project in table 4.2 and using equation 5.18.

(c) Mine methane that is still vented in the project scenario is not accounted for in the project emissions or baseline emissions since it is vented in both scenarios.

Equation 5.18: Project Emissions

$PE = PE_{EC} + PE_{MD} + PE_{UM}$

Where,

PE	=	Project emissions during the reporting period (MT CO_2e)
PE_{EC}	=	Project emissions from energy consumed to capture and destroy methane during the reporting period (MT CO_2e)

PE_{MD}	=	Project emissions from destruction of methane during the reporting period (MT CO_2e)
PE_{UM}	=	Project emissions from uncombusted methane during the reporting period (MT CO_2e)

(d) If the project uses fossil fuel or grid electricity to power additional equipment required for project activities (e.g., capturing and destroying mine gas, transporting mine gas, etc.), the resulting CO_2 emissions from the energy consumed to capture and destroy methane (PE_{EC}) must be quantified using equation 5.19.

(e) If the total electricity generated by project activities is greater than the additional electricity consumed for the capture and destruction of methane, then $CONS_{ELEC}$ = 0 in equation 5.19.

Equation 5.19: Project Emissions from Energy Consumed to Capture and Destroy Methane

$$PE_{EC} = (CONS_{ELEC} \times CEF_{ELEC}) + \frac{(CONS_{HEAT} \times CEF_{HEAT} + CONS_{FF} \times CEF_{FF})}{1000}$$

Where,

PE_{EC}	=	Project emissions from energy consumed to capture and destroy methane during the reporting period (MT CO_2e)
$CONS_{ELEC}$	=	Additional electricity consumption for the capture and destruction of methane during the reporting period (MWh)
CEF_{ELEC}	=	CO_2 emission factor of electricity used from appendix A (MT CO_2e/MWh)
$CONS_{HEAT}$	=	Additional heat consumption for the capture and destruction of methane during the reporting period (volume)
CEF_{HEAT}	=	CO_2 emission factor of heat used from appendix A (kg CO_2/volume)
$CONS_{FF}$	=	Additional fossil fuel consumption for the capture and destruction of methane during the reporting period (volume)
CEF_{FF}	=	CO_2 emission factor of fossil fuel used from appendix A (kg CO_2/volume)
1/1000	=	Conversion of kg to metric tons

(f) Project emissions from the destruction of methane (PE_{MD}) must be quantified using equation 5.20.

(g) Project emissions must include the CO_2 emissions resulting from the destruction of all MG from pre-mining surface wells that took place during the reporting period regardless of whether or not the well is mined through by the end of the reporting period.

Equation 5.20: Project Emissions from Destruction of Captured Methane

$$PE_{MD} = \sum_i MD_{P,i} \times CEF_{CH4}$$

Where,

PE_{MD}	=	Project emissions from destruction of methane during the reporting period (MT CO_2e)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by all qualifying and non-qualifying destruction devices
$MD_{P,i}$	=	Methane destroyed through use i by qualifying and non-qualifying devices during the reporting period (MT CH_4)
CEF_{CH4}	=	CO_2 emission factor for combusted methane (2.744 MT CO_2e/MT CH_4)

(h) The amount of methane destroyed (MD_i) must be quantified using equation 5.21.

(i) Offset Project Operators and Authorized Project Designees may choose to use default methane destruction efficiencies (DE_i) provided in appendix B or site-specific methane destruction efficiencies. Destruction technologies not listed in appendix B must use site-specific methane destruction efficiencies. Site-specific methane destruction efficiencies that are demonstrated to the satisfaction of the Executive Officer to be equally or more accurate than the default methane destruction efficiencies may be used upon written approval by the Executive Officer.

Equation 5.21: Methane Destroyed

$$MD_{P,i} = (MM_{P,i} \times DE_i)$$

Where,

$MD_{P,i}$	=	Methane destroyed through use i by qualifying and non-qualifying devices during the reporting period; calculated separately for each destruction device (MT CH_4)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by all qualifying and non-qualifying destruction devices

$MM_{P,i}$ = Measured methane sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (MT CH_4)

DE_i = Efficiency of methane destruction device i, either site-specific or from appendix B (%)

With:

$MM_{P,i} = (PSW_{P,all,i} \times C_{CH4} + PIB_{P,i} \times C_{CH4} + PGW_{P,i} \times C_{CH4} - MG_{SUPP,i} \times C_{CH4,MG}) \times 0.0423 \times 0.000454$

Where,

$PSW_{P,all,i}$ = Volume of MG from pre-mining surface wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)

$PIB_{P,i}$ = Volume of MG from pre-mining in-mine boreholes sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)

$PGW_{P,i}$ = Volume of MG from post-mining gob wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)

C_{CH4} = Weighted average of measured methane concentration of mine gas sent to qualifying and non-qualifying destruction devices during the reporting period; calculated separately for each methane source (scf CH_4/scf)

$MG_{SUPP,i}$ = Volume of mine gas extracted from a methane drainage system and sent with ventilation air to qualifying and non-qualifying devices for destruction during the reporting period (scf)

$C_{CH4,MG}$ = Weighted average of measured methane concentration of captured mine gas sent with ventilation air to qualifying and non-qualifying destruction devices during the reporting period (scf CH_4/scf)

0.0423 = Standard density of methane (lb CH_4/scf CH_4)

0.000454 = MT CH_4/lb CH_4

And:

$$C_{CH4} = \frac{\sum_t (DV_t \times C_{CH4,t})}{\sum_t DV_{MG,t}}$$

Where,

$C_{CH4,t}$ = Daily average methane concentration of mine gas sent to a destruction device (scf CH_4/scf)

DV_t = Daily volume of mine gas sent to a destruction device (scf)

And:

$$C_{CH4MG} = \frac{\sum_t (DV_{MG,t} \times C_{CH4,MG,t})}{\sum_t DV_{MG,t}}$$

Where,

$C_{CH4,MG,t}$ = Daily average methane concentration of mine gas sent with ventilation air to destruction device (scf CH_4/scf)

$DV_{MG,t}$ = Daily volume of mine gas sent with ventilation air to destruction device (scf)

Methane concentrations and flow rates must be recorded every two minutes with averages calculated at least hourly. If the Offset Project Operator or Authorized Project Designee monitors and records data at a higher frequency, this data may be used within appropriate variables of the above equations to reflect the higher frequency of data collection.

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 and the methane concentration must be in mass percent.

(j) Project emissions from uncombusted methane (PE_{UM}) must be quantified using equation 5.22.

(k) Project emissions from uncombusted methane must include emissions from all MG from pre-mining surface wells sent to destruction devices during the reporting period regardless of whether or not the well is mined through by the end of the reporting period.

(l) Offset Project Operators and Authorized Project Designees may choose to use default methane destruction efficiencies (DE_i) provided in appendix B or site-specific methane destruction efficiencies. Destruction technologies not listed in appendix B must use site-specific methane destruction efficiencies. Site-specific methane destruction efficiencies that are demonstrated to the satisfaction of the Executive Officer to be equally or more accurate than the default methane destruction efficiencies may be used upon written approval by the Executive Officer.

Equation 5.22: Project Emissions from Uncombusted Methane

$$PE_{UM} = \sum_i [MM_{P,i} \times (1 - DE_i)] \times GWP_{CH4}$$

Where,

PE_{UM} = Project emissions from uncombusted methane during the reporting period (MT CO_2e)

i = Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline etc.) by all qualifying and non-qualifying destruction devices

$MM_{P,i}$ = Measured methane sent to qualifying and non-qualifying devices for destruction through use i during the reporting period; calculated separately for each destruction device (MT CH_4)

DE_i = Efficiency of methane destruction device i, either site-specific or from appendix B (%)

GWP_{CH4} = Global warming potential of methane (MT CO_2e/MT CH_4)

With:

$$MM_{P,i} = (PSW_{P,all,i} \times C_{CH4} + PIB_{P,i} \times C_{CH4} + PGW_{P,i} \times C_{CH4} - MG_{SUPP,i} \times C_{CH4,MG}) \times 0.0423 \times 0.000454$$

Where,

$PSW_{P,all,i}$ = Volume of MG from pre-mining surface wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)

$PIB_{P,i}$ = Volume of MG from pre-mining in-mine boreholes sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)

$PGW_{P,i}$ = Volume of MG from post-mining gob wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)

C_{CH4} = Weighted average of measured methane concentration of mine gas sent to qualifying and non-qualifying destruction devices during the reporting period; calculated separately for each methane source (scf CH_4/scf)

$MG_{SUPP,i}$ = Volume of mine gas extracted from a methane drainage system and sent with ventilation air to qualifying and non-qualifying devices for destruction during the reporting period (scf)

$C_{CH4,MG}$ = Weighted average of measured methane concentration of captured mine gas sent with ventilation air to qualifying and non-qualifying destruction devices during the reporting period (scf CH_4/scf)

0.0423 = Standard density of methane (lb CH_4/scf CH_4)

0.000454 = MT CH_4/lb CH_4

And:

$$C_{CH4} = \frac{\sum_t (DV_t \times C_{CH4,t})}{\sum_t DV_t}$$

Where,

$C_{CH4,t}$ = Daily average methane concentration of mine gas sent to a destruction device (scf CH_4/scf)

DV_t = Daily volume of mine gas sent to a destruction device (scf)

And:

$$C_{CH4MG} = \frac{\sum_t (DV_{MG,t} \times C_{CH4,MG,t})}{\sum_t DV_{MG,t}}$$

Where,

$C_{CH4,MG,t}$ = Daily average methane concentration of mine gas sent with ventilation air to destruction device (scf CH_4/scf)

$DV_{MG,t}$ = Daily volume of mine gas sent with ventilation air to destruction device (scf)

Methane concentrations and flow rates must be recorded every two minutes with averages calculated at least hourly. If the Offset Project Operator or Authorized Project Designee monitors and records data at a higher frequency, this data may be used within appropriate variables of the above equations to reflect the higher frequency of data collection.

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 and the methane concentration must be in mass percent.

(m) If gas flow metering equipment provides an actual flow rate or volume instead of a flow rate or volume adjusted to standard conditions, use equation 5.23 to standardize the amount of MG sent to each qualifying and non-qualifying device during the reporting period.

Equation 5.23: MG Flow Rate or Volume Adjusted for Temperature and Pressure

$$MG_{adjusted,y} = MG_{actual,y} \times \frac{519.67}{T_{MG,y}} \times \frac{P_{MG,y}}{1}$$

Where,

$MG_{adjusted,y}$ = Average flow rate or total volume of MG sent to a destruction device during time interval y, adjusted to standard conditions (scfm or scf)

$MG_{actual,y}$ = Measured average flow rate or total volume of MG sent to a destruction device during time interval y (acfm or acf)

$T_{MG,y}$	=	Measured absolute temperature of MG for the time interval y, °R=°F + 459.67 (°R)
$P_{MG,y}$	=	Measured absolute pressure of MG for the time interval y (atm)

5.3. Active Surface Mine Methane Drainage Activities

(a) GHG emission reductions for a reporting period (ER) must be quantified by subtracting the project emissions for that reporting period (PE) from the baseline emissions for that reporting period (BE) using equation 5.24.

Equation 5.24: GHG Emission Reductions

$ER = BE - PE$

Where,

ER	=	Emission reductions achieved by the project during the reporting period (MT CO_2e)
BE	=	Baseline emissions during the reporting period (MT CO_2e)
PE	=	Project emissions during the reporting period (MT CO_2e)

5.3.1. Quantifying Baseline Emissions

(a) Baseline emissions for a reporting period (BE) must be estimated by summing the baseline emissions for all SSRs identified as included in the baseline in table 4.3 and using equation 5.25.

Equation 5.25: Baseline Emissions

$BE = BE_{MD} + BE_{MR}$

Where,

BE	=	Baseline emissions during the reporting period (MT CO_2e)
BE_{MD}	=	Baseline emissions from destruction of methane during the reporting period (MT CO_2e)
BE_{MR}	=	Baseline emissions from release of methane into the atmosphere during the reporting period (MT CO_2e)

(b) Baseline emissions from the destruction of SMM (BE_{MD}) must be quantified using equation 5.26.

(c) BE_{MD} must include the estimated CO_2 emissions from the destruction of SMM in non-qualifying devices.

(d) If there is no destruction of methane in the baseline, then $BE_{MD} = 0$.

Equation 5.26: Baseline Emissions from Destruction of Methane

$BE_{MD} = \sum_{i} MD_{B,i} \times CEF_{CH4}$

Where,

BE_{MD}	=	Baseline emissions from destruction of methane during the reporting period (MT CO_2e)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by non-qualifying destruction devices
$MD_{B,i}$	=	Methane that would have been destroyed through use i by non-qualifying devices during the reporting period (MT CH_4)
CEF_{CH4}	=	CO_2 emission factor for combusted methane (2.744 MT CO_2e/MT CH_4)

(e) The amount of mine methane destroyed ($MD_{B,i}$) must be quantified using equation 5.27.

(f) MG can originate from five distinct sources for active surface mine methane drainage activities: pre-mining surface wells, pre-mining in-mine boreholes, existing CBM wells that would otherwise be shut-in and abandoned as a result of encroaching mining, abandoned wells that are reactivated, and converted dewatering wells. MG from these sources must be measured and accounted for individually per the equations in this section.

(g) For the purpose of baseline quantification, only non-qualifying destruction devices that were operating during the year prior to offset project commencement should be taken into account.

(h) For each eligible methane source, the volume or mass of MG that would have been sent to a non-qualifying device for destruction during the reporting period in the baseline must be determined by calculating and comparing:

(1) The volume or mass of MG sent to non-qualifying destruction devices during the current reporting period, adjusted for temperature and pressure using equation 5.38, if applicable;

(2) The volume or mass of MG sent to non-qualifying destruction devices during the three-year period prior to offset project commencement (or during the length of time the devices are operational, if less than three years), adjusted for temperature and pressure using equation 5.38, if

applicable, and averaged according to the length of the reporting period; and

(3) The volume or mass of MG sent to non-qualifying destruction devices during the time period a law, regulation, or legally binding mandate, in place for less than three years prior to offset project commencement, was in effect, adjusted for temperature and pressure using equation 5.38, if applicable, and averaged according to the length of the reporting period.

(i) For each methane source, the largest of the three quantities determined in sections 5.3.1(h)(1)-(3) must be used for the volume of MG that would have been sent to a non-qualifying device for destruction through use i during the reporting period in the baseline scenario ($PSW_{B,i}$, $PIB_{B,i}$, $ECW_{B,i}$, $AWR_{B,i,}$ and $CDW_{B,i}$) in equations 5.27 and 5.28.

(j) If using a quantity for $PSW_{B,i}$, $PIB_{B,i}$, $ECW_{B,i}$, $AWR_{B,i,}$ and $CDW_{B,i}$ determined by section 5.3.1(h)(1), data for daily volume of mine gas (DV_t) and methane concentration of mine gas ($C_{CH4,t}$) must be monitored for the non-qualifying destruction devices and used in equations 5.27 and 5.28.

(k) If using a quantity for $PSW_{B,i}$, $PIB_{B,i}$, $ECW_{B,i}$, $AWR_{B,i,}$ and $CDW_{B,i}$ determined by section 5.3.1(h)(2) or 5.3.1(h)(3), historical data for daily volume of mine gas (DV_t), and methane concentration of mine gas ($C_{CH4,t}$) must be used in equations 5.27 and 5.28, if available.

(l) If using a quantity for $PSW_{B,i}$, $PIB_{B,i}$, $ECW_{B,i}$, $AWR_{B,i,}$ and $CDW_{B,i}$ determined by section 5.3.1(h)(2) or 5.3.1(h)(3), and historical data for daily volume of mine gas (DV_t) is not available, the highest single day volume of mine gas sent to any qualifying or non-qualifying destruction device during the reporting period must be used in place of historical data.

(m) If using a quantity for $PSW_{B,i}$, $PIB_{B,i}$, $ECW_{B,i}$, $AWR_{B,i,}$ and $CDW_{B,i}$ determined by section 5.3.1(h)(2) or 5.3.1(h)(3), and historical data for methane concentration of mine gas ($C_{CH4,t}$) is not available, the highest single-hour average methane concentration during the reporting period must be used in place of historical data.

(n) Offset Project Operators and Authorized Project Designees may choose to use default methane destruction efficiencies (DE_i) provided in appendix B or site-

specific methane destruction efficiencies. Destruction technologies not listed in appendix B must use site-specific methane destruction efficiencies. Site-specific methane destruction efficiencies that are demonstrated to the satisfaction of the Executive Officer to be equally or more accurate than the default methane destruction efficiencies may be used upon written approval by the Executive Officer.

Equation 5.27: Methane Destroyed in Baseline

$MD_{B,i} = (MM_{B,i} \times DE_i)$

Where,

$MD_{B,i}$	=	Methane that would have been destroyed through use i by non-qualifying devices during the reporting period; calculated separately for each destruction device (MT CH_4)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by non-qualifying destruction devices
$MM_{B,i}$	=	Measured methane that would have been sent to non-qualifying devices for destruction through use i during the reporting period (MT CH_4)
DE_i	=	Efficiency of methane destruction device i, either site-specific or from appendix B (%)

With:

$MM_{B,i} = (PSW_{B,i} \times C_{CH4} + PIB_{B,i} \times C_{CH\,4} + ECW_{B,i} \times C_{CH4} + AWR_{B,i} \times C_{CH4} + CDW_{B,i} \times C_{CH4}) \times 0.0423 \times 0.000454$

Where,

$PSW_{B,i}$	=	Volume of MG from pre-mining surface wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period (scf)
$PIB_{B,i}$	=	Volume of MG from pre-mining in-mine boreholes that would have been sent to non-qualifying devices for destruction through use i during the reporting period (scf)
$ECW_{B,i}$	=	Volume of MG from existing coalbed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining that would have been sent to non-qualifying devices for destruction through use i during the reporting period (scf)

$AWR_{B,i}$	=	Volume of MG from abandoned wells that are reactivated that would have been sent to non-qualifying devices for destruction through use i during the reporting period (scf)
$CDW_{B,i}$	=	Volume of MG from converted dewatering wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period (scf)
C_{CH4}	=	Weighted average of measured methane concentration of mine gas that would have been sent to non-qualifying destruction devices during the reporting period; calculated separately for each methane source (scf CH_4/scf)
0.0423	=	Standard density of methane (lb CH_4/scf CH_4)
0.000454	=	MT CH_4/lb CH_4

With:

$$C_{CH4} = \frac{\sum_t (DV_t \times C_{CH4,t})}{\sum_t DV_t}$$

Where,

$C_{CH4,t}$	=	Daily average methane concentration of mine gas sent to a destruction device (scf CH_4/scf)
DV_t	=	Daily volume of mine gas sent to a destruction device (scf)

Methane concentrations and flow rates must be recorded every two minutes with averages calculated at least hourly. If the Offset Project Operator or Authorized Project Designee monitors and records data at a higher frequency, this data may be used within appropriate variables of the above equations to reflect the higher frequency of data collection.

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 and the methane concentration must be in mass percent.

(o) Baseline emissions from the release of methane (BE_{MR}) must be quantified using equation 5.28.

(p) BE_{MR} must account for the total amount of methane actually destroyed by all qualifying and non-qualifying devices during the reporting period.

(q) Emissions from the release of methane are only accounted for in the baseline during the reporting period in which the emissions would have occurred (i.e., when the well is mined through). With the exception of pre-mining in-mine boreholes, all other methane sources must demonstrate that the well is mined

through. For the purposes of this protocol, a well at an active surface mine is considered mined through when either of the following occurs:

(1) The well is physically bisected by surface mining activities, such as excavation of overburden, drilling and blasting, and removal of the coal; or

(2) The well produces elevated amounts of atmospheric gases (the percent concentration of nitrogen in MG increases by five compared to baseline levels). A full gas analysis using a gas chromatograph must be completed by an ISO 17025 accredited lab or a lab that has been certified by an accreditation body conformant with ISO 17025 to perform test methods appropriate for atmospheric gas content analysis. To ensure that elevated nitrogen levels are the result of a well being mined through and not the result of a leak in the well, the gas analysis must show that oxygen levels did not increase by the same proportion as the nitrogen levels.

(r) If using section 5.3.1(g)(1) to demonstrate that a well is mined through, an up-to-date mine plan must be used to identify which wells were mined through and therefore eligible for baseline quantification in any given reporting period.

(s) SMM that is still vented in the project scenario is not accounted for in the project emissions or baseline emissions, since it is vented in both scenarios.

Equation 5.28: Baseline Emissions from Release of Methane

$$BE_{MR} = \sum_{i} [(PSW_{P,i} \times C_{CH4} - PSW_{B,i} \times C_{CH4}) + (PIB_{P,i} \times C_{CH4} - PIB_{B,i} \times C_{CH4}) + (ECW_{P,i} \times C_{CH4} - ECW_{B,i} \times C_{CH4}) + (AWR_{P,i} \times C_{CH4} - AWR_{B,i} \times C_{CH4}) + (CDW_{P,i} \times C_{CH4} - CDW_{B,i} \times C_{CH4})] \times 0.0423 \times 0.000454 \times GWP_{CH4}$$

Where,

BE_{MR}	=	Baseline emissions from release of methane into the atmosphere during the reporting period (MT CO_2e)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by all qualifying and non-qualifying destruction devices
$PSW_{P,i}$	=	Volume of MG from pre-mining surface wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, only the eligible amount per equation 5.29 in accordance with sections 5.3.1(q) and (r) must be quantified (scf)

$PSW_{B,i}$	=	Volume of MG from pre-mining surface wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period (scf)
$PIB_{P,i}$	=	Volume of MG from pre-mining in-mine boreholes sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)
$PIB_{B,i}$	=	Volume of MG from pre-mining in-mine boreholes that would have been sent to non-qualifying devices for destruction through use i during the reporting period (scf)
$ECW_{P,i}$	=	Volume of MG from existing coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, only the eligible amount per equation 5.30 in accordance with sections 5.3.1(q) and (r) must be quantified (scf)
$ECW_{B,i}$	=	Volume of MG from existing coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining that would have been sent to non-qualifying devices for destruction through use i during the reporting period (scf)
$AWR_{P,i}$	=	Volume of MG from abandoned wells that are reactivated sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, only the eligible amount per equation 5.31 in accordance with sections 5.3.1(q) and (r) must be quantified (scf)
$AWR_{B,i}$	=	Volume of MG from abandoned wells that are reactivated that would have been sent to non-qualifying devices for destruction through use i during the reporting period (scf)
$CDW_{P,i}$	=	Volume of MG from converted dewatering wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, only the eligible amount per equation 5.32 in accordance with sections 5.3.1(q) and (r) must be quantified (scf)
$CDW_{B,i}$	=	Volume of MG from converted dewatering wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period (scf)
C_{CH4}	=	Weighted average of measured methane concentration of mine gas sent to qualifying and non-qualifying destruction devices during the reporting period; calculated separately for each methane source (scf CH_4/scf)
0.0423	=	Standard density of methane (lb CH_4/scf CH_4)
0.000454	=	MT CH_4/lb CH_4

GWP_{CH4} = Global warming potential of methane (MT CO_2e/MT CH_4)

With:

$PSW_{P,i} = PSWe_i + PSWnqd_i$

Where,

$PSWe_i$ = Volume of MG from pre-mining surface wells sent to qualifying devices for destruction through use i that is eligible for quantification in the reporting period; quantified using equation 5.29 (scf)

$PSWnqd_i$ = Volume of MG from pre-mining surface wells sent to non-qualifying devices for destruction through use i during the reporting period (scf)

And:

$ECW_{P,i} = ECWe_i + ECWnqd_i$

Where,

$ECWe_i$ = Volume of MG from existing coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining sent to qualifying devices for destruction through use i that is eligible for quantification in the reporting period; quantified using equation 5.30 (scf)

$ECWnqd_i$ = Volume of MG from existing coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining sent to non-qualifying devices for destruction through use i during the reporting period (scf)

And:

$AWR_{P,i} = AWRe_i + AWRnqd_i$

Where,

$AWRe_i$ = Volume of MG from abandoned wells that are reactivated sent to qualifying devices for destruction through use i that is eligible for quantification in the reporting period; quantified using equation 5.31 (scf)

$AWRnqd_i$ = Volume of MG from abandoned wells that are reactivated sent to non-qualifying devices for destruction through use i during the reporting period (scf)

And:

$CDW_{P,i} = CDWe_i + CDWnqd_i$

Where,

$CDWe_i$	=	Volume of MG from converted dewatering wells sent to qualifying devices for destruction through use i that is eligible for quantification in the reporting period; quantified using equation 5.32 (scf)
$CDWnqd_i$	=	Volume of MG from converted dewatering wells sent to non-qualifying devices for destruction through use i during the reporting period (scf)

And:

$$C_{CH4} = \frac{\sum_t (DV_t \times C_{CH4,t})}{\sum_t DV_t}$$

Where,

$C_{CH4,t}$	=	Daily average methane concentration of mine gas sent to a destruction device (scf CH_4/scf)
DV_t	=	Daily volume of mine gas sent to a destruction device (scf)

Methane concentrations and flow rates must be recorded every two minutes with averages calculated at least hourly. If the Offset Project Operator or Authorized Project Designee monitors and records data at a higher frequency, this data may be used within appropriate variables of the above equations to reflect the higher frequency of data collection.

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 and the methane concentration must be in mass percent.

(t) The eligible amount of MG destroyed by qualifying devices must be determined by using equations 5.29, 5.30, 5.31, and 5.32.

Equation 5.29: Eligible MG from Pre-mining Surface Wells

$$PSWe_i = PSWe_{pre,i} + PSWe_{post,i}$$

Where,

$PSWe_i$	=	Volume of MG from pre-mining surface wells sent to qualifying devices for destruction through use i that is eligible for quantification in the reporting period for use in equation 5.28 (scf)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by qualifying destruction devices
$PSWe_{pre,i}$	=	Volume of MG sent to qualifying destruction devices, from the beginning of the crediting period through the end of the reporting period, captured from pre-mining surface wells that were mined through during the reporting period (scf)

$PSWe_{post,i}$	=	Volume of MG sent to qualifying destruction devices in the reporting period captured from pre-mining surface wells that were mined through during earlier reporting periods (scf)

Equation 5.30: Eligible MG from Existing Coal Bed Methane Wells that Would Otherwise Be Shut-in and Abandoned as a Result of Encroaching Mining

$ECWe_i = ECWe_{pre,i} + ECWe_{post,i}$

Where,

$ECWe_i$	=	Volume of MG from existing coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining sent to qualifying devices for destruction through use i that is eligible for quantification in the reporting period for use in equation 5.28 (scf)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by qualifying destruction devices
$ECWe_{pre,i}$	=	Volume of MG sent to qualifying destruction devices, from the beginning of the crediting period through the end of the reporting period, captured from existing coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining that were mined through during the reporting period (scf)
$ECWe_{post,i}$	=	Volume of MG sent to qualifying destruction devices in the reporting period captured from existing coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining that were mined through during earlier reporting periods (scf)

Equation 5.31: Eligible MG from Abandoned Wells that are Reactivated

$AWRe_i = AWRe_{pre,i} + AWRe_{post,i}$

Where,

$AWRe_i$	=	Volume of MG from abandoned wells that are reactivated sent to qualifying devices for destruction through use i that is eligible for quantification in the reporting period for use in equation 5.28 (scf)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by qualifying destruction devices
$AWRe_{pre,i}$	=	Volume of MG sent to qualifying destruction devices, from the beginning of the crediting period through the end of the reporting period, captured from abandoned wells that are reactivated that were mined through during the current reporting period (scf)

$AWRe_{post,i}$	=	Volume of MG sent to qualifying destruction devices in the reporting period captured from abandoned wells that are reactivated that were mined through during earlier reporting periods (scf)

Equation 5.32: Eligible MG from Converted Dewatering Wells that are Reactivated

$CDWe_i = CDWe_{pre,i} + CDWe_{post,i}$

Where,

$CDWe_i$	=	Volume of MG from converted dewatering wells sent to qualifying devices for destruction through use i that is eligible for quantification in the reporting period for use in equation 5.28 (scf)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by qualifying destruction devices
$CDWe_{pre,i}$	=	Volume of MG sent to qualifying destruction devices, from the beginning of the crediting period through the end of the reporting period, captured from converted dewatering wells that were mined through during the reporting period (scf)
$CDWe_{post,i}$	=	Volume of MG sent to qualifying destruction devices in the reporting period captured from converted dewatering wells that were mined through during earlier reporting periods (scf)

5.3.2 Quantifying Project Emissions

(a) Project emissions must be quantified over a consecutive twelve month period.

(b) Project emissions for a reporting period (PE) must be quantified by summing the emissions for all SSRs identified as included in the project in table 4.3 and using equation 5.33.

(c) SMM that is still vented in the project scenario is not accounted for in the project emissions or baseline emissions, since it is vented in both scenarios.

Equation 5.33: Project Emissions

$PE = PE_{EC} + PE_{MD} + PE_{UM}$

Where,

PE	=	Project emissions during the reporting period (MT CO_2e)
PE_{EC}	=	Project emissions from energy consumed to capture and destroy methane during the reporting period (MT CO_2e)
PE_{MD}	=	Project emissions from destruction of methane during the reporting period (MT CO_2e)

PE_{UM}	=	Project emissions from uncombusted methane during the reporting period (MT CO_2e)

(d) If the project uses fossil fuel or grid electricity to power additional equipment required for project activities (e.g., drilling and completing additional wells or boreholes, capturing and destroying mine gas, transporting mine gas, etc.), the resulting CO_2 emissions from the energy consumed to capture and destroy methane (PE_{EC}) must be quantified using equation 5.34.

(e) If the total electricity generated by project activities is greater than the additional electricity consumed for the capture and destruction of methane, then $CONS_{ELEC}$ = 0 in equation 5.34.

Equation 5.34: Project Emissions from Energy Consumed to Capture and Destroy Methane

$$PE_{EC} = (CONS_{ELEC} \times CEF_{ELEC}) + \frac{(CONS_{HEAT} \times CEF_{HEAT} + CONS_{FF} \times CEF_{FF})}{1000}$$

Where,

PE_{EC}	=	Project emissions from energy consumed to capture and destroy methane during the reporting period (MT CO_2e)
$CONS_{ELEC}$	=	Additional electricity consumption for the capture and destruction of methane during the reporting period (MWh)
CEF_{ELEC}	=	CO_2 emission factor of electricity used from appendix A (MT CO_2e/MWh)
$CONS_{HEAT}$	=	Additional heat consumption for the capture and destruction of methane during the reporting period (volume)
CEF_{HEAT}	=	CO_2 emission factor of heat used from appendix A (kg CO_2/volume)
$CONS_{FF}$	=	Additional fossil fuel consumption for the capture and destruction of methane during the reporting period (volume)
CEF_{FF}	=	CO_2 emission factor of fossil fuel used from appendix A (kg CO_2/volume)
1/1000	=	Conversion of kg to metric tons

(f) Project emissions from the destruction of methane (PE_{MD}) must be quantified using equation 5.35.

(g) Project emissions must include the CO_2 emissions resulting from the destruction of all MG that took place during the reporting period regardless of whether or not the well is mined through by the end of the reporting period.

Equation 5.35: Project Emissions from Destruction of SMM

$PE_{MD} = \sum_{i} MD_{P,i} \times CEF_{CH4}$

Where,

PE_{MD}	=	Project emissions from destruction of methane during the reporting period (MT CO_2e)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by all qualifying and non-qualifying destruction devices
$MD_{P,i}$	=	Methane destroyed through use i by qualifying and non-qualifying devices during the reporting period (MT CH_4)
CEF_{CH4}	=	CO_2 emission factor for combusted methane (2.744 MT CO_2e/MT CH_4)

(h) The amount of mine methane destroyed (MD_i) must be quantified using equation 5.36.

(i) Offset Project Operators and Authorized Project Designees may choose to use default methane destruction efficiencies (DE_i) provided in appendix B or site-specific methane destruction efficiencies. Destruction technologies not listed in appendix B must use site-specific methane destruction efficiencies. Site-specific methane destruction efficiencies that are demonstrated to the satisfaction of the Executive Officer to be equally or more accurate than the default methane destruction efficiencies may be used upon written approval by the Executive Officer.

Equation 5.36: Methane Destroyed

$MD_{P,i} = (MM_{P,i} \times DE_i)$

Where,

$MD_{P,i}$	=	Methane destroyed through use i by qualifying and non-qualifying devices during the reporting period; calculated separately for each destruction device (MT CH_4)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by all qualifying and non-qualifying destruction devices
$MM_{P,i}$	=	Measured methane sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (MT CH_4)
DE_i	=	Efficiency of methane destruction device i, either site-specific or from appendix B (%)

With:

$MM_{P,i}$ = ($PSW_{P,all,i}$ x C_{CH4} + $PIB_{P,i}$ x C_{CH4} + $ECW_{P,all,i}$ x C_{CH4} + $AWR_{P,all,i}$ x C_{CH4} x $CDW_{P,all,i,}$ x C_{CH4}) x 0.0423 x 0.000454

Where,

$PSW_{P,all,i}$ = Volume of MG from pre-mining surface wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)

$PIB_{P,i}$ = Volume of MG from pre-mining in-mine boreholes sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)

$ECW_{P,all,i}$ = Volume of MG from existing coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)

$AWR_{P,all,i}$ = Volume of MG from abandoned wells that are reactivated sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)

$CDW_{P,all,i}$ = Volume of MG from converted dewatering wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)

C_{CH4} = Weighted average of measured methane concentration of mine gas sent to qualifying and non-qualifying destruction devices during the reporting period; calculated separately for each methane source (scf CH_4/scf)

0.0423 = Standard density of methane (lb CH_4/scf CH_4)

0.000454 = MT CH_4/lb CH_4

With:

$$C_{CH4} = \frac{\sum_t (DV_t \times C_{CH4,t})}{\sum_t DV_t}$$

Where,

$C_{CH4,t}$ = Daily average methane concentration of mine gas sent to a destruction device (scf CH_4/scf)

DV_t = Daily volume of mine gas sent to a destruction device (scf)

Methane concentrations and flow rates must be recorded every two minutes with averages calculated at least hourly. If the Offset Project Operator or Authorized Project Designee monitors and records data at a higher frequency, this data may be used within

appropriate variables of the above equations to reflect the higher frequency of data collection.

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 and the methane concentration must be in mass percent.

(j) Project emissions from uncombusted methane (PE_{UM}) must be quantified using equation 5.37.

(k) Project emission from uncombusted methane must include emissions from all MG sent to destruction devices during the reporting period regardless of whether or not the well is mined through by the end of the reporting period.

(l) Offset Project Operators and Authorized Project Designees may choose to use default methane destruction efficiencies (DE_i) provided in appendix B or site-specific methane destruction efficiencies. Destruction technologies not listed in appendix B must use site-specific methane destruction efficiencies. Site-specific methane destruction efficiencies that are demonstrated to the satisfaction of the Executive Officer to be equally or more accurate than the default methane destruction efficiencies may be used upon written approval by the Executive Officer.

Equation 5.37: Project Emissions from Uncombusted Methane

$$PE_{UM} = \sum_{i} [MM_{P,i} \times (1 - DE_i)] \times GWP_{CH4}$$

Where,

PE_{UM}	=	Project emissions from uncombusted methane during the reporting period (MT CO_2e)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by all qualifying and non-qualifying destruction devices
$MM_{P,i}$	=	Measured methane sent to qualifying and non-qualifying devices for destruction through use i during the reporting period; calculated separately for each destruction device (MT CH_4)
DE_i	=	Efficiency of methane destruction device i, either site-specific or from appendix B (%)
GWP_{CH4}	=	Global warming potential of methane (MT CO_2e/MT CH_4)

With:

$MM_{P,i}$ = ($PSW_{P,all,i}$ x C_{CH4} + $PIB_{P,i}$ x C_{CH4} + $ECW_{P,all,i}$ x C_{CH4} + $AWR_{P,all,i}$ x C_{CH4} x $CDW_{P,all,i,}$ x C_{CH4}) x 0.0423 x 0.000454

Where,

$PSW_{P,all,i}$ = Volume of MG from pre-mining surface wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)

$PIB_{P,i}$ = Volume of MG from pre-mining in-mine boreholes sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)

$ECW_{P,all,i}$ = Volume of MG from existing coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)

$AWR_{P,all,i}$ = Volume of MG from abandoned wells that are reactivated sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)

$CDW_{P,all,i}$ = Volume of MG from converted dewatering wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)

C_{CH4} = Weighted average of measured methane concentration of mine gas sent to qualifying and non-qualifying destruction devices during the reporting period; calculated separately for each methane source (scf CH_4/scf)

0.0423 = Standard density of methane (lb CH_4/scf CH_4)

0.000454 = MT CH_4/lb CH_4

With:

$$C_{CH4} = \frac{\sum_t (DV_t \times C_{CH4,t})}{\sum_t DV_t}$$

Where,

$C_{CH4,t}$ = Daily average methane concentration of mine gas sent to a destruction device (scf CH_4/scf)

DV_t = Daily volume of mine gas sent to a destruction device (scf)

Methane concentrations and flow rates must be recorded every two minutes with averages calculated at least hourly. If the Offset Project Operator or Authorized Project Designee monitors and records data at a higher frequency, this data may be used within appropriate variables of the above equations to reflect the higher frequency of data collection.

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 and the methane concentration must be in mass percent.

(m) If gas flow metering equipment provides an actual flow rate or volume instead of a flow rate or volume adjusted to standard conditions, use equation 5.38 to standardize the amount of MG sent to each qualifying and non-qualifying device during the reporting period.

Equation 5.38: MG Flow Rate or Volume Adjusted for Temperature and Pressure

$$MG_{adjusted,y} = MG_{actual,y} \times \frac{519.67}{T_{MG,y}} \times \frac{P_{MG,y}}{1}$$

Where,

$MG_{adjusted,y}$	=	Average flow rate or total volume of MG sent to a destruction device during time interval y, adjusted to standard conditions (scfm)
$MG_{actual,y}$	=	Measured average flow rate or total volume of MG sent to a destruction device during time interval y (acfm)
$T_{MG,y}$	=	Measured absolute temperature of MG for the time interval y, °R=°F + 459.67 (°R)
$P_{MG,y}$	=	Measured absolute pressure of MG for the time interval y (atm)

5.4. Abandoned Underground Mine Methane Recovery Activities

(a) GHG emission reductions for a reporting period (ER) must be quantified by subtracting the project emissions for that reporting period (PE) from the baseline emissions for that reporting period (BE) and applying an uncertainty deduction (UD) using equation 5.39.

(b) Abandoned underground mine methane recovery activities that meet the following conditions are not subject to an uncertainty deduction and should calculate GHG emission reductions for a reporting period (ER) using an uncertainty deduction (UD) equal to 1:

(1) The project uses hyperbolic emission rate decline curve coefficients derived from mine-specific data measured from pre-existing wells or boreholes open to the atmosphere according to the provisions of section 5.4.1(u); or

(2) The project extracts methane exclusively from mines that utilized methane drainage systems when active.

Equation 5.39: GHG Emission Reductions

$ER = (BE - PE) \times UD$

Where,

ER	=	Emission reductions achieved by the project during the reporting period (MT CO_2e)
BE	=	Baseline emissions during the reporting period (MT CO_2e)
PE	=	Project emissions during the reporting period (MT CO_2e)
UD	=	Uncertainty deduction; UD = 0.8 if using default hyperbolic emission rate decline curve coefficients and the mine did not utilize a methane drainage system when active, UD = 1 if using default hyperbolic emission rate decline curve coefficients and the abandoned mine utilized a methane drainage system when active, UD = 1 if using hyperbolic emission rate decline curve coefficients derived from measured data from pre-existing wells or boreholes open to the atmosphere

5.4.1 Quantifying Baseline Emissions

(a) Baseline emissions for a reporting period (BE) must be estimated by summing the baseline emissions for all SSRs identified as included in the baseline in table 4.4 and using equation 5.40.

(b) The emission reductions in any given reporting period must be equal to or less than the baseline emissions for that reporting period.

Equation 5.40: Baseline Emissions

$BE = BE_{MD} + BE_{MR}$

Where,

BE	=	Baseline emissions during the reporting period (MT CO_2e)
BE_{MD}	=	Baseline emissions from destruction of methane during the reporting period (MT CO_2e)
BE_{MR}	=	Baseline emissions from release of methane into the atmosphere during the reporting period (MT CO_2e)

(c) Baseline emissions from the destruction of AMM (BE_{MD}) must be quantified using equation 5.41.

(d) BE_{MD} must include the estimated CO_2 emissions from the destruction of AMM in non-qualifying devices.

(e) If there is no destruction of methane in the baseline, then $BE_{MD} = 0$.

Equation 5.41: Baseline Emissions from Destruction of Methane

$$BE_{MD} = \sum_i MD_{B,i} \times CEF_{CH4}$$

Where,

BE_{MD}	=	Baseline emissions from destruction of methane during the reporting period (MT CO_2e)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by non-qualifying destruction devices
$MD_{B,i}$	=	Methane that would have been destroyed through use i by non-qualifying devices during the reporting period (MT CH_4)
CEF_{CH4}	=	CO_2 emission factor for combusted methane (2.744 MT CO_2e/MT CH_4)

(f) The amount of methane that would have been destroyed by non-qualifying devices ($MD_{B,i}$) must be quantified using equation 5.42.

(g) MG can originate from four distinct sources for abandoned underground mine methane recovery activities: pre-mining surface wells drilled into the mine during active mining operations, pre-mining in-mine boreholes drilled into the mine during active mining operations, post-mining gob wells drilled into the mine during active mining operations, and newly drilled surface wells. MG from these sources must be measured and accounted for individually per the equations in this section.

(h) For the purpose of baseline quantification, only non-qualifying destruction devices that were operating during the year prior to offset project commencement should be taken into account.

(i) For each eligible methane source, the volume or mass of MG that would have been sent to a non-qualifying device for destruction during the reporting period in the baseline must be determined by calculating and comparing:

(1) The volume or mass of MG sent to non-qualifying destruction devices during the current reporting period, adjusted for temperature and pressure using equation 5.50, if applicable;

(2) The volume or mass of MG sent to non-qualifying destruction devices during the three-year period prior to offset project commencement (or during the length of time the devices are operational, if less than three years), adjusted for temperature and pressure using equation 5.50, if applicable and averaged according to the length of the reporting period; and

(3) The volume or mass of MG sent to non-qualifying destruction devices during the time period a law, regulation, or legally binding mandate, in place for less than three years prior to offset project commencement, was in effect, adjusted for temperature and pressure using equation 5.50, if applicable, and averaged according to the length of the reporting period.

(j) For each methane source, the largest of the three quantities determined in sections 5.4.1(i)(1)-(3) must be used for volume of MG that would have been sent to a non-qualifying device for destruction through use i during the reporting period in the baseline scenario ($PSW_{B,i}$, $PIB_{B,i}$, $PGW_{B,i}$, and $NSW_{B,i}$) in equation 5.42

(k) If using a quantity for $PSW_{B,i}$, $PIB_{B,i}$, $PGW_{B,i}$, and $NSW_{B,i}$ determined by section 5.4.1(i)(1), data for daily volume of mine gas (DV_t) and methane concentration of mine gas ($C_{CH4,t}$) must be monitored for the non-qualifying destruction devices and used in equation 5.42.

(l) If using a quantity for $PSW_{B,i}$, $PIB_{B,i}$, $PGW_{B,i}$, and $NSW_{B,i}$ determined by section 5.4.1(i)(2) or 5.4.1(i)(3), historical data for daily volume of mine gas (DV_t), and methane concentration of mine gas ($C_{CH4,t}$) must be used in equation 5.2, if available.

(m) If using a quantity for $PSW_{B,i}$, $PIB_{B,i}$, $PGW_{B,i}$, and $NSW_{B,i}$ determined by section 5.4.1(i)(2) or 5.4.1(i)(3), and historical data for daily volume of mine gas (DV_t) is not available, the highest single day volume of mine gas sent to any qualifying or non-qualifying destruction device during the reporting period must be used in place of historical data.

(n) If using a quantity for $PSW_{B,i}$, $PIB_{B,i}$, $PGW_{B,i}$, and $NSW_{B,i}$ determined by section 5.4.1(i)(2) or 5.4.1(i)(3), and historical data for methane concentration of mine

gas ($C_{CH4,t}$) is not available, the highest single-hour average methane concentration during the reporting period must be used in place of historical data.

(o) Offset Project Operators and Authorized Project Designees may choose to use default methane destruction efficiencies (DE_i) provided in appendix B or site-specific methane destruction efficiencies. Destruction technologies not listed in appendix B must use site-specific methane destruction efficiencies. Site-specific methane destruction efficiencies that are demonstrated to the satisfaction of the Executive Officer to be equally or more accurate than the default methane destruction efficiencies may be used upon written approval by the Executive Officer.

Equation 5.42: Methane Destroyed in Baseline

$MD_{B,i} = (MM_{B,i} \times DE_i)$

Where,

$MD_{B,i}$	=	Methane that would have been destroyed through use i by non-qualifying devices during the reporting period; calculated separately for each destruction device (MT CH_4)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by non-qualifying destruction devices
$MM_{B,i}$	=	Measured methane that would have been sent to non-qualifying devices for destruction through use i during the reporting period (MT CH_4)
DE_i	=	Efficiency of methane destruction device i, either site-specific or from appendix B (%)

With:

$MM_{B,i} = (PSW_{B,i} \times C_{CH4} + PIB_{B,i} \times C_{CH4} + PGW_{B,i} \times C_{CH4} \times NSW_{B,i} \times C_{CH4}) \times 0.0423 \times 0.000454$

Where,

$PSW_{B,i}$	=	Volume of MG from pre-mining surface wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period (scf)
$PIB_{B,i}$	=	Volume of MG from pre-mining in-mine boreholes that would have been sent to non-qualifying devices for destruction through use i during the reporting period (scf)

$PGW_{B,i}$	=	Volume of MG from post-mining gob wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period (scf)
$NSW_{B,i}$	=	Volume of MG from newly drilled surface wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period (scf)
C_{CH4}	=	Weighted average of measured methane concentration of mine gas that would have been sent to non-qualifying destruction devices during the reporting period; calculated separately for each methane source (scf CH_4/scf)
0.0423	=	Standard density of methane (lb CH_4/scf CH_4)
0.000454	=	MT CH_4/lb CH_4

With:

$$C_{CH4} = \frac{\sum_t (DV_t \times C_{CH4,t})}{\sum_t DV_t}$$

Where,

$C_{CH4,t}$	=	Daily average methane concentration of mine gas sent to a destruction device (scf CH_4/scf)
DV_t	=	Daily volume of mine gas sent to a destruction device (scf)

Methane concentrations and flow rates must be recorded every two minutes with averages calculated at least hourly. If the Offset Project Operator or Authorized Project Designee monitors and records data at a higher frequency, this data may be used within appropriate variables of the above equations to reflect the higher frequency of data collection.

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 and the methane concentration must be in mass percent.

(p) Baseline emissions from the release of methane (BE_{MR}) must be quantified using equation 5.43. Calculations include the application of a hyperbolic emissions rate decline curve. The function is directly related the gassiness of the mine, which is reflective of physical parameters of the coal mine such as the mine size, gas content of the coal, permeability of the coal to the flow of gas.

(q) The decline curve estimates the emission rate of an abandoned mine over time by taking into account the time elapsed since mine closure, the average methane emission rate calculated using available data collected by MSHA over the life of

the mine, and whether the mine is sealed or venting. The decline curve for a given mine is initialized at the date of abandonment and extrapolated through the crediting period.

(r) The amount of AMM released in the baseline scenarios (MT CH_4) must be determined by calculating and comparing:

(1) The emissions of methane for that reporting period calculated by the decline curve using equation 5.44; and

(2) The total amount of measured methane sent to all qualifying and non-qualifying devices during the reporting period ($MM_{P,i}$) calculated using equation 5.48.

(s) AMM that is still vented in the project scenario is not accounted for in the project emissions or baseline emissions, since it is vented in both scenarios.

Equation 5.43: Baseline Emissions from Release of Methane

$$BE_{MR} = \left[\min\left(AMM_{DC}, \sum_i MM_{P,i}\right) - \sum_i MM_{B,i}\right] \times GWP_{CH4}$$

Where,

BE_{MR}	=	Baseline emissions from release of methane into the atmosphere avoided by the project during the reporting period (MT CO_2e)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by all qualifying and non-qualifying destruction devices
AMM_{DC}	=	Emissions of methane during the reporting period as calculated by the decline curve (MT CH_4)
$MM_{P,i}$	=	Measured methane sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (MT CH_4)
$MM_{B,i}$	=	Measured methane that would have been sent to non-qualifying devices for destruction through use i during the reporting period (MT CH_4)
GWP_{CH4}	=	Global warming potential of methane (MT CO_2e/MT CH_4)

Equation 5.44: Methane Emissions Derived from the Hyperbolic Emission Rate Decline Curve

AMM_{DC} = $ER_{AMM} \times S \times (1 + b \times D_i \times t)^{\left(\frac{-1}{b}\right)} \times RP_{days} \times 0.0423 \times 0.000454$

Where,

AMM_{DC}	=	Emissions of methane during the reporting period (MT CH_4)
ER_{AMM}	=	Average ventilation air methane emission rate over the life of the mine (Mscf/d)
S	=	Default effective degree of sealing; S = 1 for venting mines and 0.5 for sealed mines
b	=	Dimensionless hyperbolic exponent
D_i	=	Initial decline rate (1/day)
t	=	Time elapsed from the date of mine closure to midpoint of the reporting period (days)
RP_{days}	=	Days in reporting period
0.0423	=	Standard density of methane (lb CH_4/scf CH_4)
0.000454	=	MT CH_4/lb CH_4

(t) The decline curve relies upon hyperbolic emission rate decline curve coefficients. Offset Project Operators or Authorized Project Designees may elect to:

(1) Use the default hyperbolic emission rate decline curve coefficients presented in table 5.1 based upon whether the mine is venting or sealed; or

(2) Use hyperbolic emission rate decline curve coefficients derived from measured data from pre-existing wells or boreholes open to the atmosphere that are demonstrated to the satisfaction of the Executive Officer to be equally or more accurate than the default hyperbolic emission rate decline curve coefficients upon written approval by the Executive Officer. If natural gas seeps are present, an Offset Project Operator or Authorized Project Designee may also include measured data from those emissions.

Table 5.1: Default Hyperbolic Decline Curve Coefficients

Variable	Venting	Sealed
b	1.886581	2.016746
D_i (1/day)	0.003519	0.000835

(u) To derive hyperbolic emission rate decline curve coefficients using measured data from pre-existing wells or boreholes open to the atmosphere and natural

gas seeps, an Offset Project Operator or Authorized Project Designee must do the following:

(1) Obtain average methane emission rate calculated using available data collected by MSHA over the life of the mine.

(2) After mine closure, three parameters must be monitored:

  (A) MG flow rates;

  (B) local barometric pressure; and

  (C) methane concentration of MG.

(3) Measurements must be of natural flow only with no assist from vacuum pumps or compressors.

(4) If gas flow metering equipment provides an actual flow rate instead of a flow rate adjusted to standard conditions, apply equation 5.50 to standardize the flow rate of MG venting from pre-existing wells or boreholes open to the atmosphere and natural gas seeps.

(5) The monitored data must be used to develop a correlation between barometric pressure and methane flow rate. Annual average barometric pressure at the site must then be used to normalize the annual methane flow rate.

(6) This normalized flow rate must then be plotted against the time since mine closure in order to derive the hyperbolic emission rate decline curve by fitting the data to a curve in the form of equation 5.44.

5.4.2. Quantifying Project Emissions

(a) Project emissions must be quantified over a consecutive twelve month period.

(b) Project emissions for a reporting period (PE) must be quantified by summing the emissions for all SSRs identified as included in the project in table 4.4 and using equation 5.45.

(c) AMM that is still vented in the project scenario is not accounted for in the project emissions or baseline emissions, since it is vented in both scenarios.

Equation 5.45: Project Emissions

$PE = PE_{EC} + PE_{MD} + PE_{UM}$

Where,

PE	=	Project emissions during the reporting period (MT CO_2e)
PE_{EC}	=	Project emissions from energy consumed to capture and destroy methane during the reporting period (MT CO_2e)
PE_{MD}	=	Project emissions from destruction of methane during the reporting period (MT CO_2e)
PE_{UM}	=	Project emissions from uncombusted methane during the reporting period (MT CO_2e)

(d) If the project uses fossil fuel or grid electricity to power additional equipment required for project activities (e.g., drilling and completing additional wells or boreholes, capturing and destroying mine gas, transporting mine gas, etc.), the resulting CO_2 emissions from the energy consumed to capture and destroy methane (PE_{EC}) must be quantified using equation 5.46.

(e) If the total electricity generated by project activities is greater than the additional electricity consumed for the capture and destruction of methane, then $CONS_{ELEC}$ = 0 in equation 5.46.

Equation 5.46: Project Emissions from Energy Consumed to Capture and Destroy Methane

$$PE_{EC} = (CONS_{ELEC} \times CEF_{ELEC}) + \frac{(CONS_{HEAT} \times CEF_{HEAT} + CONS_{FF} \times CEF_{FF})}{1000}$$

Where,

PE_{EC}	=	Project emissions from energy consumed to capture and destroy methane during the reporting period (MT CO_2e)
$CONS_{ELEC}$	=	Additional electricity consumption for the capture and destruction of methane during the reporting period (MWh)
CEF_{ELEC}	=	CO_2 emission factor of electricity used from appendix A (MT CO_2e/MWh)
$CONS_{HEAT}$	=	Additional heat consumption for the capture and destruction of methane during the reporting period (volume)
CEF_{HEAT}	=	CO_2 emission factor of heat used from appendix A (kg CO_2/volume)
$CONS_{FF}$	=	Additional fossil fuel consumption for the capture and destruction of methane during the reporting period (volume)
CEF_{FF}	=	CO_2 emission factor of fossil fuel used from appendix A (kg CO_2/volume)
1/1000	=	Conversion of kg to metric tons

(f) Project emissions from the destruction of methane (PE_{MD}) must be quantified using equation 5.47.

Equation 5.47: Project Emissions from Destruction of Captured Methane

$$PE_{MD} = \sum_{i} MD_{P,i} \times CEF_{CH4}$$

Where,

PE_{MD}	=	Project emissions from destruction of methane during the reporting period (MT CO_2e)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by all qualifying and non-qualifying destruction devices
$MD_{P,i}$	=	Methane destroyed through use i by qualifying and non-qualifying devices during the reporting period (MT CH_4)
CEF_{CH4}	=	CO_2 emission factor for combusted methane (2.744 MT CO_2e/MT CH_4)

(g) The amount of methane destroyed ($MD_{P,i}$) must be quantified using equation 5.48.

(h) Offset Project Operators and Authorized Project Designees may choose to use default methane destruction efficiencies (DE_i) provided in appendix B or site-specific methane destruction efficiencies. Destruction technologies not listed in appendix B must use site-specific methane destruction efficiencies. Site-specific methane destruction efficiencies that are demonstrated to the satisfaction of the Executive Officer to be equally or more accurate than the default methane destruction efficiencies may be used upon written approval by the Executive Officer.

Equation 5.48: Methane Destroyed

$$MD_{P,i} = (MM_{P,i} \times DE_i)$$

Where,

$MD_{P,i}$	=	Methane destroyed through use i by qualifying and non-qualifying devices during the reporting period; calculated separately for each destruction device (MT CH_4)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by all qualifying and non-qualifying destruction devices

$MM_{P,i}$ = Measured methane sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (MT CH_4)

DE_i = Efficiency of methane destruction device i, either site-specific or from appendix B (%)

With:

$MM_{P,i} = (PSW_{P,i} \times C_{CH4} + PIB_{P,i} \times C_{CH4} + PGW_{P,i} \times C_{CH4} + NSW_{P,i} \times C_{CH4}) \times 0.0423 \times 0.000454$

Where,

$PSW_{P,i}$ = Volume of MG from pre-mining surface wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)

$PIB_{P,i}$ = Volume of MG from pre-mining in-mine boreholes sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)

$PGW_{P,i}$ = Volume of MG from post-mining gob wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)

$NSW_{P,i}$ = Volume of MG from newly drilled surface wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)

C_{CH4} = Weighted average of measured methane concentration of mine gas sent to qualifying and non-qualifying destruction devices during the reporting period; calculated separately for each methane source (scf CH_4/scf)

0.0423 = Standard density of methane (lb CH_4/scf CH_4)

0.000454 = MT CH_4/lb CH_4

With:

$$C_{CH4} = \frac{\sum_t (DV_t \times C_{CH4,t})}{\sum_t DV_t}$$

Where,

$C_{CH4,t}$ = Daily average methane concentration of mine gas sent to a destruction device (scf CH_4/scf)

DV_t = Daily volume of mine gas sent to a destruction device (scf)

Methane concentrations and flow rates must be recorded every two minutes with averages calculated at least hourly. If the Offset Project Operator or Authorized Project Designee monitors and records data at a higher frequency, this data may be used within

appropriate variables of the above equations to reflect the higher frequency of data collection.

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 and the methane concentration must be in mass percent.

(i) Project emissions from uncombusted methane (PE_{UM}) must be quantified using equation 5.49.

(j) Offset Project Operators and Authorized Project Designees may choose to use default methane destruction efficiencies (DE_i) provided in appendix B or site-specific methane destruction efficiencies. Destruction technologies not listed in appendix B must use site-specific methane destruction efficiencies. Site-specific methane destruction efficiencies that are demonstrated to the satisfaction of the Executive Officer to be equally or more accurate than the default methane destruction efficiencies may be used upon written approval by the Executive Officer.

Equation 5.49: Uncombusted Methane Emissions

$$PE_{UM} = \sum_{i} [MM_{P,i} \times (1 - DE_i)] \times GWP_{CH4}$$

Where,

PE_{UM}	=	Project emissions from uncombusted methane during the reporting period (MT CO_2e)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline etc.) by all qualifying and non-qualifying destruction devices
$MM_{P,i}$	=	Measured methane sent to qualifying and non-qualifying devices for destruction through use i during the reporting period; calculated separately for each destruction device (MT CH_4)
DE_i	=	Efficiency of methane destruction device i, either site-specific or from appendix B (%)
GWP_{CH4}	=	Global warming potential of methane (MT CO_2e/MT CH_4)

With:

$$MM_{P,i} = (PSW_{P,i} \times C_{CH4} + PIB_{P,i} \times C_{CH4} + PGW_{P,i} \times C_{CH4} + NSW_{P,i} \times C_{CH4}) \times 0.0423 \times 0.000454$$

Where,

$PSW_{P,i}$	=	Volume of MG from pre-mining surface wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)
$PIB_{P,i}$	=	Volume of MG from pre-mining in-mine boreholes sent to by qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)
$PGW_{P,i}$	=	Volume of MG from post-mining gob wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)
$NSW_{P,i}$	=	Volume of MG from newly drilled surface wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)
C_{CH4}	=	Weighted average of measured methane concentration of mine gas sent to qualifying and non-qualifying destruction devices during the reporting period; calculated separately for each methane source (scf CH_4/scf)
0.0423	=	Standard density of methane (lb CH_4/scf CH_4)
0.000454	=	MT CH_4/lb CH_4

With:

$$C_{CH4} = \frac{\sum_t (DV_t \times C_{CH4,t})}{\sum_t DV_t}$$

Where,

$C_{CH4,t}$	=	Daily average methane concentration of mine gas sent to a destruction device (scf CH_4/scf)
DV_t	=	Daily volume of mine gas sent to a destruction device (scf)

Methane concentrations and flow rates must be recorded every two minutes with averages calculated at least hourly. If the Offset Project Operator or Authorized Project Designee monitors and records data at a higher frequency, this data may be used within appropriate variables of the above equations to reflect the higher frequency of data collection.

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 and the methane concentration must be in mass percent.

(k) If gas flow metering equipment provides an actual flow rate or volume instead of a flow rate or volume adjusted to standard conditions, use equation 5.50 to standardize the amount of MG sent to each qualifying and non-qualifying device

during the reporting period and MG flow rates, if deriving hyberbolic emission rate decline curve coefficients from measured data.

Equation 5.50: MG Flow Rate or Volume Adjusted for Temperature and Pressure

$$MG_{adjusted,y} = MG_{actual,y} \times \frac{519.67}{T_{MG,y}} \times \frac{P_{MG,y}}{1}$$

Where,

$MG_{adjusted,y}$	=	Average flow rate or total volume of MG sent to a destruction device during time interval y, adjusted to standard conditions (scfm or scf)
$MG_{actual,y}$	=	Measured average flow rate or total volume of MG sent to a destruction device during time interval y (acfm or acf)
$T_{MG,y}$	=	Measured absolute temperature of MG for the time interval y, °R=°F + 459.67 (°R)
$P_{MG,y}$	=	Measured absolute pressure of MG for the time interval y (atm)

Chapter 6. Monitoring – Quantification Methodology

6.1. General Monitoring Requirements

(a) The Offset Project Operator or Authorized Project Designee is responsible for monitoring the performance of the offset project and operating each component of the collection and destruction system(s) in a manner consistent with the manufacturer's specifications.

(b) Operational activity of the methane drainage and ventilation systems and the destruction devices must be monitored and documented at least hourly to ensure actual methane destruction. GHG reductions will not be accounted for during periods in which the destruction device is not operational.

(1) For flares, operation is defined as thermocouple readings above 500°F.

(2) For all other destruction devices, the Offset Project Operator or Authorized Project Designee must demonstrate the destruction device was operational. This demonstration is subject to the review and verification of an ARB-approved third party offset project verification body.

(c) If gas flow metering equipment does not internally adjust for temperature and pressure, flow data must be adjusted according to the appropriate quantification methodologies in chapter 5.

(d) If a project uses elevated amounts of atmospheric gases in extracted MG as evidence of a pre-mining well being mined through, nitrogen and oxygen concentrations must be determined for each well at the time of offset project commencement and when the Offset Project Operator or Authorized Project Designee reports a pre-mining well as eligible. Gas samples must be collected by a third-party technician and amounts of nitrogen and oxygen concentrations determined by a full gas analysis using a chromatograph at an ISO 17025 accredited lab or a lab that has been certified by an accreditation body conformant with ISO 17025 to perform test methods appropriate for atmospheric gas content analysis.

(e) Data substitution is allowed for limited circumstances where a project encounters flow rate or methane concentration data gaps. _Offset Project Operators or Authorized Project Designees may apply the data substitution methodology provided in appendix C. No data substitution is permissible for data gaps resulting from inoperable equipment that monitors the proper functioning of destruction devices and no emission reductions will be credited under such circumstances.

6.2. Instrument QA/QC

Instruments and equipment used to monitor the destruction of mine methane or the temperature and pressure used to adjust data measurements to STP must be inspected, maintained, checked and calibrated according to the following:

(a) All instruments must be:

(1) Inspected and maintained on a quarterly basis, with the activities performed and “as found/as left condition” of the equipment documented;

(2) Checked per manufacturer specifications by a trained professional for calibration accuracy with the percent drift documented, with the last check of the reporting period occurring no more than two months before and one day after the end date of the reporting period; and

(3) Calibrated by the manufacturer or a certified calibration service per manufacturer’s specifications or every 5 years, whichever is more

frequent. Instruments are exempted from calibration requirements if the manufacturer's specifications state that no calibration is required.

(b) A check must be performed before any corrective action (e.g., instrument calibration or repositioning) is applied.

(c) If a portable instrument is used (such as a pitot tube or handheld methane analyzer), the portable instrument must be calibrated according to manufacturer's specifications prior to each use.

(d) For active underground VAM activities, the methane concentration of the reference gas used to check methane analyzers must be below or equal to 2% methane.

(e) Flow meter and methane analyzer calibrations must be documented to show that the calibration was carried out to the range of conditions corresponding to the range of conditions as measured at the mine.

(f) If the check on a piece of equipment reveals accuracy beyond a +/- 5% threshold (reading relative to the reference value), corrective action such as calibration by the manufacturer or a certified service provider is required for that piece of equipment.

(g) If a check on a piece of equipment reveals accuracy beyond a +/- 5% threshold, all data from that piece of equipment must be scaled according to the following procedure. These adjustments must be made for the entire period from the last successful check until such time as corrective action is taken and a subsequent check demonstrates the equipment to again be within the +/-5% accuracy threshold.

(1) For each check that indicates the piece of equipment was beyond the +/- 5% accuracy threshold, the project developer shall calculate total emission reductions using:

(A) The monitored values without correction; and

(B) The monitored values adjusted based on the calibration drift recorded at the time of the check.

(2) The lower of the two emission reduction estimates shall be reported as the scaled emission reduction estimate.

6.3. Document Retention

(a) The Offset Project Operator or Authorized Project Designee is required to keep all documentation and information outlined in the Regulation and this protocol. Record retention requirements are set forth in section 95976 of the Regulation.

(b) Information that must be retained by the Offset Project Operator or Authorized Project Designee must include:

(1) All data inputs for the calculation of the project baseline emissions and project emission reductions;

(2) Emission reduction calculations;

(3) NOVs, and any administrative or legal consent orders related to project activities dating back at least three years prior to offset project commencement and for each year of project operation;

(4) Gas flow meter information (model number, serial number, manufacturer's calibration procedures);

(5) Methane analyzer information (model number, serial number, calibration procedures);

(6) Cleaning and inspection records for all gas meters;

(7) Field check results for all gas meters and methane analyzers;

(8) Calibration results for all gas meters and methane analyzers;

(9) Corrective measures taken if meter does not meet performance specifications;

(10) Gas flow data (for each flow meter);

(11) Methane concentration monitoring data;

(12) Gas temperature and pressure readings (only if flow meter does not adjust for temperature and pressure automatically);

(13) Destruction device information (model numbers, serial numbers, installation date, operation dates);

(14) Destruction device monitoring data (for each destruction device);

(15) All maintenance records relevant to the methane collection and/or destruction device(s) and monitoring equipment;

(16) If using a calibrated portable gas analyzer for CH_4 content measurement the following records must be retained:

(A) Date, time, and location of methane measurement;

(B) Methane content of gas (% by volume or mass) for each measurement;

(C) Methane measurement instrument information (model number and serial number);

(D) Date, time, and results of instrument calibration; and

(E) Corrective measures taken if instrument does not meet performance specifications.

6.4. Active Underground Mine Ventilation Air Methane Activities

(a) The flow rate of ventilation air entering the destruction device must be measured continuously, recorded every two minutes, and adjusted for temperature and pressure, if applicable, to calculate average flow per hour.

(b) The methane concentration of the ventilation air entering the destruction device and of the exhaust gas leaving the destruction device must be measured continuously and recorded every two minutes to calculate average methane concentrations per hour.

(c) If required in order to standardize the flow rate, volume, or mass of ventilation air, the temperature and pressure in the vicinity of the flow meter must be measured continuously and recorded at least every hour to calculate hourly pressure and temperature.

(d) Offset Project Operators or Authorized Project Designees must monitor the parameters prescribed in table 6.1. Data measurements may be recorded in an alternative unit, but must be appropriately converted to specified unit for use in equations provided in chapter 5.

Table 6.1. Active Underground Mine VAM Activity Monitoring Parameters

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Measured (m) Calculated (c) Operating Records (o)	Comment
5.4 5.5	$VA_{B,i}$	Volume of ventilation air that would have been sent to a non-qualifying devices for destruction through use i during the reporting period	scf	Estimated at offset project commencement; calculated each reporting period if non-qualifying device continues to operate after project start	m, c	The largest of the three values calculated per section 5.1.1(g)
5.4 5.5 5.9	$C_{CH4,t}$	Hourly average methane concentration of ventilation air sent to a destruction device	scf CH_4/scf	Continuously	m, c	Readings taken every two minutes to calculate average methane concentration per hour
5.4 5.5 5.9	$VA_{flow,t}$	Hourly average flow rate of ventilation air sent to a destruction device	scfm	Continuously	m, c	Readings taken every two minutes to calculate average flow rate per hour; adjusted to standard conditions, if applicable, using equation 5.11
5.4 5.9 5.10	y	Hours during which the destruction device was operational during reporting period	h	Continuously	m	
5.4 5.9 5.10	$CA_{flow,i,y}$	Hourly average flow rate of cooling air sent to a destruction device after the metering point of the ventilation air stream during period y	scfm	Continuously	m, c	Readings taken every two minutes to calculate flow rate per hour; adjusted to standard conditions, if applicable using equation 5.11. If the flow of cooling air is not metered, the

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Measured (m) Calculated (c) Operating Records (o)	Comment
						maximum capacity of the air intake system must be used for the flow rate.
5.4 5.9 5.10	$C_{CH4,exhaust,\ y}$	Hourly average methane concentration of exhaust gas	scf CH_4/scf	Continuously	m, c	Readings taken every two minutes to calculate average methane concentration per hour
5.5 5.9	$VA_{P,i}$	Volume of ventilation air sent to qualifying and non-qualifying devices for destruction through use i during the reporting period	scf	Continuously	m, c	Adjusted to standard conditions, if applicable, using equation 5.11
5.5 5.9	$MG_{SUPP,i}$	Volume of mine gas extracted from a methane drainage system and sent with ventilation air to qualifying and non-qualifying devices for destruction during the reporting period	scf	Every reporting period	m, c	Adjusted to standard conditions, if applicable, using equation 5.11
5.5 5.9	$C_{CH4,MG,t}$	Daily average methane concentration of mine gas sent with ventilation air to destruction device	scf CH_4/scf	Continuously	m, c	Readings taken every 15 minutes to calculate average methane concentration per day
5.5 5.9	$DV_{MG,t}$	Daily volume of mine gas sent with ventilation air to destruction device	scf	Continuously	m, c	Readings taken every 15 minutes to calculate volume per day; adjusted to standard conditions, if applicable,

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Measured (m) Calculated (c) Operating Records (o)	Comment
						using equation 5.11
5.7	$CONS_{ELEC}$	Additional electricity consumption for the capture and destruction of methane during the reporting period	MWh	Every reporting period	o	From electricity use records
5.7	$CONS_{HEAT}$	Additional heat consumption for the capture and destruction of methane during the reporting period	Volume	Every reporting period	o	From heat use records
5.7	$CONS_{FF}$	Additional fossil fuel consumption for the capture and destruction of methane during the reporting period	Volume	Every reporting period	o	From fuel use records
5.9 5.10	$VA_{flow,i,y}$	Hourly average flow rate of ventilation air sent to a device for destruction through use i during the reporting period	scfm	Continuously	m, c	Readings taken every two minutes to calculate flow rate per hour; adjusted to standard conditions, if applicable using equation 5.11.
5.11	$VA_{actual,y}$	Measured average flow rate or total volume of ventilation air sent to a destruction device during period y	acfm or acf	Continuously	m, c	Readings taken every two minutes to calculate average flow rate per hour; adjusted to standard conditions, if applicable, using equation 5.11
5.11	$T_{VAinflow,y}$	Measured absolute temperature of ventilation air	°R	Continuously	m, c	Readings taken at least every hour to calculate

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Measured (m) Calculated (c) Operating Records (o)	Comment
		sent to a destruction device for the time interval y, °R=°F + 459.67				temperature for time interval y
5.11	$P_{VAinflow,y}$	Measured absolute pressure of ventilation air sent to a destruction device for the time interval y	atm	Continuously	m, c	Readings taken at least every hour to calculate pressure for time interval y

6.5. Active Underground Mine Methane Drainage Activities

(a) Mine gas from each methane source (i.e., pre-mining surface wells, pre-mining in-mine boreholes, or post-mining gob wells) must be monitored separately prior to interconnection with other MG sources. The volumetric or mass gas flow, methane concentration, temperature, and pressure must be monitored and recorded separately for each methane source.

(b) The flow rate of MG sent to a destruction device must be measured continuously, recorded every 15 minutes, and adjusted for temperature and pressure, if applicable, to calculate daily volume of MG sent to a destruction device. The flow of mine gas to a destruction device must be monitored separately for each destruction device, unless:

(1) A project consists of destruction devices that are of identical efficiency and verified to be operational throughout the reporting period; then a single flow meter may be used to monitor gas flow to all destruction devices; or

(2) A project consists of destruction devices that are not of identical efficiency, in which case the methane destruction efficiency of the least efficient destruction device must be used as the methane destruction efficiency for all destruction devices monitored by that meter.

(c) If a project using a single meter to monitor gas flow to multiple destruction devices has any periods of time when not all destruction devices downstream of a single flow meter are operational, methane destruction from the set of downstream devices during these periods of time will only be eligible provided

that the offset verifier can confirm all of the following requirements and conditions are met:

(1) The methane destruction efficiency of the least efficient downstream destruction device in operation must be used as the methane destruction efficiency for all destruction devices downstream of the single meter;

(2) 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

(3) For any period of time 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.

(d) The methane concentration of the mine gas extracted from each methane source must be measured continuously and recorded every 15 minutes to calculate daily average methane concentration.

(e) If required in order to adjust the flow rate, volume, or mass of mine gas, the temperature and pressure of the mine gas from each methane source must be measured continuously and recorded at least every hour to calculate hourly temperature and pressure.

(f) Offset Project Operators or Authorized Project Designees must monitor the parameters prescribed in table 6.2. Data measurements may be recorded in an alternative unit, but must be appropriately converted to specified unit for use in equations provided in chapter 5.

Table 6.2. Active Underground Mine Methane Drainage Activity Monitoring Parameters

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Measured (m) Calculated (c) Operating Records (o) Reference (r)	Comment
5.15	DE_i	Efficiency of	%	Each reporting	r or m	Default

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Measured (m) Calculated (c) Operating Records (o) Reference (r)	Comment
5.21 5.22		methane destruction device i		period		methane destruction efficiencies provided in appendix B or site-specific methane destruction efficiencies approved by the Executive Officer
5.15 5.16	$PSW_{B,i}$	Volume of MG from pre-mining surface wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period	scf	Estimated at offset project commencement; calculated each reporting period if non-qualifying device continues to operate after project start	m, c	The largest of the three values calculated per section 5.2.1(h).
5.15 5.16	$PIB_{B,i}$	Volume of MG from pre-mining in-mine boreholes that would have been sent to non-qualifying devices for destruction through use i during the reporting period	scf	Estimated at offset project commencement; calculated each reporting period if non-qualifying device continues to operate after project start	m, c	The largest of the three values calculated per section 5.2.1(h)
5.15 5.16	$PGW_{B,i}$	Volume of MG from post-mining gob wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period	scf	Estimated at offset project commencement; calculated each reporting period if non-qualifying device continues to operate after project start	m, c	The largest of the three values calculated per section 5.2.1(h)
5.15 5.16 5.21 5.22	$C_{CH4,t}$	Daily average methane concentration of mine gas sent to a destruction device	scf CH_4/scf	Continuously	m, c	Readings taken every 15 minutes to calculate average methane concentration per day; calculated

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Measured (m) Calculated (c) Operating Records (o) Reference (r)	Comment
						separately for each methane source
5.15 5.16 5.21 5.22	DV_t	Daily volume of mine gas sent to a destruction device	scf	Continuously	m, c	Readings taken every 15 minutes to calculate volume per day; adjusted to standard conditions, if applicable, using equation 5.23. Calculated separately for each methane source.
5.16 5.21 5.22	$PIB_{P,i}$	Volume of MG from pre-mining in-mine boreholes sent to qualifying and non-qualifying devices for destruction through use i during the reporting period	scf	Every reporting period	m, c	Adjusted to standard conditions, if applicable, using equation 5.23
5.16 5.21 5.22	$PGW_{P,i}$	Volume of MG from post-mining gob wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period	scf	Every reporting period	m, c	Adjusted to standard conditions, if applicable, using equation 5.23
5.16 5.21 5.22	$MG_{SUPP,i}$	Volume of mine gas extracted from a methane drainage system and sent with ventilation air to qualifying and non-qualifying devices for destruction during	scf	Every reporting period	m, c	Adjusted to standard conditions, if applicable, using equation 5.23

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Measured (m) Calculated (c) Operating Records (o) Reference (r)	Comment
		the reporting period				
5.16 5.21 5.22	$C_{CH4,MG,t}$	Daily average methane concentration of mine gas sent with ventilation air to destruction device	scf CH_4/scf	Continuously	m, c	Readings taken every 15 minutes to calculate average methane concentration per day
5.16 5.21 5.22	$DV_{MG,t}$	Daily volume of mine gas sent with ventilation air to destruction device	scf	Continuously	m, c	Readings taken every 15 minutes to calculate volume per day; adjusted to standard conditions, if applicable, using equation 5.23
5.16	$PSWnqd_i$	Volume of MG from pre-mining surface wells sent to non-qualifying devices for destruction through use i during the reporting period	scf	Every reporting period	m, c	Adjusted to standard conditions, if applicable, using equation 5.23
5.17	$PSWe_{pre,i}$	Volume of MG sent to qualifying destruction devices, from the beginning of the crediting period through the end of the reporting period, captured from pre-mining surface wells that were mined through during the reporting period	scf	Every reporting period	m, c	Adjusted to standard conditions, if applicable, using equation 5.23
5.17	$PSWe_{post,i}$	Volume of MG sent to qualifying destruction devices in the reporting period captured from	scf	Every reporting period	m, c	Adjusted to standard conditions, if applicable, using equation 5.23

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Measured (m) Calculated (c) Operating Records (o) Reference (r)	Comment
		pre-mining surface wells that were mined through during earlier reporting periods				
5.19	$CONS_{ELEC}$	Additional electricity consumption for the capture and destruction of methane during the reporting period	MWh	Every reporting period	o	From electricity use records
5.19	$CONS_{HEAT}$	Additional heat consumption for the capture and destruction of methane during the reporting period	Volume	Every reporting period	o	From heat use records
5.19	$CONS_{FF}$	Additional fossil fuel consumption for the capture and destruction of methane during the reporting period	Volume	Every reporting period	o	From fuel use records
5.21 5.22	$PSW_{P,all,i}$	Volume of MG from pre-mining surface wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, all MG must be quantified regardless of whether or not the well is mined through by the end of the reporting period	scf	Every reporting period	m, c	Adjusted to standard conditions, if applicable, using equation 5.23
5.23	$MG_{actual,y}$	Measured average flow rate or total volume of	acfm or acf	Continuously	m	

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Measured (m) Calculated (c) Operating Records (o) Reference (r)	Comment
		MG sent to a destruction device during time interval y				
5.23	$T_{MG,y}$	Measured absolute temperature of MG for the time interval y, °R=°F + 459.67	°R	Continuously	m, c	Readings taken at least every hour to calculate temperature for time interval y
5.23	$P_{MG,y}$	Measured absolute pressure of MG for the time interval y	atm	Continuously	m, c	Readings taken at least every hour to calculate pressure for time interval y

6.6. Active Surface Mine Methane Drainage Activities

(a) Mine gas from each methane source (i.e., pre-mining surface wells, pre-mining in-mine boreholes, existing CBM wells that would otherwise be shut-in and abandoned as a result of encroaching mining, abandoned wells that reactivated, and converted dewatering wells) must be monitored separately prior to interconnection with other MG sources. The volumetric or mass gas flow, methane concentration, temperature, and pressure must be monitored and recorded separately for each methane source.

(b) The flow rate of MG sent to a destruction device must be measured continuously, recorded every 15 minutes, and adjusted for temperature and pressure, if applicable, to calculate daily volume of MG sent to a destruction device. The flow of gas to a destruction device must be monitored separately for each destruction device, unless:

(1) A project consists of destruction devices that are of identical efficiency and verified to be operational throughout the reporting period; then a single flow meter may be used to monitor gas flow to all destruction devices; or

(2) A project consists of destruction devices that are not of identical efficiency, in which case the methane destruction efficiency of the least efficient

methane destruction device must be used as the methane destruction efficiency for all destruction devices monitored by that meter.

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

(1) The methane destruction efficiency of the least efficient downstream destruction device in operation must be used as the methane destruction efficiency for all destruction devices downstream of the single meter;

(2) 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

(3) For any period of time 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.

(d) The methane concentration of the SMM extracted from each methane source must be measured continuously and recorded every 15 minutes to calculate daily average methane concentration.

(e) If required in order to adjust the flow rate, volume, or mass of mine gas, the temperature and pressure of the SMM must be measured continuously and recorded at least every hour to calculate hourly temperature and pressure.

(f) Offset Project Operators or Authorized Project Designees must monitor the parameters prescribed in table 6.3. Data measurements may be recorded in an alternative unit, but must be appropriately converted to specified unit for use in equations provided in chapter 5.

Table 6.3. Active Surface Mine Methane Drainage Activity Monitoring Parameters

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Measured (m) Calculated (c) Operating Records (o) Reference (r)	Comment
5.27 5.36 5.37	DE_i	Efficiency of methane destruction device i	%	Each reporting period	r or m	Default methane destruction efficiencies provided in appendix B or site-specific methane destruction efficiencies approved by the Executive Officer
5.27 5.28	$PSW_{B,i}$	Volume of MG from pre-mining surface wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period	scf	Estimated at offset project commencement; calculated each reporting period if non-qualifying device continues to operate after project start	m, c	The largest of the three values calculated per section 5.3.1(h)
5.27 5.28	$PIB_{B,i}$	Volume of MG from pre-mining in-mine boreholes that would have been sent to non-qualifying devices for destruction through use i during the reporting period	scf	Estimated at offset project commencement; calculated each reporting period if non-qualifying device continues to operate after project start	m, c	The largest of the three values calculated per section 5.3.1(h)
5.27 5.28	$ECW_{B,i}$	Volume of MG from existing coalbed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining that would have been sent to non-qualifying	scf	Estimated at offset project commencement; calculated each reporting period if non-qualifying device continues to operate after project start	m, c	The largest of the three values calculated per section 5.3.1(h)

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Measured (m) Calculated (c) Operating Records (o) Reference (r)	Comment
		devices for destruction through use i during the reporting period				
5.27 5.28	$AWR_{B,i}$	Volume of MG from abandoned wells that are reactivated that would have been sent to non-qualifying devices for destruction through use i during the reporting period	scf	Estimated at offset project commencement; calculated each reporting period if non-qualifying device continues to operate after project start	m, c	The largest of the three values calculated per section 5.3.1(h)
5.27 5.28	$CDW_{B,i}$	Volume of MG from converted dewatering wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period	scf	Estimated at offset project commencement; calculated each reporting period if non-qualifying device continues to operate after project start	m, c	The largest of the three values calculated per section 5.3.1(h)
5.27 5.28 5.36 5.37	$C_{CH4,t}$	Daily average methane concentration of mine gas sent to a destruction device	scf CH_4/scf	Continuously	m, c	Readings taken every 15 minutes to calculate average methane concentration per day; calculated separately for each methane source
5.27 5.28 5.36 5.37	DV_t	Daily volume of mine gas sent to a destruction device	scf	Continuously	m, c	Readings taken every 15 minutes to calculate volume per day; adjusted to standard conditions, if applicable using

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Measured (m) Calculated (c) Operating Records (o) Reference (r)	Comment
						equation 5.23. Calculated separately for each methane source.
5.28 5.36 5.37	$PIB_{P,i}$	Volume of MG from pre-mining in-mine boreholes sent to qualifying and non-qualifying devices for destruction through use i during the reporting period	scf	Every reporting period	m, c	Adjusted to standard conditions, if applicable, using equation 5.38
5.28	$PSWnqd_i$	Volume of MG from pre-mining surface wells sent to non-qualifying devices for destruction through use i during the reporting period	scf	Every reporting period	m, c	Adjusted to standard conditions, if applicable, using equation 5.38
5.28	$ECWnqd_i$	Volume of MG from existing coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining sent to non-qualifying devices for destruction through use i during the reporting period	scf	Every reporting period	m, c	Adjusted to standard conditions, if applicable, using equation 5.38
5.28	$AWRnqd_i$	Volume of MG from abandoned wells that are reactivated sent to non-qualifying devices for	scf	Every reporting period	m, c	Adjusted to standard conditions, if applicable, using equation 5.38

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Measured (m) Calculated (c) Operating Records (o) Reference (r)	Comment
		destruction through use i during the reporting period				
5.28	$CDWnqd_i$	Volume of MG from converted dewatering wells sent to non-qualifying devices for destruction through use i during the reporting period	scf	Every reporting period	m, c	Adjusted to standard conditions, if applicable, using equation 5.38
5.29	$PSWe_{pre,i}$	Volume of MG sent to qualifying destruction devices, from the beginning of the crediting period through the end of the reporting period, captured from pre-mining surface wells that were mined through during the reporting period	scf	Every reporting period	m, c	Adjusted to standard conditions, if applicable, using equation 5.38
5.29	$PSWe_{post,i}$	Volume of MG sent to qualifying destruction devices in the reporting period captured from pre-mining surface wells that were mined through during earlier reporting periods	scf	Every reporting period	m, c	Adjusted to standard conditions, if applicable, using equation 5.38
5.30	$ECWe_{pre,i}$	Volume of MG sent to qualifying destruction devices, from the beginning of the crediting period through the end of the reporting period, captured from existing	scf	Every reporting period	m, c	Adjusted to standard conditions, if applicable, using equation 5.38

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Measured (m) Calculated (c) Operating Records (o) Reference (r)	Comment
		coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining that were mined through during the reporting period				
5.30	$ECWe_{post,i}$	Volume of MG sent to qualifying destruction devices in the reporting period captured from existing coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining that were mined through during earlier reporting periods	scf	Every reporting period	m, c	Adjusted to standard conditions, if applicable, using equation 5.38
5.31	$AWRe_{pre,i}$	Volume of MG sent to qualifying destruction devices, from the beginning of the crediting period through the end of the reporting period, captured from abandoned wells that are reactivated that were mined through during the reporting period	scf	Every reporting period	m, c	Adjusted to standard conditions, if applicable, using equation 5.38
5.31	$AWRe_{post,i}$	Volume of MG sent to qualifying destruction devices in the reporting period	scf	Every reporting period	m, c	Adjusted to standard conditions, if applicable, using

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Measured (m) Calculated (c) Operating Records (o) Reference (r)	Comment
		captured from abandoned wells that are reactivated that were mined through during earlier reporting periods				equation 5.38
5.32	$CDWe_{pre,i}$	Volume of MG sent to qualifying destruction devices, from the beginning of the crediting period through the end of the reporting period, captured from converted dewatering wells that were mined through during the reporting period	scf	Every reporting period	m, c	Adjusted to standard conditions, if applicable, using equation 5.38
5.32	$CDWe_{post,i}$	Volume of MG sent to qualifying destruction devices in the reporting period captured from converted dewatering wells that were mined through during earlier reporting periods	scf	Every reporting period	m, c	Adjusted to standard conditions, if applicable, using equation 5.38
5.34	$CONS_{ELEC}$	Additional electricity consumption for the capture and destruction of methane during the reporting period	MWh	Every reporting period	o	From electricity use records
5.34	$CONS_{HEAT}$	Additional heat consumption for the capture and destruction of methane during the reporting period	Volume	Every reporting period	o	From heat use records
5.34	$CONS_{FF}$	Additional fossil	Volume	Every reporting	o	From fuel use

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Measured (m) Calculated (c) Operating Records (o) Reference (r)	Comment
		fuel consumption for the capture and destruction of methane during the reporting period		period		records
5.36 5.37	$PSW_{P,all,i}$	Volume of MG from pre-mining surface wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, all MG must be quantified regardless of whether or not the well is mined through by the end of the reporting period	scf	Every reporting period	m, c	Adjusted to standard conditions, if applicable, using equation 5.38
5.36 5.37	$ECW_{P,all,i}$	Volume of MG from existing coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, all MG must be quantified regardless of whether or not	scf	Every reporting period	m, c	Adjusted to standard conditions, if applicable, using equation 5.38

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Measured (m) Calculated (c) Operating Records (o) Reference (r)	Comment
		the well is mined through by the end of the reporting period				
5.36 5.37	$AWR_{P,all,i}$	Volume of MG from abandoned wells that are reactivated sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, all MG must be quantified regardless of whether or not the well is mined through by the end of the reporting period	scf	Every reporting period	m, c	Adjusted to standard conditions, if applicable, using equation 5.38
5.36 5.37	$CDW_{P,all,i}$	Volume of MG from converted dewatering wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, all MG must be quantified regardless of whether or not the well is mined through by the end of the reporting period	scf	Every reporting period	m, c	Adjusted to standard conditions, if applicable, using equation 5.38
5.38	$MG_{actual,y}$	Measured average flow rate or total volume of MG sent to a destruction	acfm or acf	Continuously	m	

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Measured (m) Calculated (c) Operating Records (o) Reference (r)	Comment
		device during time interval y				
5.38	$T_{MG,y}$	Measured absolute temperature of MG for the time interval y, °R=°F +459.67	°R	Continuously	m, c	Readings taken at least every hour to calculate temperature for time interval y
5.38	$P_{MG,y}$	Measured absolute pressure of MG for the time interval y	atm	Continuously	m, c	Readings taken at least every hour to calculate pressure for time interval y

6.7. Abandoned Underground Mine Methane Recovery Activities

(a) Mine gas from each methane source (i.e., pre-mining surface wells drilled into the mine during active mining operations, pre-mining in-mine boreholes drilled into the mine during active mining operations, post-mining gob wells drilled into the mine during active mining operations, and newly drilled surface wells) must be monitored separately prior to interconnection with other MG sources. The volumetric or mass gas flow, methane concentration, temperature, and pressure must be monitored and recorded separately for each methane source.

(b) The flow rate of MG sent to a destruction device must be measured continuously, recorded every 15 minutes, and adjusted for temperature and pressure, if applicable, to calculate daily volume of MG sent to a destruction device. The flow of gas to a destruction device must be monitored separately for each destruction device, unless:

(1) A project consists of destruction devices that are of identical efficiency and verified to be operational throughout the reporting period; then a single flow meter may be used to monitor gas flow to all destruction devices; or

(2) A project consists of destruction devices that are not of identical efficiency, in which case the methane destruction efficiency of the least efficient destruction device must be used as the methane destruction efficiency for all destruction devices monitored by that meter.

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

(1) The methane destruction efficiency of the least efficient downstream destruction device in operation must be used as the methane destruction efficiency for all destruction devices downstream of the single meter;

(2) 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

(3) For any period of time 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.

(d) The methane concentration of the MG extracted from each methane source must be measured continuously and recorded every 15 minutes to calculate daily average methane concentration.

(e) If required in order to adjust the flow rate, volume, or mass of AMM, the temperature and pressure of the AMM must be measured continuously and recorded at least every hour to calculate hourly temperature and pressure.

(f) Offset Project Operators or Authorized Project Designees that elect to seek written approval from the Executive Officer to derive mine-specific hyperbolic emission rate decline curve coefficients using measured data from pre-existing wells or boreholes open to the atmosphere and natural gas seeps, rather than using default decline curve coefficients in table 5.1, must adhere to the following:

(1) Offset Project Operators and Authorized Project Designees must monitor the:

(A) MG flow rates;

(B) local barometric pressure; and

(C) methane concentration of MG.

(2) Data must be monitored over a 72 hour period on at least three separate occasions each separated by a minimum of 90 days.

(3) MG flow rates and the barometric pressure must be monitored continuously and recorded at least on an hourly basis.

(4) Methane concentration must be measured at least daily.

(g) Offset Project Operators and Authorized Project Designees must monitor the parameters prescribed in table 6.4. Data measurements may be recorded in an alternative unit, but must be appropriately converted to specified unit for use in equations provided in chapter 5.

Table 6.4. Abandoned Underground Mine Methane Recovery Activity Monitoring Parameters

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Measured (m) Calculated (c) Operating Records (o) Reference (r)	Comment
5.42 5.48 5.49	DE_i	Efficiency of methane destruction device i	%	Each reporting period	r or m	Default methane destruction efficiencies provided in appendix B or site-specific methane destruction efficiencies approved by the Executive Officer.
5.42	$PSW_{B,i}$	Volume of MG from pre-mining surface wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period	scf	Estimated at offset project commencement; calculated each reporting period if non-qualifying device continues to operate after project start	m, c	The largest of the three values calculated per section 5.4.1(i).
5.42	$PIB_{B,i}$	Volume of MG from pre-mining in-mine boreholes that	scf	Estimated at offset project commencement; calculated each	m, c	The largest of the three values calculated

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Measured (m) Calculated (c) Operating Records (o) Reference (r)	Comment
		would have been sent to non-qualifying devices for destruction through use i during the reporting period		reporting period if non-qualifying device continues to operate after project start		per section 5.4.1(i).
5.42	$PGW_{B,i}$	Volume of MG from post-mining gob wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period	scf	Estimated at offset project commencement; calculated each reporting period if non-qualifying device continues to operate after project start	m, c	The largest of the three values calculated per section 5.4.1(i).
5.42	$NSW_{B,i}$	Volume of MG from newly drilled surface wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period	scf	Estimated at offset project commencement; calculated each reporting period if non-qualifying device continues to operate after project start	m, c	The largest of the three values calculated per section 5.4.1(i).
5.42 5.48 5.49	$C_{CH4,t}$	Daily average methane concentration of mine gas sent to a destruction device	scf CH_4/scf	Continuously	m, c	Readings taken every 15 minutes to calculate average methane concentration per day; calculated separately for each methane source
5.42 5.48 5.49	DV_t	Daily volume of mine gas sent to a destruction device	scf	Continuously	m, c	Readings taken every 15 minutes to calculate volume per day; adjusted to standard conditions, if

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Measured (m) Calculated (c) Operating Records (o) Reference (r)	Comment
						applicable, using equation 5.50. Calculated separately for each methane source.
5.44	ER_{AMM}	Average ventilation air emission rate over the life of the mine calculated using available data collected by MSHA	Mscf/d	At offset project commencement	o	Available from MSHA
5.44	t	Time elapsed from the date of mine closure to midpoint of the reporting period	days	At offset project commencement	o	Available from public agency (i.e., MSHA, EPA)
5.44	RP_{days}	Days in reporting period	days	Each reporting period	o	
5.46	$CONS_{ELEC}$	Additional electricity consumption for the capture and destruction of methane during the reporting period	MWh	Every reporting period	o	From electricity use records
5.46	$CONS_{HEAT}$	Additional heat consumption for the capture and destruction of methane during the reporting period	Volume	Every reporting period	o	From heat use records
5.46	$CONS_{FF}$	Additional fossil fuel consumption for the capture and destruction of methane during the reporting period	Volume	Every reporting period	o	From fuel use records
5.48 5.49	$PSW_{P,i}$	Volume of MG from pre-mining surface wells	scf	Every reporting period	m, c	Adjusted to standard conditions, if

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Measured (m) Calculated (c) Operating Records (o) Reference (r)	Comment
		sent to qualifying and non-qualifying devices for destruction through use i during the reporting period				applicable, using equation 5.50
5.48 5.49	$PIB_{P,i}$	Volume of MG from pre-mining in-mine boreholes sent to by qualifying and non-qualifying devices for destruction through use i during the reporting period	scf	Every reporting period	m, c	Adjusted to standard conditions, if applicable, using equation 5.50
5.48 5.49	$PGW_{P,i}$	Volume of MG from post-mining gob wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period	scf	Every reporting period	m, c	Adjusted to standard conditions, if applicable, using equation 5.50
5.48 5.49	$NSW_{P,i}$	Volume of MG from newly drilled surface wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period	scf	Every reporting period	m, c	Adjusted to standard conditions, if applicable, using equation 5.50
5.50	$MG_{actual,y}$	Measured average flow rate or total volume of MG sent to a destruction device during time interval y	acfm or acf	Continuously	m	
5.50	$T_{MG,y}$	Measured absolute temperature of MG for the time	°R	Continuously	m, c	Readings taken at least every hour to calculate

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Measured (m) Calculated (c) Operating Records (o) Reference (r)	Comment
		interval y, °R=°F + 459.67				temperature for time interval y
5.50	$P_{MG,y}$	Measured absolute pressure of MG for the time interval y	atm	Continuously	m, c	Readings taken at least every hour to calculate pressure for time interval y
Monitoring Parameters for Deriving Mine-Specific Hyperbolic Emission Rate Decline Curve Coefficients						
Description			Data Unit	Measurement Frequency	Measured (m) Calculated (c)	Comment
MG flow rate			Mscf/d	Continuously	m, c	Recordings taken at least on an hourly basis during the monitoring period
Local barometric pressure			atm	Continuously	m	Recordings taken at least on an hourly basis during the monitoring period
Measured methane concentration of mine gas captured from methane source			scf CH_4/scf	Continuously	m	Readings taken at least daily during the monitoring period

Chapter 7. Reporting

In addition to the offset project requirements set forth in sections 95975 and 95976 the Regulation, mine methane capture offset projects must adhere to the project listing and reporting eligibility requirements below.

7.1. Listing Requirements

(a) Listing information must be submitted by the Offset Project Operator or Authorized Project Designee no later than the date on which the Offset Project Operator or Authorized Project Designee submits the first Offset Project Data Report.

(b) In order for a mine methane capture Compliance Offset Project to be listed, the Offset Project Operator or Authorized Project Designee must submit the information required by section 95975 the Regulation, in addition to the following information:

(1) Offset project name.

(2) Mine methane capture activity type (i.e., active underground mine VAM activity, active underground mine methane drainage activity, active surface mine methane drainage activity, or abandoned underground mine methane recovery activity).

(3) Contact information including name, phone number, mailing address, physical address (if different from mailing address), email address, and, if applicable, organizational affiliation for the:

(A) Offset Project Operator;

(B) Authorized Project Designee (if applicable);

(C) The person submitting the information; and

(D) Any technical consultants.

(4) CITSS ID number for the:

(A) Offset Project Operator; and

(B) Authorized Project Designee (if applicable).

(5) Date of form completion.

(6) *Name and mailing address of mine owner(s) and parent company(ies), if different from mine owner.

(7) *Name of surface owner(s), if different from mine owner.

(8) *Name and mailing address of mine methane owner(s), if different from mine owner.

(9) *Name and mailing address of mine operator(s), if different from mine owner.

(10) *Name and mailing address of methane destruction system owner(s), if different from mine owner, Offset Project Operator, or Authorized Project Designee.

(11) Other parties with a material interest in the mine methane.

(12) A description of the mine and resource ownership and operation structures.

(13) *Documentation showing the Offset Project Operator's legal authority to implement the offset project (e.g., title report, coal lease, gas lease, permit, or contract agreement).

(14) *Latitude and longitude coordinates and physical address (if available) of mine site.

(15) *Indicate if the project occurs on private or public lands and further specify if the project occurs on any of the following categories of land:

(A) Land that is owned by, or subject to an ownership or possessory interest of a Tribe;

(B) Land that is "Indian lands" of a Tribe, as defined by 25 U.S.C. §81(a)(1); or

(C) Land that is owned by any person, entity, or Tribe, within the external borders of such Indian lands.

(16) *If the project is located on one the above categories of land, a description and copies of documentation demonstrating that the land is owned by (or subject to an ownership or possessory interest of) a tribe or private entities.

(17) *MSHA mine identification number.

(18) *MSHA classifications.

(A) Coal or metal and nonmetal;

(B) Underground or surface; and

(C) Active or abandoned.

(19) Mine basin as defined by AAPG Geologic Note: AAPG-CSD Geological Provinces Code Map: AAPG Bulletin, Prepared by Richard F. Meyer, Laurie G. Wallace, and Fred J. Wagner, Jr., Volume 75, Number 10 (October 1991).

(20) *Mining method(s) employed (e.g., longwall, room and pillar, or open-pit).

(21) *Average annual mineral production (specify mineral produced and unit).

(22) *Year of initial production.

(23) *Year of closure (estimate if mine is not yet closed).

(24) Name of state and/or federal agency(ies) responsible for issuing mine leases and/or permits.

(25) List any permits obtained, or to be obtained, to build and operate the project.

(26) Offset project commencement date and specification of the action(s) that identify the commencement date.

(27) First reporting period.

(28) A qualitative characterization and quantitative estimate of the baseline emissions at the mine including an explanation of how the quantitative estimate was reached.

(29) Describe any mine methane destruction occurring at the mine prior to the offset project commencement date. List the source of the methane destroyed, destruction device(s) used, and device operation dates.

(30) A description of the project activities that will lead to GHG emission reductions including the methane end-use management option(s), destruction devices, and metering and data collection systems to be employed by the project.

(31) Declaration that the project is not being implemented as a result of any federal, state or local law, statute, regulation, court order, or other legally binding mandate.

(32) *Disclose if any GHG reductions associated with the offset project have ever been registered with or claimed by another registry or program, or sold to a third party prior to our listing. Identify the registry or program as well as the vintage(s) of credits issued, reporting period(s), and verification bodies that have performed verification services.

(33) State whether the project is transitioning to the Compliance Offset Protocol Mine Methane Capture Projects, after previously being listed as an early action offset project.

(34) *Bird's-eye view map of the mine site that includes:

(A) Longitude and latitude coordinates;

(B) Governing jurisdictions;

(C) Public and private roads;

(D) Mine permit boundary; and

(E) Mine lease boundary, if applicable.

(35) For active underground mine VAM activities, a diagram of the project site that includes:

(A) Location of ventilation shafts included in the project. Assign a number to each piece of equipment and, on a separate sheet of paper:

1. Indicate whether the ventilation shaft is currently existing or planned; and

2. Indicate whether or not the ventilation shaft was connected to a non-qualifying destruction device at any point during the year prior to offset project commencement.

(B) Location of equipment used to collect, treat, store, meter, and destroy ventilation air methane in use prior to offset project commencement. Assign a number to each piece of equipment and, on a separate sheet of paper:

1. Indicate whether or not the piece of equipment will be part of the project;

2. Provide a description, including the purpose, of the piece of equipment;

3. For destruction devices, provide the operation dates (approximate dates are acceptable);

3. For destruction devices, indicate whether it is a qualifying or non-qualifying destruction device in accordance with chapter 2;

4. For non-qualifying destruction devices that were operating at the mine prior to offset project commencement and during the year immediately preceding offset project commencement, provide the volume or mass of ventilation

air sent to the device during the three-year period prior to offset project commencement (or during the length of time the device is operational, if less than three years), adjusted for temperature and pressure using equation 5.11, if applicable, averaged according to the length of the initial reporting period; and

5. For non-qualifying destruction devices that were operating at the mine prior to offset project commencement and during the year immediately preceding offset project commencement, provide the volume or mass of ventilation air sent to the device during the time period a law, regulation, or legally binding mandate, in place for less than three years prior to offset project commencement, was in effect, adjusted for temperature and pressure using equation 5.11, if applicable, and averaged according to the length of the initial reporting period.

(C) Location of equipment used to collect, treat, store, meter, and destroy ventilation air methane installed as part of the project. Assign a number to each piece of equipment and, on a separate sheet of paper:

1. Provide a description, including the purpose, of the piece of equipment;
2. For destruction devices, provide the operational date or expected operational date (approximate dates are acceptable); and
3. For destruction devices, indicate whether it is a qualifying or non-qualifying destruction device in accordance with chapter 2.

(36) *For active underground mine methane drainage activities, active surface mine methane drainage activities, and abandoned underground mine methane recovery activities, a diagram of the project site that includes:

(A) Location of wells and boreholes included in the project. Assign a number to each piece of equipment and, on a separate sheet of paper:

1. Indicate whether the well/borehole is currently existing or planned;
2. Indicate whether or not the well/borehole was connected to a non-qualifying destruction device at any point during the year prior to offset project commencement;
3. Indicate the methane source type (i.e., pre-mining surface well, pre-mining in-mine borehole, post-mining gob well, existing CBM well that would otherwise be shut-in and abandoned, abandoned well that is reactivated, or converted dewatering wells); and
4. For pre-mining surface wells, indicate whether or not the well is mined through, and when the well was, or is expected to be, mined through.

(B) Location of equipment used to collect, treat, store, meter, and destroy MM/SMM/AMM in use prior to offset project commencement. Assign a number to each piece of equipment and, on a separate sheet of paper:

1. Indicate whether or not the piece of equipment will be part of the project;
2. Provide a description, including the purpose, of the piece of equipment;
3. For destruction devices, provide the operation dates (approximate dates are acceptable);
4. For destruction devices, indicate whether it is a qualifying or non-qualifying destruction device in accordance with chapter 2;
5. For non-qualifying destruction devices that were operating at the mine prior to offset project commencement and during

the year immediately preceding offset project commencement, provide the volume or mass of mine gas sent to the device during the three-year period prior to offset project commencement (or during the length of time the device is operational, if less than three years), adjusted for temperature and pressure using equation 5.11, if applicable, averaged according to the length of the initial reporting period; and

6. For non-qualifying destruction devices that were operating at the mine prior to offset project commencement and during the year immediately preceding offset project commencement, provide the volume or mass of mine gas sent to the device during the time period a law, regulation, or legally binding mandate, in place for less than three years prior to offset project commencement, was in effect, adjusted for temperature and pressure using equation 5.11, if applicable, and averaged according to the length of the initial reporting period.

(C) Location of equipment used to collect, treat, store, meter, and destroy MM/SMM/AMM installed as part of the project. Assign a number to each piece of equipment and, on a separate sheet of paper:

1. Provide a description, including the purpose, of the piece of equipment;
2. For destruction devices, provide the operational date or expected operational date (approximate dates are acceptable); and
3. For destruction devices, indicate whether it is a qualifying or non-qualifying destruction device in accordance with chapter 2.

(c) Abandoned mine methane recovery activities that are comprised of multiple mines as allowed for by section 2.4 must provide the items in section 7.1(b) marked with an asterisk (*) for each involved mine.

7.2. Offset Project Data Report

(a) Offset Project Operators or Authorized Project Designees must submit an OPDR at the conclusion of each Reporting Period according to the reporting schedule in section 95976 of the Regulation.

(b) Offset Project Operators or Authorized Project Designees must submit the information required by section 95976 of the Regulation, in addition to the following information:

(1) Offset project name.

(2) ARB project ID number.

(3) Mine methane capture activity type (i.e., active underground mine VAM activity, active underground mine methane drainage activity, active surface mine methane drainage activity, or abandoned underground mine methane recovery activity).

(4) Contact information including name, phone number, mailing address, physical address (if different from mailing address), email address, and, if applicable, organizational affiliation for the:

(A) Offset Project Operator;

(B) Authorized Project Designee (if applicable);

(C) The person submitting the information; and

(D) Any technical consultants.

(5) CITSS ID number for the:

(A) Offset Project Operator; and

(B) Authorized Project Designee (if applicable).

(6) Date of form completion.

(7) Reporting period.

(8) Offset project commencement date.

(9) *Mining method(s) (e.g., longwall, room and pillar, or open-pit) employed during reporting period. For abandoned underground mine methane recovery activities, mining method(s) employed while mine was active.

(10) Mineral production during reporting period (specify mineral produced and unit).

(11) Statement as to whether all the information submitted for project listing is still accurate. If not, provide updates to relevant listing information.

(12) *Statement as to whether the project has met all local, state, or federal regulatory requirements during the reporting period. If not, an explanation of the non-compliance must be provided.

(13) For active underground mine VAM activities, provide the:

(A) Emission reductions achieved by the project during the reporting period (ER);

(B) Volume of ventilation air that would have been sent to non-qualifying devices for destruction through use i during the reporting period ($VA_{B,i}$);

(C) Volume of ventilation air sent to qualifying and non-qualifying devices for destruction through use i during the reporting period ($VA_{P,i}$), reported separately for each destruction device;

(D) Weighted average of measured methane concentration of ventilation air sent to destruction devices during the reporting period (C_{CH4}), reported separately for the baseline and project scenarios;

(E) Hours during which destruction device was operational during reporting period (y), reported separately for each destruction device in the baseline and project scenarios;

(F) Hourly average flow rate of ventilation air sent to a device for destruction through use i during the reporting period ($VA_{flow,i,y}$), reported separately for each destruction device in the baseline and project scenarios;

(G) Hourly average flow rate of cooling air sent to a destruction device after the metering point of the ventilation air stream during period y ($CA_{flow,i,y}$), reported separately for each destruction device in the baseline and project scenarios, indicating whether flow rate was monitored or if default maximum quantity was used;

(H) Weighted average of measured methane concentration of exhaust gas emitted from destruction device during the reporting period ($C_{CH4,exhaust,i}$), reported separately for each destruction device in the baseline and project scenarios;

(I) Volume of mine gas extracted from a methane drainage system and sent with ventilation air to qualifying and non-qualifying devices for destruction during the reporting period ($MG_{SUPP,i}$), reported separately for each destruction device in the baseline and project scenarios;

(J) Weighted average of measured methane concentration of captured mine gas sent to qualifying and non-qualifying destruction devices with ventilation air during the reporting period ($C_{CH4,MG}$), reported separately for each destruction device in the baseline and project scenarios; and

(K) Quantities of additional electricity ($CONS_{ELEC}$), heat ($CONS_{HEAT}$), and fossil fuels ($CONS_{FF}$) consumed by the project and the CO_2 emission factors (CEF_{ELEC}), (CEF_{HEAT}), and (CEF_{FF}) applied.

(14) For active underground mine methane drainage activities, provide the:

(A) Emission reductions achieved by the project during the reporting period (ER);

(B) Volume of mine gas that would have been sent to non-qualifying devices for destruction through use i during the reporting period, ($PSW_{B,i,}$ $PIB_{B,i,}$ $PGW_{B,i}$) reported separately for each methane source and destruction device;

(C) Volume of mine gas sent to qualifying and non-qualifying devices for destruction through use i during the reporting period ($PSW_{P,i,}$

$PIB_{P,i,}$ $PGW_{P,i}$), reported separately for each methane source and destruction device;

(D) Weighted average of measured methane concentration of mine gas sent to destruction devices during the reporting period (C_{CH4}) reported separately for each methane source in the baseline and project scenarios;

(E) For pre-mining surface wells, identify all wells included in the project that were mined through during the reporting period and provide the values used for the following terms: $PSWnqd_i$, $PSWe_{pre,i}$, $PSWe_{post,i}$, and $PSW_{P,all,i}$;

(F) Volume of mine gas extracted from a methane drainage system and sent with ventilation air to qualifying and non-qualifying devices for destruction during the reporting period ($MG_{SUPP,i}$), reported separately for the baseline and project scenarios;

(G) Weighted average of measured methane concentration of captured mine gas sent with ventilation air to qualifying and non-qualifying destruction devices during the reporting period ($C_{CH4,MG}$), reported separately for the baseline and project scenarios;

(H) Any site-specific methane destruction efficiencies used and a description of the process of establishing these methane destruction efficiencies that includes the identity of any third parties involved; and

(I) Quantities of additional electricity ($CONS_{ELEC}$), heat ($CONS_{HEAT}$), and fossil fuels ($CONS_{FF}$) consumed by the project and the CO_2 emission factors (CEF_{ELEC}), (CEF_{HEAT}), and (CEF_{FF}) applied.

(15) For active surface mine methane drainage activities, provide the:

(A) Emission reductions achieved by the project during the reporting period (ER);

(B) Volume of mine gas that would have been sent to non-qualifying devices for destruction through use i during the reporting period

($PSW_{B,i,}$ $PIB_{B,i,}$ $ECW_{B,i,}$ $AWR_{B,i,}$ $CDW_{B,i}$), reported separately for each methane source and destruction device;

(C) Volume of mine gas sent to qualifying and non-qualifying devices for destruction through use i during the reporting period ($PSW_{P,i,}$ $PIB_{P,i,}$ $ECW_{P,i,}$ $AWR_{P,i,}$ $CDW_{P,i}$), reported separately for each methane source and destruction device;

(D) Weighted average of measured methane concentration of mine gas sent to destruction devices during the reporting period (C_{CH4}), reported separately for each methane source and destruction device in the baseline and project scenario;

(E) For pre-mining surface wells, identify all wells included in the project that were mined through during the reporting period and provide the values used for the following terms: $PSWnqd_i$, $PSWe_{pre,i}$, $PSWe_{post,i}$, and $PSW_{P,all,i}$;

(F) For existing coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining, identify all wells included in the project that were mined through during the reporting period and provide the values used for the following terms: $ECWnqd_i$, $ECWe_{pre,i}$, $ECWe_{post,i}$, and $ECW_{P,all,i}$;

(G) For abandoned wells that are reactivated, identify all wells included in the project that were mined through during the reporting period and provide the values used for the following terms: $AWRnqd_i$, $AWRe_{pre,i}$, $AWRe_{post,i}$, and $AWR_{P,all,i}$;

(H) For converted dewatering wells that are reactivated, identify all wells included in the project that were mined through during the reporting period and provide the values used for the following terms: $CDWnqd_i$, $CDWe_{pre,i}$, $CDWe_{post,i}$, and $CDW_{P,all,i}$;

(I) Any site-specific methane destruction efficiencies used and a description of the process of establishing these methane destruction efficiencies that includes the identity of any third parties involved; and

(J) Quantities of additional electricity ($CONS_{ELEC}$), heat ($CONS_{HEAT}$), and fossil fuels ($CONS_{FF}$) consumed by the project and the CO_2 emission factors (CEF_{ELEC}), (CEF_{HEAT}), and (CEF_{FF}) applied.

(16) For abandoned underground mine methane recovery activities, provide the:

(A) Emission reductions achieved by the project during the reporting period (ER);

(B) Volume of mine gas that would have been sent to non-qualifying devices for destruction through use i during the reporting period ($PSW_{B,i,}$ $PIB_{B,i,}$ $ECW_{B,i,}$ $AWR_{B,i,}$ $CDW_{B,i}$), reported separately for each methane source and destruction device;

(C) Volume of mine gas sent to qualifying and non-qualifying devices for destruction through use i during the reporting period ($PSW_{P,i,}$ $PIB_{P,i,}$ $ECW_{P,i,}$ $AWR_{P,i,}$ $CDW_{P,i}$), reported separately for each methane source and destruction device;

(D) Weighted average of measured methane concentration of mine gas sent to destruction devices during the reporting period (C_{CH4}), reported separately for each methane source in the baseline and project scenarios;

(E) Any site-specific methane destruction efficiencies used and a description of the process of establishing these methane destruction efficiencies that includes the identity of any third parties involved; and

(F) Quantities of additional electricity ($CONS_{ELEC}$), heat ($CONS_{HEAT}$), and fossil fuels ($CONS_{FF}$) consumed by the project and the CO_2 emission factors (CEF_{ELEC}), (CEF_{HEAT}), and (CEF_{FF}) applied.

(c) Abandoned mine methane recovery activities that are comprised of multiple mines as allowed for by section 2.4 must provide the items in section 7.2(b) marked with an asterisk (*) for each involved mine.

Chapter 8. Verification

(a) All Offset Project Data Reports are subject to regulatory verification as set forth in section 95977 of the Regulation by an ARB accredited offset verification body.

(b) The Offset Project Data Reports must receive a positive or qualified positive verification statement to be issued ARB or registry offset credits.

(c) Offset Project Operators or Authorized Project Designees are responsible for producing mine and project records requested by the offset project verifier, which could include, but is not limited to, the following:

(1) Mine plans;

(2) Mine ventilation plans;

(3) Mine maps;

(4) Mine operating permits, leases (if applicable), and air, water, and land use permits;

(5) Inspection, cleaning, and calibration records for metering equipment; and

(6) Source testing records for destruction devices that use site-specific methane destruction efficiencies.

Appendix A. Emission Factors – Quantification Methodology

Table A.1 CO_2 Emission Factors for Fossil Fuel Use

Fuel Type	Default High Heat Value	Default CO_2 Emission Factor	Default CO_2 Emission Factor
Coal and Coke	**MMBtu / short ton**	**kg CO_2 / MMBtu**	**kg CO_2 / short ton**
Anthracite	25.09	103.54	2597.819
Bituminous	24.93	93.40	2328.462
Subbituminous	17.25	97.02	1673.595
Lignite	14.21	96.36	1369.276
Coke	24.80	102.04	2530.592
Mixed (Commercial sector)	21.39	95.26	2037.611
Mixed (Industrial coking)	26.28	93.65	2461.122
Mixed (Electric Power sector)	19.73	94.38	1862.117
Natural Gas	**MMBtu / scf**	**kg CO_2 / MMBtu**	**kg CO_2 / scf**
(Weighted U.S. Average)	1.028×10^{-3}	53.02	0.055
Petroleum Products	**MMBtu / gallon**	**kg CO_2 / MMBtu**	**kg CO_2 / gallon**
Distillate Fuel Oil No. 1	0.139	73.25	10.182
Distillate Fuel Oil No. 2	0.138	73.96	10.206
Distillate Fuel Oil No. 4	0.146	75.04	10.956
Distillate Fuel Oil No. 5	0.140	72.93	10.210
Residual Fuel Oil No. 6	0.150	75.10	11.265
Used Oil	0.135	74.00	9.990
Kerosene	0.135	75.20	10.152
Liquefied petroleum gases (LPG)	0.092	62.98	5.794
Propane	0.091	61.46	5.593
Propylene	0.091	65.95	6.001
Ethane	0.069	62.64	4.322
Ethanol	0.084	68.44	5.749
Ethylene	0.100	67.43	6.743
Isobutane	0.097	64.91	6.296
Isobutylene	0.103	67.74	6.977
Butane	0.101	65.15	6.580
Butylene	0.103	67.73	6.976
Naphtha (<401 deg F)	0.125	68.02	8.503
Natural Gasoline	0.110	66.83	7.351
Other Oil (>401 deg F)	0.139	76.22	10.595
Pentanes Plus	0.110	70.02	7.702
Petrochemical Feedstocks	0.129	70.97	9.155
Petroleum Coke	0.143	102.41	14.645
Special Naphtha	0.125	72.34	9.043
Unfinished Oils	0.139	74.49	10.354
Heavy Gas Oils	0.148	74.92	11.088

Lubricants	0.144	74.27	10.695
Motor Gasoline	0.125	70.22	8.778
Aviation Gasoline	0.120	69.25	8.310
Kerosene-Type Jet Fuel	0.135	72.22	9.750
Asphalt and Road Oil	0.158	75.36	11.907
Crude Oil	0.138	74.49	10.280
Other fuels (solid)	**MMBtu / short ton**	**kg CO_2 / MMBtu**	**kg CO_2 / short ton**
Municipal Solid Waste	9.95	90.7	902.465
Tires	26.87	85.97	2310.014
Plastics	38.00	75.00	2850.000
Petroleum Coke	30.00	102.41	3072.300
Other fuels (gaseous)	**MMBtu / scf**	**kg CO_2 / MMBtu**	**kg CO_2 / scf**
Blast Furnace Gas	0.092×10^{-3}	274.32	0.025
Coke Oven Gas	0.599×10^{-3}	46.85	0.028
Propane Gas	2.516×10^{-3}	61.46	0.155
Fuel Gas	1.388×10^{-3}	59.00	0.082
Biomass Fuels (solid)	**MMBtu / short ton**	**kg CO2 / MMBtu**	**kg CO_2 / short ton**
Wood and Wood Residuals	15.38	93.80	1442.644
Agricultural Byproducts	8.25	118.17	974.903
Peat	8.00	111.84	894.720
Solid Byproducts	25.83	105.51	2725.323
Biomass Fuels (gaseous)	**MMBtu / scf**	**kg CO2 / MMBtu**	**kg CO_2 / scf**
Biogas (Captured methane)	0.841 x 10-3	52.07	0.044
Biomass Fuels (liquid)	**MMBtu / gallon**	**kg CO2 / MMBtu**	**kg CO_2 / gallon**
Ethanol	0.084	68.44	5.749
Biodiesel	0.128	73.84	9.452
Rendered Animal Fat	0.125	71.06	8.883
Vegetable Oil	0.120	81.55	9.786

Source: United States Environmental Protection Agency Mandatory Reporting of Greenhouse Gases (Title 40, Code of Federal Regulations, Part 98, Subpart C) (2013) http://www.arb.ca.gov/cc/reporting/ghg-rep/regulation/subpart_c_rule_part98.pdf.

Table A.2 Emissions & Generation Resource Integrated Database (eGRID) Table

eGRID Subregion Acronym	eGRID Subregion Name	Annual Output Emission Rates	
		(lb CO_2/MWh)	(metric ton CO_2/MWh)*
AKGD	ASCC Alaska Grid	1,280.86	0.581
AKMS	ASCC Miscellaneous	521.26	0.236
AZNM	WECC Southwest	1,191.35	0.540
CAMX	WECC California	658.68	0.299
ERCT	ERCOT All	1,181.73	0.536
FRCC	FRCC All	1,176.61	0.534
HIMS	HICC Miscellaneous	1,351.66	0.613
HIOA	HICC Oahu	1,593.35	0.723
MORE	MRO East	1,591.65	0.722
MROW	MRO West	1,628.60	0.739
NEWE	NPCC New England	728.41	0.330
NWPP	WECC Northwest	819.21	0.372
NYCW	NPCC NYC/Westchester	610.67	0.277
NYLI	NPCC Long Island	1,347.99	0.611
NYUP	NPCC Upstate NY	497.92	0.226
RFCE	RFC East	947.42	0.430
RFCM	RFC Michigan	1,659.46	0.753
RFCW	RFC West	1,520.59	0.690
RMPA	WECC Rockies	1,824.51	0.828
SPNO	SPP North	1,815.76	0.824
SPSO	SPP South	1,599.02	0.725
SRMV	SERC Mississippi Valley	1,002.41	0.455
SRMW	SERC Midwest	1,749.75	0.794
SRSO	SERC South	1,325.68	0.601
SRTV	SERC Tennessee Valley	1,357.71	0.616
SRVC	SERC Virginia/Carolina	1,035.87	0.470
U.S.		**1,216.18**	**0.552**

Source: U.S. EPA eGRID2012, Version 1.0 Year 2009 GHG Annual Output Emission Rates (Created April 2012)
http://www.epa.gov/cleanenergy/documents/egridzips/eGRID2012V1_0_year09_SummaryTables.pdf.
*Converted from lbs CO_2/MWh to metric tons CO_2/MWh using conversion factor 1 metric ton = 2,204.62 lbs.

Appendix B. Device Destruction Efficiencies – Quantification Methodology

Table B.1 Default Methane Destruction Efficiencies by Destruction Device

Destruction Device	Destruction Efficiency
Open Flare	0.960
Enclosed Flare	0.995
Lean-burn Internal Combustion Engine	0.936
Rich-burn Internal Combustion Engine	0.995
Boiler	0.980
Microturbine or large gas turbine	0.995
Upgrade and use of gas as CNG/LNG fuel	0.950
Upgrade and injection into natural gas transmission and distribution pipeline	0.981

Equation B.1: Calculating Heat Generation Emission Factor

$$CEFheat = \frac{CEF_{CO2,i}}{Eff_{heat}} \times \frac{44}{12}$$

Where,

CEF_{heat} = CO_2 emission factor for heat generation

$CEF_{CO2,i}$ = CO_2 emission factor of fuel used in heat generation (see table B.1)

Eff_{heat} = Boiler efficiency of the heat generation (either measured efficiency, manufacturer nameplate data for efficiency, or 100%)

$\frac{44}{12}$ = Carbon to carbon dioxide conversion factor

Appendix C. Data Substitution Methodology – Quantification Methodology

(a) ARB expects that MMC projects will have continuous, uninterrupted data for the entire reporting period. However, ARB recognizes that unexpected events or occurrences may result in brief data gaps.

(b) This appendix provides a quantification methodology to be applied to the calculation of GHG emission reductions for MMC projects when data integrity has been compromised due to missing data points.

(c) This methodology is only applicable to gas flow metering and methane concentration parameters. Data substitution is not allowed for equipment that monitors the proper functioning of destruction devices such as thermocouples.

(d) This methodology may be used for missing temperature and pressure data used to adjust flow rates to standard conditions.

(e) The following data substitution methodology may be used only for flow and methane concentration data gaps that are discrete, limited, non-chronic, and due to unforeseen circumstances.

(f) Data substitution is not allowed for data used to calculate mine specific hyperbolic emission rate decline curve coefficients for an abandoned underground mine methane recovery activity.

(g) Data substitution can only be applied to methane concentration *or* flow readings, but not both simultaneously. If data is missing for both parameters, no reductions can be credited.

(h) Substitution may only occur when two other monitored parameters corroborate proper functioning of the destruction device and system operation within normal ranges. These two parameters must be demonstrated as follows:

(1) Proper functioning can be evidenced by thermocouple readings for flares or engines, energy output for engines, etc.

(2) For methane concentration substitution, flow rates during the data gap must be consistent with normal operation.

(3) For flow substitution, methane concentration rates during the data gap must be consistent with normal operations.

(i) If corroborating parameters fail to demonstrate any of these requirements, no substitution may be employed. If the requirements above can be met, the following substitution methodology may be applied:

Table C.1

Duration of Missing Data	Substitution Methodology
Less than six hours	Use the average of the four hours of normal operation immediately before and following the outage
Six to 24 hours	Use the 90% lower confidence limit of the 24 hours of normal operation prior to and after the outage
One to seven days	Use the 95% lower confidence limit of the 72 hours of normal operation prior to and after the outage
Greater than one week	No data may be substituted and no credits may be generated