MARGINAL CONVENTIONAL WELL METHANE MEASUREMENT PLAN

Methane Emissions Reduction Program for Marginal Conventional Wells

November 15, 2024

WORK PERFORMED UNDER AGREEMENT

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SUBMITTED BY

Texas Commission on Environmental Quality
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Methane Measurement Plan for the

Texas Voluntary Marginal Conventional Well Plugging Program (TxMCW)

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Texas Commission on Environmental Quality (TCEQ)

Office of Air – Air Grants Division – Federal Grant Section

Inflation Reduction Act (IRA) – Methane Emission Reduction Program (MERP)
Mitigating Emissions from Marginal Conventional Wells

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Introduction:

The Texas Voluntary Marginal Conventional Well Plugging Program (TxMCW) will use Inflation Reduction Act (IRA) funding for mitigating emissions from marginal conventional wells (MCWs) to assist oil and gas well owners and operators in voluntarily and permanently plugging and abandoning MCWs on non-Federal lands. Participants who accept funding under the program will agree to the measurement of methane emissions from selected MCWs both before and after each well is plugged. Funding for selected MCWs will support well plugging, methane measurement, and the environmental restoration required for full compliance with well plugging and abandonment standards and regulations in Texas.

In addition to methane, MCW sites can emit volatile organic compounds (VOCs) and Hazardous Air Pollutants (HAPS), including benzene, toluene, ethylbenzene, xylene, and, in certain areas of the state, hydrogen sulfide (H_2S). Reduction of these emissions benefit the citizens of Texas, including those in disadvantaged communities and those living near well operations.

As outlined in the Administrative and Legal Requirements Document (ALRD) for this program, TxMCW funding will target the following goals:

- Mitigate emissions by assisting operators to voluntarily identify and permanently plug MCWs.
- Measure methane emissions from MCWs prior to and following plugging and abandonment to quantify mitigated emissions.
- Support elements of environmental restoration required for full compliance with applicable State or Federal well plugging and abandonment standards and regulations.

Projects will support permanent well plugging and abandonment activities for MCWs, including, but not limited to:

- Preparation of the well pad to permanently plug and abandon the well.
- Removal of well bore casing and other associated equipment or infrastructure.
- Placement of cement plugs.
- Excavation around the well head and capping of the well prior to surface restoration as required by applicable state or federal well plugging and abandonment standards and regulations.
- Support of activities necessary for well plugging.

Projects will require measurement of methane emissions associated with MCWs selected for subaward. Recipients of funding under TxMCW must allow methane emissions from selected MCWs to be measured prior to and after plugging activities using a qualitative detection method. If leaks are discovered during the qualitative survey, methane emissions must be quantified using an approved quantification measurement method.

Recipients will provide this information to TCEQ for publication on the TxMCW website and for reporting to the Department of Energy (DOE) National Environmental Technology Laboratory (NETL). This data will be used to quantify the amount of methane mitigated by each plugging project as well as to aggregate data for all plugging efforts under TxMCW to determine and report total methane emissions mitigated by the program. The terms and conditions of the funding award require the submission of this information.

For purposes of TxMCW, the following definitions are applicable:

Marginal Conventional Well – An onshore conventional well producing less than or equal to 15 barrels of oil equivalent per day (BOED), or less than or equal to 90 thousand cubic feet (Mcf) of gas per day (1 BOE = 6 Mcf) over one (1) calendar year. These are producing or idle wells with known operators/well owners.

Conventional Well – A vertical well producing oil or natural gas that is drilled into a geologic formation in which the reservoir and fluid characteristics permit the oil and natural gas to readily flow to the wellbore. This excludes highly deviated, horizontal, tight-gas, and mudrock or shale wells.

TCEQ developed this methane measurement plan in alignment with the methane measurement guidelines for marginal conventional wells issued by DOE/NETL as part of the National Emission Reduction Initiative. This plan may be revised to accommodate new information or program changes over the course of the grant.

Requirements for Methane Emissions Assessment

Grantees are required to agree to the measurement and reporting to TCEQ of methane emission rates prior to and following the plugging and abandonment of any MCW using applicable approaches described in these guidelines, and to quantify those emissions using the methodology provided.

The purpose of pre-plugging measurements is to detect and quantify mitigated methane. Qualitative approaches must use an established survey and quantitative approaches must have a minimum detection limit (MDL) of less than 100 grams/hour (g/h). The purpose of post-plugging measurements is to verify that methane emissions are below detection, and qualitative approaches, such as optical gas imaging (OGI), can be used to confirm there are no emission sources.

A methane detection limit of 100 g/h is required by the DOE/NETL grant guidelines and should allow a variety of options for measurement methodologies, which range in detection limits, to be used. MDLs should be verified by references to peer-reviewed publications, instrument manufacturer specifications, and/or documented demonstrations of the standard operating procedures of the approach.

Qualification of Measurement Specialist:

A measurement specialist refers to the individual who will be conducting methane measurements at a selected well site prior to and after plugging and remediating a well. To qualify for participation in TxMCW, a measurement specialist must meet the following minimum requirements as provided by DOE/NETL:

- A qualified measurement specialist should have completed all required safety training necessary to gain access to a site as well as a minimum of 20 hours of training specific to the equipment and sufficient field experience such that measurements meet the data quality objectives of the methodological approaches.
- The measurement specialist should be able to recognize, and avoid/mitigate, safety hazards related to the oil and gas well, field conditions, weather variables, etc., to maintain personal safety. Measurement specialists are required to be aware of and evaluate all potential leak, flare, and vent points at an MCW site.

- Specific site access requirements may be applicable to Measurement Specialists and all requirements must be followed, documented, and reported with quantified methane results.

Submission of Measurement Instrumentation and Methodological Approach (MIMA):

The specific measurement equipment and method(s) proposed by the qualified measurement specialist must be submitted for review by the TCEQ Air Grants Division Federal Grant Section and may require additional approval from the NETL Federal Project Manager in advance of the field measurement. Proposed equipment and method(s) should be submitted to the TCEQ using Form TxMCW-MIMA and must be approved prior to any measurements that will be used for TxMCW reporting purposes.

Safety Considerations:

MCW sites and their corresponding risks can vary relative to location, accessibility, and infrastructure type or design. MCWs may be idle or active producing wells and site safety considerations are a critical aspect of work to be performed at a well site. Active MCWs sites may carry risks to human health and the environment. In preparing for work with or around an MCW site, program participants should first assure that site access authorization is obtained, and any company or site-specific safety considerations are understood and adhered to. Certain MCW sites may require specific types of safety training (e.g., H_2S, OSHA40) to gain access. Moreover, well owners/operators may require insurance or liability waivers to gain access to a site. Company or site-specific requirements for intrinsically safe instruments should be considered, particularly for direct source emissions measurement approaches. When onsite, program participants should have proper personal protective equipment that would, at a minimum, include a hard hat, safety glasses, fire retardant clothing, steel-toed boots, and relevant personal gas detection instrumentation. Moreover, site access should never be performed individually. Site requirements may include the presence of the main site operator, or someone designated by them. Workers should not make any attempts to open or close valves or otherwise attempt to manipulate or modify equipment.

Program participants should also coordinate with operational personnel to understand all potential site risks (e.g., high-pressure, H_2S, known leaks/vents, or other issues) and to be fully aware of weather conditions to avoid increased risk during a site visit. Site safety plans should be prepared prior to access to a well or group of wells and include relevant information about local emergency response plans prior to an emergency occurring.

Methane Emission Qualitative Detection Methods

While pre-plugging emissions measurements are required for all subawards under TxMCW, a qualitative survey is not required. To make efficient use of time and resources, an optional preliminary assessment of a well site to detect emissions may be used to determine if further measurements are necessary and if any safety hazards exist at the site.

Screening techniques include measurements of methane concentration (in units, such as ppm or percent volume) collected around the well site to identify points at which the concentration significantly exceeds the background methane concentration and plume visualization for OGI.

These screening techniques do not supply a methane emission rate but do provide a triaging of wells into the following categories:

- No emissions detected; no further measurement required.
- Emitting at a detectible level, quantification required.

Screening is conducted by directing the screening instrument to all potential emission points at an MCW site, allowing enough time at each point to achieve a steady reading. Due to the intermittent emissions observed at certain wells, sufficient time for evaluation at each potential emission point is recommended.

The following information should be recorded with each screening: the date(s) and time(s) of the screening, the name and affiliation of the qualified measurement specialist(s), a supporting visible light photo and / or video when OGI is utilized, the measurement approach, a well site description (listing of equipment on site, inclusion of photographs where practical), a description and listing of emission points, and the magnitude/description of each positive instrument response (emissions detection).

Methane Concentration Instrumentation (Method 21):

Method 21 is a procedure developed by EPA used to determine the presence of volatile chemical compound leaks but can also be utilized for methane detection. It is a method that is used by certified inspectors to best identify VOC leaks on process equipment sources. Depending on the nature of the operation, these equipment sources may include valves, flanges, and other connections, pumps, and compressors, pressure relief devices, process drains, open-ended valves, pump and compressor seal system degassing vents, accumulator vessel vents, agitator seals, and access door seals. This method is not meant to be used as a gauge for a measure of mass emission rate, but rather leak detection, specifically.

Method 21 equipment is commercially available and uses portable instruments for quickly measuring methane or methane-equivalent concentrations in ambient air.

LEL monitors, for example, are small hand-held, battery-powered devices that report the concentration of combustible gases in the air relative to the concentration where the gas becomes an explosion hazard (approximately 5% by volume). However, detection limits are often ~100 ppm or greater.

Portable flame ionization detectors (FIDs) and infrared controlled interference polarization spectrometers are also capable of measuring 0–100% methane or methane-equivalent by volume with detection limits of approximately 0.5–1 ppm. Lower explosive limit (LEL) and FID (flame ionization detection) monitors provide results for all combustible gases present and can report the total concentrations “as methane” depending on the instrument calibration. These two instruments are not specific only to methane but are appropriate as screening technology options, as FID and similar devices can be used to meet equipment requirements.

Cavity ring-down spectroscopy (CRDS) and off-axis integrated cavity output spectrometers (OA-ICOS) can achieve sub-part per billion detection limits but are at the highest range in cost. These high-precision instruments are typically used for more advanced quantification methods.

If a company chooses to conduct a qualitative measurement using methane concentration instrumentation, Method 21 should be used to conduct this survey. EPA provides their Method 21 methodology in Title 40 of the Code of Federal Regulation Part 60 (40 CFR § 60) in Appendix A-7 at: https://www.ecfr.gov/current/title-40/part-60/appendix-Appendix A-7 to Part 60.

Optical Gas Imaging Instrumentation:

Although it is not a quantitative method, OGI provides a means to visualize leaks of natural gas by using its radiation absorption properties to produce an image in which the natural gas leak can clearly be distinguished. OGI is also a viable qualitative visual tool to confirm that post-plugging methane emissions are not detected. Surveys with OGI cameras allow the user to view leaks at a distance with rapid spatial coverage. Detectability of a leak is dependent on the sensitivity of the camera, the size of the leak, distance from the source, experience of the camera operator, and environmental factors. OGI cameras are commonly relied upon by the oil and gas industry to detect natural gas leaks. Although they provide a quick and safe method for leak detection and repair (LDAR), the cameras can be expensive, and typical OGI cameras do not provide quantitative emission rates. Proficiency in the use of these cameras requires a well-trained, experienced operator to ensure present leaks are found.

Various environmental factors affect the monitoring approach: temperature (most important), moisture in the atmosphere, distance from the source, wind speed, and background methane concentrations. Additionally, physical factors also affect leak detection, including the composition of the natural gas, concentration and size of the leak release point, and the rate of the release. The methane leak plume detection on an OGI camera works best when there is a significant temperature difference between the gas released and the scene background. Studies have attempted to quantify the detection limit of OGI cameras; however, the detection limit of an OGI camera is dependent on the type of camera, environmental factors, physical factors, and the ability of the OGI operator.

EPA has developed multiple protocols for OGI surveys. For TxMCW purposes, an OGI survey can be conducted using any of the federally approved methods in 40 CFR § 60. Alternative methods may also be approved by TxMCW.

Each location performing an OGI survey for TxMCW must have a monitoring plan that describes the procedures for conducting a survey, including daily verification checks, regular verification of site conditions, method for monitoring all regulated components, documentation required for surveys, and quality assurance videos for OGI camera operators.

Column-Integrated Methane Concentration Instrumentation (TDLAS):

Standoff laser-based, hand-held methane detectors can be used to identify leak points from up to 30 meters. These instruments employ TDLAS to emit an infrared laser beam specific for methane detection that is analyzed after being reflected to the detector. Between the detector and reflection point, methane molecules absorb part of the laser energy proportional to the cumulative (column-integrated) methane concentration with units of ppm-m. The response time of these devices is rapid (0.1 seconds) with a typical sensitivity of 5 ppm-m at distances from 0 m to 30 m, which is more than an adequate performance for the purposes of this program. Unlike OGIs, hand-held methane detectors provide a non-visual approach to detect small leaks that could not be identified through imaging systems and are less affected by environmental factors, such as temperature and wind.

Methane Emission Quantitative Measurement Methods

High Flow Sampling:

High flow sampling is a widely used approach for measurements of methane leakage for maintenance or regulatory compliance, as well as for academic research. By introducing a focused vacuum with a high flow rate at potential leak points, the leakage is completely captured, and the methane concentration is analyzed by thermal conductivity, catalytic oxidation, tunable diode laser adsorption spectroscopy (TDLAS), cavity ringdown spectrometers (CRDS), or other scientific measurement principles. The multiplication of methane concentration and instrument flow rate yields the methane emission rate in mass/time (i.e., g/h).

There are commercially available high flow samplers, as well as recently published open-source architecture, for building a high flow sampler from easily sourced components, platform-independent Python coding for all software, readily accessible sensor components, and the use of a commercial high-volume blower. Various attachments (e.g., bags, funnels, and wands) are available for handling irregularly shaped components. Newer commercial systems have quantification limits on the order of 0.5 g/h with a reported accuracy better than ± 5%. To get an accurate methane emission rate measurement, it is critical to verify that the high flow sampler is fully capturing the emissions from the source location. An OGI camera can be used to visually verify emissions capture.

Flux Chambers:

Static flux chambers are sealed containers with a fixed volume (V; m^3) that are placed over an identified leak. To calculate an emission rate (Q; g/h), the concentration of methane (C; g/m^3) within the container is measured over time (t; hours):

$$Q = V(\frac{C}{t})$$

Methane concentrations are determined by analyzing collected air samples from within the chamber at different points in time. The chambers do not require power, and the size of the chamber can be customized to fit the geometry of the leak. However, larger chambers may be more difficult to transport to remote locations and may be susceptible to displacement by high winds. Conversely, methane concentrations within smaller chambers may reach dangerous levels (> 5% v/v; lower explosive limit [LEL]) creating a potential hazard.

Dynamic flux chambers are similar to static chambers in that a container of known volume (V; m^3) is placed over a leak. In this approach, however, air with a known methane concentration (C_{air}; g/m^3) at a known flow rate (q; m^3/h) is flushed through the chamber, thereby decreasing the potential development of a hazardous environment. The methane concentration within the chamber, measured either by a screening instrument or from collected air samples, should reach a steady state (C_{eq}; g/m^3) after a period of time, which can vary proportionally to the leak rate and size of the chamber, and the emission rate Q (g/h) can be calculated:

$$Q = q(C_{eq} - C_{air})$$

This system requires greater logistical consideration given that a power source is needed to run both the pump for the air flow and a fan within the chamber to ensure that the system is well mixed. This method of quantification requires the complete enclosure of the identified leak. Site specific characteristics, such as the presence of a connected pumpjack or other pipes/infrastructure on the wellhead, could limit the feasibility of this approach by requiring large enclosures.

Bag Sampling:

An alternative but similar approach to a rigid flux chamber method uses a flexible anti-static (e.g., mylar) bag. This approach may be useful when leaks are difficult to capture because of irregular construction of the wellhead, multiple leak points identified at the wellhead, or difficulty isolating a leak. Bag sampling is conducted according to the EPA Protocol for Equipment Leak Emission Estimates (U.S. EPA, 1995). The method involves using flexible bags of assorted sizes to custom fit a containment around a potential leak source. The bag has an inlet port through which sweep air is introduced to the containment at a known flow rate (recommend from 5 L/minute up to 100 L/minute) and an exhaust port at which the concentration of methane is measured using a methane concentration analyzer once a steady value is achieved.

With the known exhaust methane concentration and flow rate of sweep air, an emission rate is calculated as:

$$Q = q(C_{out} - C_{in})$$

where Q is the emission rate in g/h, q is the flow rate (converted to m^3/h), and C_{out} and C_{in} are the concentration of methane (converted from parts per million [ppm] to g/m^3) in the air coming out of and going into the bag, respectively. The detection limit of this approach depends upon the analyzers selected for flow rate and methane concentration.

For the measurement of the leak flow rate only, anti-static bags of a known volume can be placed directly over a leak, and the amount of time it takes to fill the bag is recorded. This procedure requires a discrete leak point that can be completely sealed by the bag opening. This is a less expensive way to quantify a leak rate, relative to other methods; however, chemical analysis of the leaking gas would be required to generate a methane emission rate. The material of the anti-static bag must be compatible with the sampled gas such that it would not affect the chemical analysis.

Other Methane Measurement Approaches:

Due to the rapidly changing nature of technology and methods for measuring methane emissions from oil and natural gas wells, the methane emissions measurement protocol provided by DOE/NETL intentionally allows for novel approaches, subject to pre-approval, so long as they meet the requirements outlined herein.

For information about novel methane measurement approaches, please contact TxMCW at txmcw@tceq.texas.gov.

Methane Emission Quantification

The purpose of pre-plugging measurements is to quantify methane reductions realized during well plugging funded by the grant.

> Note that facilities that report to the Greenhouse Gas Reporting Program (GHGRP) under Subpart W are required to follow the Subpart W quantification methodology (Code of Federal Regulations, 40 Part 98, Subpart W) to quantify the methane mitigated from well plugging.

Both pre- and post-plugging measurements are required. However, the purpose of post-plugging measurements is to verify there are no methane emissions, Qualitative approaches can be used to confirm that there are no emission sources remaining at a site after plugging. **If no leaks are found using qualitative measurements, methane emissions are assumed to be zero and quantification is not required.**

The measurement approaches taken to quantify pre- and post-plugging emissions will vary depending on site-specific factors, including whether the site is required to submit an emissions inventory under the requirements of the GHGRP Subpart W and desired performance metrics. **Regardless of the quantification approach required, DOE/NETL requirements specify that direct measurements should be used for methane measurement.** Quantitative approaches should have an MDL of less than 100 g/h and high accuracy.

Direct source emissions measurement approaches require personnel to sample directly from potential emission locations using portable analytical systems capable of quantifying both the methane concentration and flow rate to determine the methane emission rate in mass/time (i.e., g/h).

These approaches have the highest risk of personnel exposures to a combustible atmosphere and/or air toxics, and strict adherence to the safety considerations is recommended.

Greenhouse Gas Reporting Program Applicable Facilities:

DOE/NETL requirements specify that facilities that are subject to the GHGRP are required to follow the Subpart W quantification methodology (Code of Federal Regulations, 40 Part 98, 2024) to quantify the methane mitigated from well plugging for the purposes of this program.

The GHGRP requires reporting of greenhouse gas (GHG) data and other relevant information from large GHG emission sources, fuel and industrial gas suppliers, and CO_2 injection sites in the United States. The GHGRP is a 100% federal program that is administrated by the Environmental Protection Agency (EPA). Information about the program is available on their website at https://www.epa.gov/ghgreporting.

Only facilities that emit >25,000 metric tons of carbon dioxide equivalent emissions per year are required to participate in the GHGRP; however, the Global Warming Potential (GWP) of one ton of methane emissions is 28 tons of CO_2e emissions[1]. EPA provides an Applicability Tool on their website that can assist in determining applicability at https://www.epa.gov/ghgreporting/applicability-tool.

Because the GHGRP is a 100% federal program, TCEQ encourages any questions regarding requirements for GHGRP applicable facilities be directed to EPA. For TxMCW methane measurement requirements, TCEQ will use the most recent reported year for methane emissions reported to the GHGRP and request a copy of the report that was submitted to the EPA to demonstrate compliance with all applicable measurement requirements.

Non-GHGRP Applicable Facilities:

For all other facilities, methane emissions measurement approaches are summarized below and included in Attachment 1.

Fugitive And Equipment Leak Emissions:

DOE/NETL guidelines require direct methane measurement of fugitive emissions and equipment leaks from wells chosen for grant award. Direct methane measurement equipment must have an MDL of 100 g/h.

[1] Table A-1 to Subpart A of Part 98, Title 40: https://www.ecfr.gov/current/title-40/part-98/appendix-Table A-1 to Subpart A of Part 98

Methane Emission Calculations:

For each quantified measurement, specify the type of gas and measurement methodology used. Convert the volumetric emissions of natural gas to standard conditions (e.g., temperature of 0°C and pressure of 1 atmosphere) unless the measurement methodology already accounts for standard conditions. Methane emissions measurement approaches are included in Attachment 1.

Data Reporting

Methane measurement data must be reported to TxMCW using the Methane Measurement Report Form. Information about the methane emissions measurements will be shared on the public website developed and maintained by TxMCW at https://www.tceq.texas.gov/airquality/txmcw.

The TxMCW website will be updated at a minimum of once per month in addition to the quarterly reporting to NETL. The website will include the following information relevant to the methane emissions measurements:

- Wellhead location (decimal degrees, 5–7 decimal places, WGS84) and the American Petroleum Institute (API) number.
- Estimated annual reduction of methane emissions from each plugged well.
- Total estimated annual reduction of methane emissions from all plugged wells.

The estimated annual reduction of methane emitted is equal to a year of pre-plugging emissions minus a year of emissions from the post-plugged well (calculated assuming the post-plugging measurement is constant over a year).

The following information will be required for each MCW site measured:

For pre- and post-plugging measurements:

- Date(s) and time(s) of the qualitative detection survey and quantitative emissions measurements.
- Weather conditions at the time of measurements (temperature, barometric pressure, etc.).
- Name and affiliation of the qualified measurement specialist(s).
- Description of the pre-plugging measurement approach, including instrumentation and calibration protocols.
- Well status (i.e., shut-in, idle, producing, etc.).
- Pre-plugging well site description and inventory of surface facilities (photographs recommended).
- Background methane concentration and how/when the measurement was taken.
- Description of any attempts to characterize the variability and/or uncertainty in emission rate (i.e., repeated measurements at multiple date[s]/time[s], measurements for an extended period, and measurements using multiple approaches).
- Abnormal site conditions (e.g., dilapidated equipment, open tank valves).
- Documentation of challenges and solutions.
- A description of gas compositional analysis used for quantification of methane emissions. If a representative analysis is used, justification must be provided.

- A description and listing of the sources of emissions surveyed.
- Pre-plugging individual and aggregated methane emissions rate estimates in g/h and metric tons per year.
- Date of plugging.
- Date(s) and time(s) of the qualitative detection survey and quantitative emissions measurements (if applicable).
- Description of the post-plugging measurement approach, including instrumentation and calibration protocols.
- Post-plugging well site description and inventory of surface facilities (photographs recommended).
- Post-plugging background methane concentration and how/when the measurement was taken.
- A quality assurance (QA)/quality control (QC) process is required where the contractor or qualified measurement specialist makes a second set of measurements at ~5% of randomly chosen wells to verify the precision of the selected methodology. These repeat measurements should be done on the same day because of possible longer-term, temporal variability in emission rates.

Attachment 1 - Texas Voluntary Marginal Conventional Well Plugging Program (TxMCW) Methane Measurement and Quantification Procedure:

Qualitative Detection Methods

A qualitative analysis must be performed using any approved method to conduct leak detection(s). Emissions are detected whenever a leak is detected according to the method.

Optical gas imaging instrument. Use an optical gas imaging instrument for equipment leak detection as specified in any of the following federal rules: 40 CFR § 60.18 (Alternative Work Practice), 40 CFR § 60.5397a (New Source Performance Standard OOOOa), Appendix K to 40 CFR § 60 (Determination of Volatile Organic Compound and Greenhouse Gas Leaks Using Optical Gas Imaging). Any emissions detected by the optical gas imaging instrument from an applicable component is a leak. In addition, you must operate the optical gas imaging instrument to image the source types required by this subpart in accordance with the instrument manufacturer's operating parameters.

Method 21. Use the equipment leak detection methods in Method 21 in appendix A-7 to 40 CFR § 60. You must survey all applicable source types at the facility needed to conduct a complete equipment leak survey. For the purposes of this subpart, the term "fugitive emissions component" in §60.5397a of this chapter and §60.5397b of this chapter means "component." Use methane as the reference compound. If an instrument reading of 500 ppm or greater is measured for any applicable component, a leak is detected.

Infrared laser beam illuminated instrument. Use an infrared laser beam illuminated instrument for equipment leak detection. Any emissions detected by the infrared laser beam illuminated instrument is a leak. In addition, you must operate the infrared laser beam illuminated instrument to detect the source types required by this subpart in accordance with the instrument manufacturer's operating parameters.

Alternative Monitoring Technologies. Other methane quantification equipment may be used if prior approval is received from both TCEQ and the DOE NETL. Approval will be issued in a written format and must be included in the TxMCW Methane Quantification submittal to TCEQ.

Quantitative Measurement Methods

A quantitative measurement analysis must be performed using any approved methods. All flow meters, composition analyzers, and pressure gauges used to measure quantities must be operated and calibrated. You may use an appropriate standard method published by a consensus-based standards organization, if such a method exists, or you may use an industry standard practice.

Calibrated Bags/Flux chambers. Use calibrated bags (also known as vent bags) or flux chambers only where the emissions are at near-atmospheric pressures and below the maximum temperature specified by the vent bag manufacturer such that the bag is safe to handle. The bag opening must be of sufficient size that the entire emission can be tightly encompassed for measurement till the bag is completely filled.

Hold the bag in place enclosing the emissions source to capture the entire emissions and record the time required for completely filling the bag. If the bag inflates in less than one second, assume one second inflation time.

Perform three measurements of the time required to fill the bag, report the emissions as the average of the three readings.

High Volume Sampler. Use a high-volume sampler to measure emissions within the capacity of the instrument.

A technician following manufacturer instructions shall conduct measurements, including equipment manufacturer operating procedures and measurement methods relevant to using a high-volume sampler, including positioning the instrument for complete capture of the equipment leak without creating backpressure on the source.

If the high-volume sampler, along with all attachments available from the manufacturer, is not able to capture all the emissions from the source then use antistatic wraps or other aids to capture all emissions without violating operating requirements as provided in the instrument manufacturer's manual.

Calibrate the instrument at 2.5 percent methane with 97.5 percent air and 100 percent CH_4 by using calibrated gas samples and by following manufacturer's instructions for calibration.

Alternative Measurement Technologies. Other methane quantification equipment may be used if prior approval is received from both TCEQ and the DOE NETL. Approval will be issued in a written format and must be included in the TxMCW Methane Quantification submittal to TCEQ.

Methane Quantification

For each quantified measurement, convert the volumetric emissions of natural gas determined to standard conditions unless the measurement methodology converts to standard conditions.

Calculate natural gas volumetric emissions at standard conditions using actual natural gas emission temperature and pressure using:

$$E_{s,n} = \frac{E_{a,n} \times (459.67 + 60°\mathrm{F}) \times P_a}{(459.67 + T_a) \times 14.7psia \times Z_a}$$

Where:

$E_{s,n}$ = Natural gas volumetric emissions at standard temperature and pressure (STP) conditions in cubic feet.

$E_{a,n}$ = Natural gas volumetric emissions at actual conditions in cubic feet.

T_a = Temperature at actual emission conditions (°F).

P_a = Absolute pressure at actual conditions (psia).

Z_a = Compressibility factor at actual conditions for natural gas. You may use either a default compressibility factor of 1, or a site-specific compressibility factor based on actual temperature and pressure conditions.

Estimate CH_4 emissions from natural gas emissions using:

$$E_{s,i} = E_{s,n} * M_m$$

Where:

$E_{s,i}$ = CH_4 volumetric emissions at standard conditions in cubic feet.

$E_{s,n}$ = Natural gas volumetric emissions at standard conditions in cubic feet. M_m = Mole fraction of CH_4 i in the natural gas based on a site specific or representative gas sample from the facility.
Calculate CH_4 mass emissions in metric tons by converting the CH_4 volumetric emissions at standard conditions into mass emissions: $$Mass_m = E_{s,m} \times \rho_m \times 10^{-3}$$ Where: $Mass_m$ = GHG_i (CH_4,) mass emissions in metric tons. $E_{s,m}$ = CH_4 Volumetric emissions at standard conditions, in cubic feet. ρ_i = Density of CH_4. Use 0.0192 kg/ft^3 for CH_4 at 60 °F and 14.7 psia.
Leaks Detected During MCW Equipment Leak Survey:
If the qualitative methane detection survey identifies leaks from the following equipment, quantify emissions using any of the approved leak detection quantification methods and calculate equipment leak emissions using the procedures specified in this section: • Valves, • block valves, • control valves, • orifice meters, • regulators • connectors, • open ended lines, • pressure relief valves, • pumps, • flanges, and • other components (such as instruments, loading arms, stuffing boxes, compressor seals, dump lever arms, breather caps, all other components that are associated with storage tanks, including thief hatches, all components that are associated with a vapor recovery compressor, or any other surveyed leaks).
Any component that is inaccessible is exempt from the survey requirements. An inaccessible connector is one that meets any of the specifications below: • Buried. • Insulated in a manner that prevents access to the connector by a monitor probe. • Obstructed by equipment or piping that prevents access to the connector by a monitor probe. • Unable to be reached from a wheeled scissor-lift or hydraulic-type scaffold that would allow access to connectors up to 7.6 meters (25 feet) above the ground. • Inaccessible because it would require elevating monitoring personnel more than 2 meters (7 feet) above a permanent support surface or would require the erection of scaffold. • Not able to be accessed at any time in a safe manner to perform monitoring. Unsafe access includes, but is not limited to, the use of a wheeled scissor-lift on unstable or uneven terrain, the use of a motorized man-lift basket in areas where an ignition potential exists, or access would require near proximity to hazards such as electrical lines or would risk damage to equipment.
Measure the volumetric flow rate of each natural gas leak identified during the leak survey and determine the volumetric flow rate of each natural gas leak identified during the leak survey and aggregate the emissions by the method of leak detection and component type as specified in this section.
For each leak, calculate the volume of natural gas emitted as the product of the natural gas flow rate measured and the duration of the leak. If no other leak detection survey is conducted in the calendar year, assume the component was leaking for the entire calendar year. If multiple leak detection surveys are conducted in the calendar year, assume a component found leaking in the first survey was leaking since the beginning of the year until the date of the survey; assume a component found leaking in the last survey of the year was leaking from the preceding survey through the end of the year; assume a component found leaking in a survey between the first and last surveys of the year was leaking since the preceding survey until the date of the survey. For each leaking component, account for time the component was not operational (i.e., not operating under pressure) using an engineering estimate based on best available data.
Sum the CH_4 mass emissions determined in this section separately for each type of component required to be surveyed by the method used for the survey for which a leak was detected. If equation parameters are already determined at standard conditions, which results in volumetric emissions at standard conditions, then this paragraph does not apply.