Fugitive Emissions Management Guideline

VERSION 1.1: December 2023

About the Regulator

The BC Energy Regulator (Regulator) is the single-window regulatory agency with responsibilities for regulating oil and gas activities in British Columbia, including exploration, development, pipeline transportation and reclamation.

The Regulator's core roles include reviewing and assessing applications for industry activity, consulting with First Nations, ensuring industry complies with provincial legislation and cooperating with partner agencies. The public interest is protected by ensuring public safety, protecting the environment, conserving petroleum resources and ensuring equitable participation in production.

Vision, Mission and Values

Vision

A resilient energy future where B.C.'s energy resource activities are safe, environmentally leading and socially responsible.

Mission

We regulate the life cycle of energy resource activities in B.C., from site planning to restoration, ensuring activities are undertaken in a manner that:

- Protects public safety and the environment
- Supports reconciliation with Indigenous peoples and the transition to low-carbon energy
- Conserves energy resources
- Fosters a sound economy and social well-being

Values

Respect is our commitment to listen, accept and value diverse perspectives.

Integrity is our commitment to the principles of fairness, trust and accountability.

Transparency is our commitment to be open and provide clear information on decisions, operations and actions.

Innovation is our commitment to learn, adapt, act and grow.

Responsiveness is our commitment to listening and timely and meaningful action.

Additional Guidance

As with all Regulator documents, this document does not take the place of applicable legislation. Readers are encouraged to become familiar with the acts and regulations and seek direction from Regulator staff for clarification.

The Regulator publishes both application and operations manuals and guides. The application manual provides guidance to applicants in preparing and applying for permits and the regulatory requirements in the planning and application stages. The operation manual details the reporting, compliance and regulatory obligations of the permit holder. Regulator manuals focus on requirements and processes associated with the Regulator's legislative authorities. Some activities may require additional requirements and approvals from other regulators or create obligations under other statutes. It is the applicant and permit holder's responsibility to know and uphold all legal obligations and responsibilities. For example, Federal Fisheries Act, Transportation Act, Highway Act, Workers Compensation Act and Wildlife Act.

Throughout the document there are references to guides, forms, tables and definitions to assist in creating and submitting all required information. Additional resources include:

- Glossary and acronym listing on the Regulator website.
- Documentation and guidelines on the Regulator website.
- Frequently asked questions on the Regulator website.
- Advisories, bulletins, reports and directives on the Regulator website.
- Regulations and Acts listed on the Regulator website.

In addition, this document may reference some application types and forms to be submitted outside of the Application Management System but made available on the Regulator's website. Application types and forms include:

- Heritage Conservation Act, Section 12
- Road use permits
- Water licences
- Master licence to cut
- Certificate of restoration
- Waste discharge permit
- Experimental scheme application
- Permit extension application

Table of Contents

About the Regulator 2
Additional Guidance 3
Manual Revisions 5
Chapter 1: Preface 6
1.1 Scope 6
1.2 How to Use This Guideline 6
1.3 Acknowledgement 6
Chapter 2: Developing a Fugitive Emissions Management Plan 7
2.1 Accountability 7
2.2 Roles and Responsibilities 7
2.3 Preventive Maintenance 9
2.4 Continuous Improvement 9
Chapter 3: Leak Detection Surveys 11
3.1 Survey Frequency 11
3.1.1 Proration of Required Comprehensive Survey Frequency 13
3.1.2 Proration of Required Screening Survey Frequency 14
3.1.3 General Comprehensive Survey Spacing Requirement 14
3.2 Survey Scope 15
3.3 Sources of Fugitive Emissions 17
3.4 Survey Procedures 18
3.4.1 Comprehensive Surveys- Detection Methods 18
3.4.2 Comprehensive Surveys- Measurement Methods 21
3.4.3 Screening Surveys 23
3.4.4 Training and Competency 24
Chapter 4: Repairs 26
Chapter 5: Data Management 28
Appendix A: Data Collection 30
eSubmission 30
Keep a Record 31

Manual Revisions

The Regulator is committed to the continuous improvement of its documentation. Revisions to the documentation are highlighted in this section and are posted to the Documentation Section of the Regulator's website. Stakeholders are invited to provide input or feedback on Regulator documentation to ServiceDesk@bc-er.ca or submit feedback using the feedback form.

Version Number	Posted Date	Effective Date	Chapter Section	Summary of Revision(s)
1.0	July 18, 2019	January 1, 2020	Various	This is a new document. Users are encouraged to review in full. For more information, refer to INDB 2019-18 on the Regulator's website.
1.1	Dec.21, 2023	Dec.21, 2023	Various	Replace BCOGC with BCER; OGAA with ERAA; new logos, references and associations

Chapter 1 Preface

This Fugitive Emissions Management Guideline provides regulatory requirements and guidance for fugitive emissions management in British Columbia. The guideline applies to fugitive emissions at wellsites and facilities regulated under the Energy Resource Activities Act (ERAA). It does not apply to liquefied natural gas (LNG) facilities.

1.1 Scope

This guideline focuses exclusively on requirements and processes associated with the BC Energy Regulator's (Regulator or BCER) legislative authorities and does not provide information on legal responsibilities that the BCER does not regulate. It is the responsibility of the applicant or permit holder to know and uphold its other legal responsibilities.

1.2 How to Use This Guideline

BCER requirements and recommended practices are included within each section and subsection throughout the guideline. "Must" indicates a requirement for which compliance is expected and may be subject to BCER enforcement, while "recommends" or "should" indicates a best practice that should be used by the applicable party.

1.3 Acknowledgement

The BCER would like to acknowledge the Alberta Energy Regulator (AER) for their input into this guideline through allowing the Regulator to use material from Manual 16 throughout this guideline. Contributions from industry, environmental non-governmental organizations, academia, service providers and government are also gratefully acknowledged.

Chapter 2 Developing a Fugitive Emissions Management Plan

Fugitive Emissions Management Plans (FEMP) detail how a permit holder's fugitive emissions will be systematically detected, managed and reported.

Permit holders should develop a written FEMP. FEMPs and associated data should be reviewed annually and continuous improvements to the plan should be made as appropriate.

2.1 Accountability

The FEMP should clearly identify which individual is accountable (operator representative) along with their title and contact information. This individual should be a senior officer as defined in the Greenhouse Gas Emission Reporting Regulation.

2.2 Roles and Responsibilities

The FEMP should document internal (e.g., individual staff, groups, departments) and external (e.g., contractors) resources allocated to develop, implement, maintain and update the FEMP, with their specific responsibilities identified. Table 2.1 provides an example of how a permit holder might allocate and document FEMP resources and responsibilities.

Table 2.1. Example of how resources might be allocated and documented in a FEMP

Resource	Responsibility
Corporate management	• Maintain corporate commitment to the FEMP. • Approve annual FEMP budget. • Review and sign annual certification statement.
FEMP management team	• Develop and maintain FEMP review schedule. • Create comprehensive survey and screening survey schedule. • Oversee data management system. • Submit reports to the Regulator. • Assess the FEMP's effectiveness and opportunities for continuous improvement. • Provide updates, develop annual reports, and make recommendations.
Fugitive emissions surveyors	• Maintain and calibrate test equipment. • Perform comprehensive surveys. • Perform screening surveys. • Generate individual facility/wellsite reports. • Generate summary reports. • Identify components that require repair, replacement, or retrofit. • Determine leak severity, and measure or estimate emissions rate. • Maintain electronic system to capture and retain data. • Maintain monitoring schedules. • Confirm integrity of repairs.
Field operators	• Provide guidance on comprehensive survey and screening survey schedules. • Supervise surveyors and provide them with information about facility performance and operation during comprehensive surveys and screening surveys. • Review facility /wellsite reports and develop work plans (work orders) to address recommendations.
Maintenance team	• Repair leaks or modify facilities / wellsites (e.g., install test ports, re-pipe vent lines). • Close out work orders and record repair details.

2.3 Preventive Maintenance

A FEMP should indicate what preventive maintenance practices the permit holder is using to reduce or prevent fugitive emissions. This might include checklists used by field operators during routine inspections, regularly scheduled maintenance programs, and maintenance programs or standard operating procedures that incorporate preventive maintenance practices.

The following preventive maintenance practices could be incorporated into operations and maintenance practices to reduce fugitive emissions:

- Tighten loose connections (especially in a vibrating service).
- Plug or eliminate open-ended lines.
- Inspect and confirm positive isolation capability of separator and scrubber dump valves.
- Inspect and maintain pressurized pneumatic devices and pumps (e.g., controller case seals).
- Fix or replace pressurized pneumatic devices and pumps that are not operating within manufacturer written specifications.
- Inspect and maintain thief hatches.
- Inspect and maintain pressure relief valves (PRVs) and pressure vent relief valves (PVRVs).
- Close thief hatches if found open on tanks with vent gas control.
- Ensure combustion systems remain lit when facility or wellsite is pressurized and active.
- Ensure control equipment (such as vapour recovery unit) is operational (except when it is down for maintenance) and is operating and maintained as designed.
- Look for and correct abnormal process events.

2.4 Continuous Improvement

The FEMP should describe how data will be used to evaluate performance and inform continuous improvement.

The following are indicators that could be used to evaluate the performance of a FEMP and to determine if any changes are needed:

- Quantified emissions reductions over time (e.g., by corporate or operating area, or by facility type or equipment).
- Cost of detection (e.g., $/kg methane detected).
- Volume of gas conserved by managing fugitive emissions.
- Number of leaking components over time (e.g., by corporate or operating area or by facility type or equipment).
- Specific components within facilities that are more prone to leaks.

- Time between leak detection and repair.

The FEMP should indicate methods used to review data, how often data are reviewed, and how changes will be made to the FEMP following these reviews.

Chapter 3 Leak Detection Surveys

This chapter provides technical guidance to permit holders on leak sources, detection and measurement technology and methods, as well as leak detection survey timing and frequency.

3.1 Survey Frequency

The FEMP should have documented procedures and plans for meeting the required frequency of fugitive emissions comprehensive surveys and screening surveys detailed in Tables 3.1 to 3.3 including tracking for:

- Number of comprehensive surveys or screening surveys required and completed at each facility or wellsite (Drilling and Production Regulation (DPR) Section 41.1 (2) (3)).
- Results of comprehensive surveys and screening surveys and the status of all repairs (DPR Section 41.1(7)).

Fugitive emissions comprehensive survey and screening survey requirements apply only to facilities and wellsites with active (e.g. pressurized in part or in whole) equipment. Required comprehensive survey frequencies vary according to facility type, control equipment present in the case of single well batteries (controlled versus uncontrolled storage tanks of any size that store produced water, condensate, or oil), by production type, and by the presence or absence of storage tanks. Minimum acceptable comprehensive survey frequencies for regulatory compliance are detailed in Table 3.1.

Screening surveys must be done a minimum of annually at any facility not listed in Table 3.1 (DPR Section 41.1(2)) and at any conventional wellsite (wellsite producing from a zone not listed in Schedule 2 of the DPR) that does not have a storage tank (DPR Section 41.1(3)).

The FEMP should indicate how companies track when comprehensive or screening surveys are required and (DPR Section 41.1 (2)(3)(4)) the procedures used to ensure that all applicable components and natural gas driven pressurized pneumatic devices are surveyed at each site (DPR Section 41.1(2)).

Survey frequencies do not change based on the hydrogen sulphide concentration within any stream at a facility or wellsite.

Table 3.1: Minimum Acceptable Comprehensive Survey Frequencies

Facility Type	Description	Number of Comprehensive Surveys Required Per Year
Gas Processing Plant	As defined in the Drilling and Production Regulation	3
Compressor Station	Any facility containing a type A or type B compressor, as defined in the Drilling and Production Regulation	3
Multi-well Battery	Battery as defined in the Drilling and Production Regulation with link to more than one well	3
Single-well Battery with Controlled Storage Tank	Battery as defined in the Drilling and Production Regulation with link to one well	3
Custom Treating Facility	As defined in the Oil and Gas Glossary and Definitions	1
Injection/Disposal Facility	Injection station or disposal station, as defined in the Oil and Gas Glossary and Definitions	1
Wellsites with Unconventional Production	Unconventional production as defined in Schedule 2 of the Drilling and Production Regulation	1
Facility or Well with Storage Tank	Example include: Gas Dehydrator, Fractionation Facility, Pump Station, and Tank Terminal, as defined in the Oil and Gas Glossary and Definitions	1

It is expected that all co-located wellsites and facilities undergo leak detection surveys whenever any of them is surveyed. For example, if a wellsite is co-located with a multi-well battery, each time the multi-well battery is surveyed, the co-located wellsite would also be surveyed.

3.1.1 Proration of Required Comprehensive Survey Frequency

The number of comprehensive surveys undertaken per calendar year at a facility may be adjusted as indicated in Table 3.2. Minimum comprehensive survey spacing requirements are not affected by the adjustments.

Table 3.2: Proration of Three Comprehensive Surveys per Year

Days Active (Pressurized) per Calendar Year	Number of Comprehensive Surveys Required per Calendar Year
0-30	0
31-121	1
122-243	2
244-365	3

The number of comprehensive surveys undertaken per calendar year at a facility or wellsite may be adjusted as indicated in Table 3.3. Minimum comprehensive survey spacing requirements are not affected by the adjustments.

Table 3.3: Proration of One Comprehensive Survey per Year

Days Active (Pressurized) Per Calendar Year	Number of Comprehensive Surveys Required Per Calendar Year
0-90	0
91-365	1

If proration of comprehensive survey frequencies is used, records of well and/or facility operating hours must be submitted to the Regulator through eSubmission by no later than May 31 of the year after which the proration was used.

3.1.2 Proration of Required Screening Survey Frequency

Proration of the number of screening surveys undertaken per year at facilities and wellsites is not permissible.

3.1.3 General Comprehensive Survey Spacing Requirement

At facilities where more than one comprehensive survey is required per calendar year each comprehensive survey must be conducted at least 60 days from the last comprehensive survey conducted as per Section 41.1(4)(a) of the DPR. The spacing between surveys may cross calendar years. For example, a survey at a gas plant could be conducted in December of one year and then again in March of the following year. At facilities where one comprehensive survey is required per calendar year each comprehensive survey must be conducted a minimum of 9 months apart from the last comprehensive survey conducted as per Section 41.1(4)(b) of the DPR. The spacing between surveys may cross calendar years.

Facility Turnarounds

Comprehensive surveys should be conducted within 14 days after the completion of a facility turnaround. The end of the turnaround is determined by the resumption of operations (full or partial).

Comprehensive surveys conducted after a facility turnaround apply towards the number of comprehensive surveys required at a facility each calendar year provided they also meet the general comprehensive survey spacing requirement.

Post Construction

Comprehensive surveys and screening surveys should be conducted within 30 days after the completion of construction activities. This includes the construction of new facilities (greenfield), as well as any modifications of existing (brownfield) facilities.

Pre-commissioning inspections are considered by the Regulator to be a suitable alternative to post construction surveys.

For facilities and wellsites, the start of the 30 day time period is the first day of startup.

Comprehensive surveys conducted after facility construction apply towards the number of comprehensive surveys required at a facility each calendar year provided they also meet the general comprehensive survey spacing requirement.

Inactive Wells and Facilities

Comprehensive surveys and screening surveys should be conducted within 14 days after the reactivation of a facility or well. Reactivation is achieved the first day of production (wellsite) or receipts to a facility.

Comprehensive surveys and screening surveys conducted after the reactivation of a facility or well apply towards the number of comprehensive surveys and screening surveys required at a facility or well each calendar year provided they also meet the general comprehensive survey and screening survey spacing requirements.

3.2 Survey Scope

Comprehensive surveys and screening surveys must include all equipment and components at a facility or wellsite that could be a source of fugitive emissions, including pressurized pneumatic devices (Section 41.1(2) DPR) unless the components are unsafe to survey, difficult to survey or inaccessible to survey. Unsafe, difficult or inaccessible components do not need to be included until it becomes feasible to do so. Documentation stating why the component is unsafe, difficult or inaccessible to include in the survey must be detailed in each survey report.

Difficult to survey components are those that cannot be surveyed without elevating the surveyor more than two (2) metres above a supported surface or are unable to be reached via a wheeled scissor-lift or hydraulic type scaffold that allows access to components up to 7.6 metres above the ground.

Unsafe to survey components are those that cannot be surveyed without exposing surveyor to an immediate danger as a consequence of completing the survey. This is dependent on the survey method used.

Inaccessible to survey components are those that are buried, insulated, or obstructed by equipment or piping that prevents access to the components by surveyor.

Survey technicians must use survey techniques that allow them to safely and effectively detect leaks at storage tank components. When the survey method used includes optical gas imaging, if there is a reasonable line of sight to a component, it must be surveyed.

The permit holder must survey the following:

- Pressurized equipment components with hydrocarbon throughput.
- Natural gas–driven pressurized pneumatic devices.
- Tank-top equipment, including thief hatches and gauge-board assemblies and pressure relief devices.
- Pressure relief valves.
- Equipment used to combust vent gas, including burners, flare ignitors, pilots.
- Combustors.
- Equipment used to conserve vent gas, including vapour recovery units and vent gas capture systems.

It is recommended that, should liquid loading/unloading activities take place while a comprehensive survey using an optical gas imaging camera is being conducted, that the liquid loading/unloading activities be included within the scope of the survey.

Leaks detected as part of comprehensive surveys must be quantified by measurement (DPR Section 41.1(7)). Where quantification by measurement is not possible for safety reasons, because the leak is inaccessible, difficult to survey or because the leak is too small or large to measure, quantification must be done by engineering estimate or emission factor (DPR Section 41.1(7)).

Leaks detected as part of screening surveys must be quantified by either measurement, engineering estimate, or emission factor (DPR Section 41.1(7)).

Leak rates and corresponding quantification methods must be submitted to the Regulator using eSubmission.

When leak rates are quantified by engineering estimate or emission factor a methodology that is in accordance with the Greenhouse Gas Emission Reporting Regulation must be used. The estimation of leaks by empirical experience is not acceptable (DPR Section 41.1(7)).

A summary of leak quantification requirements is provided in Table 3.4.

Table 3.4: Leak Quantification Requirements

Type of Survey	Type of Leak		
	Outside Measurement Device Range	Inaccessible, Difficult to Survey or Unsafe to Access	Other
Comprehensive	Emission Factor or Engineering Estimate		Measure
Screening	Emission Factor, Engineering Estimate, or Measure		

3.3 Sources of Fugitive Emissions

Standard Equipment Components

Fugitive emissions from standard equipment components are the result of components wearing out or failing over time, being improperly installed, or loosening due to vibration. These fugitive emissions can often be easily detected during a fugitive emissions comprehensive survey or screening survey, and the component can often be immediately refitted, repaired, or replaced.

The following components are common sources of fugitive emissions:

- Connections (especially threaded connections) and fittings.
- Instruments and valves (e.g., pressure relief valves and control valves).
- Seals and housings (e.g., pressurized pneumatic controller case seals and tank thief hatch seals).

Abnormal Processes

Fugitive emissions from abnormal processes typically result from equipment malfunctioning or becoming inoperative, or from processes functioning abnormally. These types of emissions may be more difficult to detect because they can be more intermittent and may require a detailed investigation before the source can be identified and repaired.

The following abnormal processes are common sources of fugitive emissions:

- Unlit flares (ignitors and pilots).
- Malfunctioning pressurized pneumatic devices.
- Conservation units (e.g., vapour recovery units) that have quit operating.
- Equipment components emitting vent gas upstream of equipment actively controlling vent gas.

Hydrocarbon storage tanks can also be sources of fugitive emissions from abnormal processes when:

- Thief hatches are open outside the time required for pressure relief.
- Leaking process gas or volatile product moves past the seats of drains or blowdown valves.
- Gas and liquids are separated inefficiently allowing gas to carry through.
- Production changes result in high vapour carry through.
- Pigging operations displace large volumes of gas to the tank.

3.4 Survey Procedures

A FEMP should describe the methods and equipment used for comprehensive surveys and screening surveys including the make and model of the equipment used. It is not necessary to use the same type of equipment for all comprehensive surveys and screening surveys (DPR Section 41.1 (1)).

3.4.1 Comprehensive Surveys- Detection Methods

The two leak detection survey technologies that, when they meet the minimum specifications in this guideline and when used in accordance with the procedures in the guideline, are accepted as comprehensive survey methods under the Drilling and Production Regulation are organic vapour analyzers (US EPA Method 21[1]) and optical gas imaging (OGI) cameras.

OGI cameras must be capable under laboratory conditions of detecting 1 gram per hour of pure methane emitted at:

- A distance of 3 metres between the camera and the emission.
- A difference between air temperature and background temperature of no greater than 10 degrees Celsius.

Before using any survey equipment, the surveyor must make sure that it can be safely operated in the area and take any necessary precautions. Before starting the survey, the surveyor should identify a scanning path to ensure all areas of the facility are surveyed. It is usually best to follow the path of the product from inlet to outlet. The surveyor might also conduct the survey by individual process units and then check off each unit as it is surveyed.

Meteorological conditions, such as rain and wind, can make it more difficult to detect fugitive emissions. For example, higher winds can distribute plumes more quickly, making them harder to detect. Comprehensive surveys conducted during meteorological conditions that substantially compromise their effectiveness should be avoided, were practicable (surveys done at wind speeds greater than 4 m/s, during moderate to heavy precipitation events, at ambient temperatures below -20 degrees Celsius).

[1] ***EPA Method 21*** means the method of the Environmental Protection Agency of the United States entitled *Method 21 — Determination of Volatile Organic Compound Leaks*, set out in Appendix A-7 to Part 60 of Title 40, chapter I of the *Code of Federal Regulations* of the United States.

Leaks detected as part of comprehensive surveys must be quantified as described in Table 3.4 (DPR Section 41.1(7)).

Organic Vapour Analyzer

Organic vapour analyzers, sometimes called toxic vapour analyzers, are portable analyzers typically equipped with photoionization detectors (PIDs) or flame ionization devices (FIDs). Other types of sensors include catalytic oxidation or infrared absorption sensors.

When completing surveys using an organic vapour analyzer:

- Manufacturer written recommendations for the specific type of equipment used must be followed (DPR Section 41.1(1) (a)).
- The tip of the analyzer's probe must be traced along the leak interface as close as possible to the component's surface.
- Surveyors must ensure that the analyzer reaches its full metre reading by keeping the analyzer's probe in place until the reading levels out or peaks.
- To prevent falls when surveying elevated components, surveyors may use an extension probe on the analyzer rather than a ladder.
- When multiple components are close together, it can be difficult to identify the location of a leak. Surveyors must take the time to ensure that the correct source is identified and may use soap testing to help confirm the leak location.
- Surveys must be conducted at a pace that is appropriate for the size of the component and its configuration. Larger components will take more time to survey if a uniform probe speed is used. As a general rule, a speed of 3 cm per second should be used, moving more slowly when inspecting areas with higher potential for leaks.

Gas Imaging Cameras

Gas imaging cameras, often referred to as optical gas imaging cameras, are a tool for detecting fugitive emission sources. These cameras provide images and video recordings of leaks that are invisible to the human eye. In addition, they can be used when it is not practical to use an organic vapour analyzer (e.g., when the component is hard to reach or is difficult to access with the analyzer's probe) and can be used to detect fugitive emissions from a distance.

The ability of an OGI camera to detect fugitive emissions depends on several factors, such as distance from source, atmospheric conditions, thermal gradient, and surveyor competency.

When completing comprehensive surveys using an OGI camera:

- Manufacturer written recommendations for the specific type of equipment used must be followed. (DPR Section 41.1(1) (a)).
- Surveyors should stand 1.5 to 3 metres from the equipment being surveyed (for detection purposes), depending on the size and accessibility of the equipment. (For quantification by quantitative OGI, standing further back may be sometimes be appropriate.)
- Surveyors should divide the field of view in the camera view finder into quadrants and scan each quadrant to look for gas movement from each component. Gas movement might be visible only when the gas moves from the component to the background. If contrast is low or movement is difficult to observe, the high-sensitivity mode of the camera might help with detection.
- Each piece or group of equipment should be scanned from a wide angle in order to identify any apparent emissions. After a wide-angle scan, detailed scans should be done to identify the specific fugitive emissions source and to detect any lower-rate fugitive emissions not visible in the wide-angle scan. Each piece of equipment should also be scanned from at least two separate viewpoints to increase the probability of emissions detection.
- If the temperature of the leaking gas is similar to the surrounding area, surveyors should adjust the temperature span on the camera to compensate for low thermal contrast to improve their ability to identify a leak (e.g., when the component being surveyed is close to a heater or boiler) (DPR Section 41.1(1) (b)).
- Surveyors must consider, to the extent practicable, whether there are any factors such as ambient weather conditions or surrounding physical structures that could affect the ability to detect the fugitive emissions and take these into account when conducting a survey. Surveys should not be conducted during weather conditions that undermine quality when it can be avoided (moderate and heavy precipitation, wind speeds> 4m/s, ambient temperatures below -20 degrees Celsius).
- It is difficult to see gas movement when the camera is in motion, so the camera is to be held still on one scene for a few seconds before moving on to the next. This is so that video can be used for quantitative OGI by the surveyors or by others after the survey is complete.
- It can be challenging to distinguish between hydrocarbon gas and other hot gases, such as steam. When viewed through a camera, steam will dissipate quickly as it cools, but a hydrocarbon gas plume often remains visible for longer.

When comprehensive surveys using optical gas imaging cameras are conducted at very cold temperatures (below approximately -20 Celsius) physical limitations with the camera may be experienced such as LCD screen freezing or a high battery discharge rate. Efforts to keep the camera warm such as minimizing the time spent outside and the use of heating pads and/or blankets may be used. (DPR section 41.1(1) (b)).

Acoustic Leak Detection

Leakage from level control valves on separators and scrubbers to tankage without operating vapour recovery or thermal control devices must be monitored as part of comprehensive surveys by using an acoustic leak detection device as per the Greenhouse Gas Emission Reporting Regulation. Any leakage found must be reported as a leak (DPR Section 41.1(7)).

When completing comprehensive surveys using an acoustic leak detection device follow manufacturer written recommendations for the specific device used.

3.4.2 Comprehensive Surveys- Measurement Methods

BCER approved leak measurement devices for comprehensive surveys are as follows:

1. Quantitative optical gas imaging.
2. High flow sampler.
3. Full flow meter.
4. Calibrated bag.
5. Other measurement devices, approved in consultation with the Regulator.

Quantitative Optical Gas Imaging Camera

Quantitative Optical Gas Imaging (QOGI) is a technology that is designed to work with an optical gas imaging camera as an add-on module. The module uses image information (pixel intensity and number of pixels) and supplementary data (distance from camera to the plume and ambient air temperature) to calculate the mass rate of the release. Leak video should be collected for a minimum of 120 seconds for audit purposes (DPR Section 41.1(7)).

When measuring emissions using an optical gas imaging camera follow manufacturer written specifications for the specific device used.

When QOGI is being used for measurement purposes, a tripod should be used to steady the camera (DPR Section 41.1 (7)).

It is expected that leaks between 0.018 m^3/hr and 18 m^3/hr can be measured using QOGI[2].

High Flow Sampler

A high flow sampler includes a sampling hose, an instrumentation box containing a blower and combustibles sensors, a battery pack, and a control pad/display. The high flow sampler draws a sample of the air around

[2] FAQ: Providence Photonics QL320 and QOGI

a leak and measures pressure differential across an orifice restrictor as well as methane concentration using sensors. This information is used to calculate the leak flowrate.

It is expected that leaks between 0.085 m^3/hr and 13.6 m^3/hr can be measured using a high flow sampler[3].

When measuring emissions using a high flow sampler follow manufacturer written recommendations for the specific device used with the following exceptions:

- High flow sampler is recommended to be calibrated daily (must be calibrated monthly).
- Firmware version 3.03 or greater must be used[4].

If the high flow sampler is not calibrated daily or Firmware version 3.03 or greater is not used, an additional method of measurement should be undertaken in addition to the use of the high flow sampler (DPR 41.1 Section (7)).

Full Flow Meter

Leak flow rate can be measured with a variety of instruments such as a diaphragm flow meter, rotary meter, orifice meters and ultrasonic flow meter.

When measuring emissions using a full flow meter written manufacturer specifications are to be followed.

Calibrated Bag

A calibrated bag is a bag for measuring the flow rate from a vent or open line. The bag has a known volume and a neck sized to fit over openings. The leak rate is determined as the volume of the calibrated bag divided by the fill time.

It is expected that leaks up to 408 m^3/hr can be measured using a calibrated bag.[5]

When measuring emissions using a calibrated bag follow written manufacturer recommendations for the specific bag used.

[3] Section 8.5.2.3 Update of Equipment, Component and Fugitive Emission Factors for Alberta Upstream Oil and Gas, Alberta Energy Regulator, June 10, 2018
[4] Howard, T., T. W. Ferrara, and A. Townsend-Small. 2015. Sensor transition failure in the high flow sampler: Implications for methane emission inventories of natural gas infrastructure. J. Air Waste Manag. Assoc. 65:856–862. doi:10.1080/10962247.2015.1025925
[5] Section 8.5.2.1 Update of Equipment, Component and Fugitive Emission Factors for Alberta Upstream Oil and Gas, Alberta Energy Regulator, June 10, 2018

Equipment Calibration and Maintenance

The FEMP should describe the methods of calibrating and practices for maintaining the survey equipment. This should include how frequently any maintenance or calibration activities are conducted and any procedures or tracking systems used to ensure that these activities are carried out (DPR Section 41.1(1)).

Documentation to demonstrate that equipment is being maintained and calibrated to the manufacturer's written specifications must be maintained.

3.4.3 Screening Surveys

The two screening survey methods that are currently approved for use by the Regulator are the use of a soap solution (bubble test) and using the senses of hearing, sight, and small (also known as Audio, Visual, Olfactory (AVO)). Comprehensive survey methods approved by the Regulator may also be used in place of screening survey methods.

Leaks detected as part of screening surveys must be quantified as specified in Table 3.4 (DPR Section 41.1(7)).

Leak rates and the quantification methods must be submitted to the Regulator using eSubmission.

Meteorological conditions, such as rain and wind, can make it more difficult to detect fugitive emissions. Screening surveys conducted during under meteorological conditions that substantially compromise their effectiveness (moderate or heavy precipitation, wind speeds greater than 4 m/s, ambient temperature below -20 degrees Celsius) should be avoided, when practicable.

AVO Inspections

When carrying out AVO inspections, check for the following:

- Stains, wet areas, or dripping around thief hatches, pressure vacuum relief valves, and gauge board assemblies on storage tanks.
- Frosting or sweating of valves and pressure-relief devices connected to vent lines.
- Visible vapour or steam plumes from components.
- Normally closed valves connected to vents or open-ended lines that are not fully closed or plugged.
- Components that have been temporarily removed for inspection, maintenance, or other purposes and have not been put back in place.
- Unlit pilots and flares.

- Odours inside buildings and downwind of piping, process equipment, and storage tanks.
- Sounds indicative of a leak.
- Responses on hydrocarbon detection monitors (personal monitors).

Permit holders should make screening surveys part of their routine site visits.

Soap Testing

Soap or bubble testing can be an effective method to detect smaller leaks. A sprayer or squeeze bottle is used to apply a soapy solution to an area where a leak is suspected. If a leak is present, bubbling occurs at the location of a leak. Soap tests may not be effective in detecting leaks from equipment that is inaccessible, has continuously moving parts, or has a surface temperature greater than the boiling point or less than the freezing point of the soap solution.

3.4.4 Training and Competency

The FEMP should describe any internal and external surveyor training programs, including the topics covered and the duration of training, and relevant certifications. The FEMP must also describe the specific training for the types of equipment being used. The FEMP should also indicate how frequently the surveyors will be trained and how often they will be retrained or recertified (DPR Section 41.1(1)).

Training of individuals conducting fugitive emissions comprehensive surveys and screening surveys should include, at a minimum, the following:

- Principles of detecting emissions with the equipment or method.
- Operation and calibration of equipment.
- Sources of fugitive emissions.
- Factors that affect estimates of fugitive emissions (e.g., weather, temperature) and how to account for them.
- Interpretation of results.

Surveyors must also have experience detecting, measuring, recording, and reporting fugitive emissions. If they do not, such as in the case of a person that is being trained, the trainee must work under the direct supervision of a trained and experienced individual (DPR Section 41.1(1)).

Surveyors must have adequate training and experience with design and operation of pneumatic devices so that any natural gas driven malfunctioning (leaking) pneumatic devices and pumps will be detected during both comprehensive and screening surveys.

Additionally, it is expected that all surveyors will have applicable site safety training and certificates.

Chapter 4 Repairs

Permit holders must have procedures to track, manage, and verify the status of repairs and repair information must be submitted to the Regulator through eSubmission (DPR Section 41.1(7)).

The FEMP should describe the data management practices and systems used to ensure that comprehensive survey and screening survey results trigger required repairs and that the repairs are captured for reporting purposes. System details might include the names of software programs or applications used and the type of data managed by each system. When multiple systems are used, the FEMP should explain how data flows between systems (e.g., how data from surveys performed by third parties are integrated into the permit holder's internal systems to track repairs).

The first attempt to repair a leak should be made quickly after discovery, unless parts are unavailable, the equipment requires shutdown to complete repair, or other good cause exists.

Repairs can either be completed on site during or after comprehensive surveys or screening surveys. It is recommended that maintenance or operations staff who can perform repairs accompany surveyors to complete repairs that can be done immediately.

If parts are unavailable, they should be ordered promptly and the repair must be made within 30 working days of receipt of the parts (DPR Section 41.1 (5)(6)). If successful repairs cannot be completed within 30 days due to the need to order parts an exemption request to DPR Section 41.1(5)(a) must[6] be made to the Regulator to avoid noncompliance. Requests must be in writing to air.monitoring@bc-er.ca.

Some leaks might require a shutdown to repair them, such as leaks from components that cannot be isolated and leaks requiring the site to be depressured. If the facility must be depressured to complete the repair, the repair may be deferred until the next facility turnaround provided that it does not create an offsite odour or safety hazard (DPR Section 41(1)(a)(b)) or as directed by the Regulator (DPR Section 41.1(5)).

All leaks at wellsites must be repaired within 30 days regardless of the need to depressure the wellsite (DPR Section 41.1(6)).

The integrity of all repairs made must be verified using either a soap solution or an instrument based method such as optical gas imaging (DPR Section 41.1 (5)(6)) for the repairs to be considered to be successful.

[6] This statement is must because the DPR does not allow for repair times to extend beyond 30 days.

A repairable leak includes:

- Any unintentional natural gas emission detected by an organic vapour analyzer with a concentration equal to or greater than 500 parts per million.
- Any unintentional natural gas emission detected by a gas imaging camera.

Information on each leak detected and repair made must be submitted to the Regulator using the Regulator's eSubmission portal (DPR Section 41.1 (7)).

Tagging

Physical tagging (tag is affixed to a leaking component that cannot be immediately repaired), is the most common method of tagging. These tags should be hung either directly on the leaking component or in a position where it is easy to determine the location of the leaking component. Tags should be uniquely numbered, weather resistant, designed for high visibility, and securely hung using plastic zip ties or corrosion-resistant wire.

Alternative methods of tagging, such as geospatial identifiers, should identify fugitive emission sources and provide sufficient information to enable repair. This information must include the date the leak was detected (DPR Section 41.1 (7)).

Consideration should be given to leaving tags in place after repairs are made to monitor for recurrent leaks.

Chapter 5 Data Management

Data management systems allow permit holders to track, manage, and analyze fugitive emissions data. These systems should:

- Track completed comprehensive, and screening surveys and repairs (including work orders).
- Track scheduled comprehensive, and screening surveys and upcoming repairs (including tagging).
- Track facility /wellsite and component performance data over time.
- Enable data analysis to identify trends.
- Generate data summaries for use in regulatory reports.

Record Keeping

Detailed records of all surveys conducted, leaks detected, and repairs made are required to be reported to the Regulator. Appendix A identifies the information that permit holders are required to either keep a record of for audit purposes or submit to the Regulator through eSubmission.

The keeping of and submission of records to the Regulator, as detailed in Appendix A, is as follows:

- Comprehensive surveys – required.
- Screening surveys at facilities and wellsites
    - **Mandatory Screening Surveys**: Those surveys conducted to meet the minimum requirements of DPR Section 41.1(2) (3) – Records must be submitted to the Regulator through eSubmission.
    - **Voluntary Screening Surveys:** Those surveys conducted in addition to those needed to meet the minimum requirements of DPR Section 41.1(3) (b) - keep a record. Voluntary submission can be made to the Regulator through eSubmission.

An example of a mandatory screening survey is an annual screening survey at a wellsite with conventional production (not listed in Schedule 2 of the DPR) that does not have a storage tank. If the conventional wellsite has a storage tank, it would be subject to a minimum of one comprehensive survey per year (DPR Section 41.1(3) (a) (i)) and any screening surveys conducted at the wellsite would be considered to be voluntary.

An example of a voluntary screening survey is a daily screening survey at a compressor station. This is because compressor stations are subject to mandatory comprehensive surveys under Section 41.1(2) (a) (ii) of the DPR.

Data for each comprehensive survey and mandatory screening survey conducted must be submitted electronically to the Regulator through eSubmission by May 31 of each year for each survey conducted during the previous calendar year. If May 31 occurs on a Saturday or a Sunday, the data are due on the following Monday (DPR Section 41.1 (7)). The first report is due by May 31, 2021.

Data for each leak found and for repairs must be submitted electronically to the Regulator through eSubmission by May 31 of each year for each survey conducted during the previous calendar year. If May 31 occurs on a Saturday or a Sunday, the data are due on the following Monday (DPR Section 41.1 (7)). The first report is due by May 31, 2021.

Records related to leak detection, quantification, and repair must be retained for a period of not less than 7 years after the date the leak detection, quantification, or repair was complete to meet the requirements of the Greenhouse Gas Emission Reporting Regulation.

Data must be certified by a permit holder representative. This individual should be a senior officer as defined in the Greenhouse Gas Emission Reporting Regulation.

Appendix A: Data Collection

eSubmission

The following information is to be submitted to the Regulator using eSubmission on an annual basis:

Facility/Well Data:

- BCER facility / wellsite identifier.
- Information on whether natural gas emitting pressurized pneumatic devices are present.
- Information on whether storage tanks are present and whether or not they are controlled.
- Reporting year.
- Number of days facility or well was pressurized or partially pressurized.

Measurement Device Data (comprehensive surveys only):

- Make.
- Model.

Technician Data:

- Name.

Leak Survey Data:

- Date.
- Ambient temperature (comprehensive surveys only).
- Barometric pressure (comprehensive surveys only).
- Wind speed (comprehensive surveys only).
- Precipitation (comprehensive surveys only).
- Information regarding whether the survey was conducted internally or by third parties.
- Survey method.
- Detection instrument make.
- Detection instrument model.
- Information regarding whether a leak or leaks were detected.

Leak Data:

- Information on whether or not the leak contains hydrogen sulphide.
- Information on whether or not the leak is located within a building.
- Process block in which the leak is located.
- Leaking component type.
- Leaking component service type.
- Distance detection camera is located from leak (if applicable).
- Distance quantification camera is located from leak (if applicable).
- Leak rate.
- Leak methane content.
- Leak rate quantification method (if applicable).
- Reason for non-measurement of leak (if applicable).

Repair Data:

- Date of repair.
- Information on whether the leak was repaired on the same day it was detected.
- Leak repair confirmation method.
- Leak repair method applied.
- Basis of delay of leak (if repaired after 30 days of detection).
- Information on whether the leak is scheduled to be repaired at the next turnaround (if applicable).
- Anticipated date of next turnaround (if applicable).

Keep a Record

The following information is to be submitted to the Regulator upon request:

Measurement Device Data:

- Software version (if applicable).
- Calibration date.
- Maximum margin of error.
- Calibration report.

Technician Data:

- Information on whether or not the technician's employer is the site permit holder.
- Employer name.
- Employer business address.
- Training entity name.
- Training entity address.
- Name of trainer.
- Job title of trainer.
- Training date(s).
- Number of hours of training received.
- Description of training received.

Leak Survey Data:

- Survey report.

Leak Data:

- Photograph of leak (comprehensive surveys only).
- Video of leak (if applicable).

Repair Data:

- Documentation verifying repair of leak.