

SENSIA RedLook System Methane Alternative Test Method (MATM)

1. Scope and Application

1.1 Scope

This method outlines the procedure for using the SENSIA RedLook System as a Methane Alternative Test Method (MATM). A key component of this method is the SENSIA Mileva 33F Optical Gas Imaging (OGI) camera. Hereafter, “SENSIA RedLook System MATM” or, simply, “this method” refers to the holistic method described by this Alternative Test Method, utilizing the Mileva 33F OGI camera. This method is broadly applicable across the sector to demonstrate compliance with the guidelines in 40 CFR §60.5398b for fugitive emissions components affected facilities and compliance with periodic inspection and monitoring requirements for covers and closed vent systems, specifically demonstrating compliance through periodic monitoring, as approved, per 40 CFR §60.5398b(b). Applicable sites could include but are not limited to single wellhead sites, small well sites, multi-wellhead sites, well sites with major production and processing equipment, centralized production facilities, and compressor stations.

1.2 Application

1.2.1. The application of this method is per the Environmental Protection Agency’s (EPA) 40 CFR part 60 New Source Performance Standards (NSPS): Subparts OOOO, OOOOa, and OOOOb, and Emissions Guidelines (EG): OOOOc, for the Oil and Natural Gas Source Category.

1.2.2. The method is applicable to methane (CH₄, CAS No. 74-82-9) emissions from oil and gas facilities. This method can be used, as approved by the Administrator, in lieu of the applicable fugitive monitoring requirements in either §60.5397a or §60.5397b and inspection and monitoring of covers and closed vent systems in either §60.5416a or §60.5416b. This method may be used for fugitive monitoring requirements in §60.5397c and monitoring of covers and closed vent systems under §60.5416c when a state, local, or tribal authority incorporates the model rule (i.e. OOOOc) for the emission guidelines as part of their State Implementation Plan (SIP) or elsewhere approved as applicable. The method is a performance-based method to determine whether individual component emissions remain below prescribed thresholds.

1.2.3. The method is a stationary in-situ sensor and is broadly applicable across the sector.

1.3 Method Sensitivity

1.3.1 The sensitivity of this test method is a 1 kg/hr alerting threshold as applied to the details of screening frequency (see Section 1.4).

1.3.2 This method can confirm the detection of fugitive emissions at a component-level spatial resolution (as defined at 40 CFR §60.5398b(b)(5)(iv)) and provides OGI imagery and video of the emission point so that an operator can visually define the source.

1.3.3 This method has a minimum detection limit (MDL) of 0.27 kg/hr at 90% probability of detection (PoD).

1.4 Data Quality Objectives

Adherence to the requirements of this method will ensure the data supporting the SENSIA RedLook System MATM objective will be accurate and of quality. The method's objective is to periodically screen for fugitive emissions at oil and gas infrastructure, alerting on detected emissions. The screening frequency of infrastructure in scope, as per the minimum detection threshold of 1 kg/hr and 40 CFR part 60 subparts OOOOa, OOOOb, and Emissions Guidelines (EG): OOOOc, for the Oil and Natural Gas Sector Operations is, at a minimum, quarterly at well sites, centralized production facilities, and compressor stations subject to AVO inspections with quarterly OGI or EPA Method 21 monitoring, and semi-annually at well sites and centralized production facilities subject to AVO inspections and/or semiannual OGI or EPA Method 21 monitoring.

2. Summary of Method

2.1 The SENSIA RedLook System MATM is an autonomous solution which uses machine learning algorithms to detect emissions in OGI video footage collected by SENSIA's proprietary OGI camera, the Mileva 33F. The underlying detection algorithms are locked in the sense that the detection principles do not change from deployment to deployment. The method has been deployed for a wide range of application cases, but this protocol describes the method's use for leak detection and repair (LDAR). This overview of the method is broken down into data collection, data manipulation and interpretation, and data reporting - all of which will be expanded upon in further sections.

2.2 The data collection of the SENSIA RedLook System MATM is facilitated by the SENSIA Mileva 33F OGI camera(s). Briefly, OGI cameras are infrared (thermal) cameras which can visualize methane and various other organic gases that are inherently invisible to the human eye. The Mileva 33F creates images of long-wave infrared spectrum where methane and other hydrocarbons actively absorb; as a result, methane plumes become visible in the OGI camera footage. As such, the method collects the same data (OGI video footage) a "traditional" OGI operator would, using a handheld OGI camera. Prior to data collection, at each site monitored by the method, camera deployment engineering (siting) identifies the optimal number of Mileva 33F OGI cameras, and their installation location. During the camera deployment engineering phase, the Mileva 33F can optionally be mounted on a pan and tilt device which autonomously moves the camera through a "tour" of operator and SENSIA defined field of views (FoV) which encompass multiple equipment requiring monitoring. After camera deployment engineering, a Commissioning Phase further refines the monitoring plan. Camera deployment engineering and commissioning phases are highly site specific, SENSIA and the operator will ensure an installation which optimizes viewing angles of equipment requiring monitoring. Upon completion of the camera deployment engineering and commissioning phases, the SENSIA RedLook System MATM is ready to collect OGI video data. Figure 1 is the Mileva 33F OGI camera, and Figure 2 is the pan and tilt device.



Figure 1: The Mileva 33F OGI camera.



Pan & Tilt unit.

Figure 2: The pan and tilt device.

2.3 Data manipulation and interpretation is carried out by the method's computer vision and machine learning algorithms. First, these algorithms autonomously transform incoming OGI video footage into data which can be interpreted by detection algorithms. At a high level, this involves quantifying the color

(digital levels) and rate of color change of the pixels in the OGI video footage. Second, algorithms are used to scan the now converted OGI video footage for emissions, detecting them if they are present. Part of this process involves the SENSIA RedLook System MATM calculating wind speed based on the behavior of the emissions plume. This calculated wind speed is used in emissions detection. These algorithms have been extensively trained on emissions data and are additionally trained on OGI video footage of the deployment site prior to official monitoring during a commissioning phase. This robust model training drastically reduces the occurrences of false positives. Thirdly, the algorithms will identify emissions plumes in the OGI video footage by coloring them on the infrared image, making them easier to detect for operators reviewing the OGI video footage. All these processes happen autonomously. Figure 3 is an example of OGI video footage which contains a detection that has therefore been colored.



Figure 3: Example an emissions plume detected by the SENSIA RedLook System MATM.

2.4 Data reporting is handled autonomously by the method and primarily is focused on alerting the operator of detection events. Alarms are communicated to the workstation in the Control Block (further details in Section 6), via on-screen alerts, audible alerts, emails to operator, or standard communication protocols, such as Modbus TCP and OPC UA.

3. Definitions of Method

3.1 Definitions

3.1.1 Alarm Event: The notification which the operator receives once the SENSIA RedLook System MATM has detected an emission event (Detection Event). The operator is notified via the Control Computer with details including time, location, and visual evidence.

3.1.2 Alarm Report: An automated report generated by the method that documents all alarm events triggered over the periodic screening window. The report includes relevant details such as timestamps, and OGI video footage with the detected emissions highlighted for each Alarm Event.

3.1.3 Camera Deployment Engineering: The first phase of installation of the RedLook System MATM at a site. This involves SENSIA leading decision making around the optimal number of Mileva 33F cameras, their installation locations, the use of pan and tilt mounts, and their lenses. Camera deployment engineering is a highly site-specific process.

3.1.4 Close Range Survey: A handheld OGI or Method 21 inspection following EPA CFR 60.5397b.

3.1.5 Commissioning: The process conducted to configure the SENSIA RedLook System MATM for full operational readiness prior to deployment. It involves setting and validating all system parameters to ensure reliable detection, recording, and alarm functionality under site-specific conditions. It occurs after camera deployment engineering.

3.1.6 Convolutional Neural Network (CNN): A type of artificial neural network designed to process and analyze data with a grid-like structure, notably images. Convolutional layers apply filters across the input data to detect local patterns such as edges, textures, or shapes. SENSIA's detection algorithm component of the RedLook Software leverages a Convolutional Neural Network.

3.1.7 Control Block: The Control Block can be present either on, or off site and encompasses the physical hardware and associated software necessary for data processing, autonomous emissions detection, and communication with the Mileva 33F OGI camera(s).

3.1.8 Control Computer: Runs the RedLook Software (see RedLook Software definition). The Control Computer also includes the user interface and dashboards, allowing for direct observation of the method's real-time monitoring data and facilitating communication of alerts and system status.

3.1.9 Data Logging: The process of recording emissions detection events along with associated metadata (time, location, intensity) for further analysis, reporting, or compliance purposes.

3.1.10 Emissions Detection Event: An occurrence where the SENSIA RedLook System MATM detects emissions from on-site equipment, triggering an Alarm Event. Additional details are provided in Section 12.

3.1.11 Field of View (FoV): The total area visible through an OGI camera as captured by the OGI camera lens. It is commonly measured in degrees to express angular coverage.

3.1.12 Field Block: Encompasses the physical hardware present at the site requiring monitoring. Includes the Mileva 33F OGI camera, the Pan and Tilt Device the camera is mounted on, termination boxes used for communication and transfer of data to the Control Block, and a power source. Optional components include a 4G antenna for deployment at unmanned sites.

3.1.13 Manned Sites: Sites which have field personnel present daily. Follows a specific System Architecture.

3.1.14 Methane Emissions Technology Evaluation Center (METEC): METEC is a controlled-release test facility located at the Colorado State University in Fort Collins, Colorado. In this facility, realistic oil and gas scenarios are simulated to test and benchmark methane leak detection and quantification technologies.

3.1.15 OGI cameras: Specialized cameras that detect and visualize gases that are otherwise invisible to the naked eye. These cameras use infrared technology to capture the thermal radiation emitted by gases, allowing for the identification of gas leaks.

3.1.16 Operator: The Operator of a facility, or site, being monitored. In this protocol, the operator is the end-user of the method.

3.1.17 Optical Gas Imaging (OGI): A non-invasive imaging technique used to visualize and identify gases that are otherwise invisible to the naked eye, often employed for detecting leaks or emissions in industrial settings.

3.1.18 Pan and Tilt Device: A device capable of both horizontal (pan) and vertical (tilt) movement, designed to perform pre-programmed "tours" through various positions. As per this method, they are used in conjunction with an OGI Camera to capture different fields of view of the site, pointing at different equipment from multiple angles for comprehensive monitoring.

3.1.19 Periodic Screening Window: A 24-hour window of time during which the SENSIA RedLook System MATM autonomously and continuously screens the site. The 24-hour screening window is scheduled for the 1st day of the periodic screening interval defined by the site type and the method's 90% PoD of 1 kg/hr. The annual occurrences of the periodic screening windows for different site types are as follows:

- Single Wellhead Only: At the start of each 6-month interval (2 times per year).
- Multi Wellhead Only Sites: At the start of each 6-month interval (2 times per year).
- Small Well Sites: At the start of each 6-month interval (2 times per year).
- Compressor Stations: At the start of each quarter (4 times per year).
- Major Well Sites or Centralized Production Facilities: At the start of each quarter (4 times per year).

The Periodic Screening Window can be adjusted based on the operational conditions on the scheduled day. For example, if a site was scheduled for the 24-hour Periodic Screening Window on January 1st, but there were abnormally low temperatures, the Periodic Screening Window could be re-evaluated daily and postponed until a date later than January 1st with warmer temperatures. Based on the operational envelopes of the method (Section 5), these occurrences are rare.

3.1.20 Probability of Detection (PoD): A measure representing the chance that a methane detection technology will successfully detect an emission of a certain rate when it occurs. A 90% PoD refers to the minimum emission rate at which a methane detection technology will achieve a 90% detection probability.

3.1.21 Real-Time Monitoring: The continuous collection and analysis of data from an emissions monitoring system, where information is processed and potentially acted upon instantly or with minimal delay.

3.1.22 RedLook Software: The software suite that operates on the control computer, responsible for managing and analyzing data collected from the Mileva 33F OGI camera. It includes functionalities for autonomous emissions detection, data visualization, system configuration, and real-time communication with the Mileva 33F OGI camera(s). The RedLook Software is designed to process emissions data, trigger

alerts for detected anomalies, and provide a user interface for system monitoring and reporting.

3.1.23 Region of Interest (RoI): A predefined section within the Mileva 33F OGI camera's FoV where the RedLook Software can apply its emission detection algorithms.

3.1.24 Site: The oil and gas facility requiring monitoring.

3.1.25 Scenario Based Tuning (SBT): The final stage of the method installation, following camera deployment engineering and commissioning. Involves training the RedLook Software detection algorithms on OGI data specific to the site being monitored. Note that this training does not impact underlying detection algorithm methodology, it is a SENSIA led work practice to identify common potential sources of false positives. As per this ATM, all detections must be addressed.

3.1.26 Sensitivity: The ability of the method to detect emissions at different rates (kg/hr). It is an important factor in determining the performance of an emissions detection system.

3.1.27 System Architecture: The organization of the method's infrastructure. The SENSIA RedLook System MATM's infrastructure is divided into two main segments, or blocks: the Field Block and the Control Block. The Field Block includes the physical hardware located at the site requiring monitoring, such as cameras, pan and tilt units, and other detection equipment. The Control Block encompasses the physical hardware and associated software responsible for data processing, autonomous emissions detection, and communication with the Mileva 33F OGI cameras. The Control Block can be located either on-site or off-site, depending on the system configuration and requirements.

3.1.28 Tour: A predefined, automated sequence of camera movements through specified positions or fields of view.

3.1.29 Unmanned Sites: Sites which do not have field personnel present daily. Follows a specific System Architecture.

3.1.30 Volatile Organic Compound (VOC): A class of organic chemicals that vaporize at room temperature. These are regulated airborne chemicals in many jurisdictions.

3.2 Abbreviations

The following abbreviations are used within this document.

3.2.1 CNN: Convolutional Neural Network

3.2.2 FoV: Field of View

3.2.3 METEC: Methane Emissions Technology Evaluation Center

3.2.4 OGI: Optical Gas Imaging

3.2.5 PoD: Probability of Detection

3.2.6 RoI: Region of Interest

3.2.7 **SBT**: Scenario-Based Tuning

3.2.8 **VOC**: Volatile Organic Compound

4. Method Interferences and Envelope of Operation

4.1 Operational envelopes are essential to ensure the method delivers the expected data quality while maintaining safe working conditions. To achieve this, the following conditions must be met, as outlined in Table 1. Most operational envelopes pertain to the Mileva 33F OGI camera as it is the component of the method which must be physically present, often outside, at the facility being monitored.

Table 1: Summary of Method Interferences and Envelope of Operation

Condition	Summary	Mitigation
Operating Temperature	The Mileva 33F OGI camera is the most susceptible method component to varying temperatures. The Mileva 33F camera is rated to operate within ambient temperatures ranging from -20°C to +50°C. Performance may degrade outside this range.	Ensure Periodic Screening Window occurs when temperatures fall within the operating envelope.
Storage Temperature Range	The Mileva 33F OGI camera must be stored in environments with temperatures between -40°C and +71°C. In extreme conditions, insulated or climate-controlled containers should be used. Performance may degrade outside this range.	Ensure the Mileva 33F OGI camera is stored in environments within the specified operating temperature range.
Maximum Relative Humidity	The Mileva 33F OGI camera is rated to operate in environments with relative humidity up to 95%. Exceeding this threshold may compromise system reliability.	Ensure that the Mileva 33F FY OGI camera is operated and stored in environments with ≤95% relative humidity. Confirm that all seals and enclosures maintain their IP65 or higher ingress protection rating. In cases where incoming OGI video footage is of insufficient quality to

Condition	Summary	Mitigation
		facilitate detections, the RedLook System will automatically raise a flag indicating this. Periodic screening can only be conducted when this flag is not raised. This flag will be raised in situations where there is condensation on the lens due to humidity.
Indoor and Outdoor Settings	The Mileva 33F OGI camera is designed for both indoor and outdoor deployment without compromising performance.	Select appropriate mounting and power configurations based on site conditions. For outdoor use, ensure weatherproofing components (e.g., enclosures, cabling) are properly installed.
Daytime and Nighttime Operation	The Mileva 33F OGI camera maintains detection capability in both daytime and nighttime conditions, independent of visible light.	No mitigation is required.
Wind Speed	Wind impacts the detection performance of the method by dispersing or diluting gas plumes, reducing thermal contrast and therefore decreasing the efficacy of emission detections.	While wind conditions cannot be controlled, Scenario-Based Tuning (SBT) can improve system performance by refining detection algorithms under site-specific wind patterns. Consider wind trends during camera placement and FoV configuration to minimize crosswind effects. Observe local wind conditions and ensure the Periodic Screening Window occurs when wind speeds fall within the operating envelope.
Precipitation	Light precipitation (fog, rain, or snow) has minimal impact on the Mileva 33F OGI camera	Ensure the Mileva 33F OGI camera enclosures remain sealed to prevent water

Condition	Summary	Mitigation
	due to its spectral tuning. However, heavy precipitation can obscure the FoV and reduce detection reliability.	ingress. In addition, in cases where incoming OGI video footage is of insufficient quality to facilitate detections, the RedLook System will automatically raise a flag indicating this. Periodic screening can only be conducted when this flag is not raised. This flag will be raised in situations where heavy precipitation renders OGI video quality insufficient.
Dust	Dust accumulation on the lens or dense airborne particulates can reduce image clarity and detection performance of the Mileva 33F OGI camera, especially in arid or industrial environments.	Maintain the IP65-rated enclosure to prevent dust ingress and protect internal components. In cases where incoming OGI video footage is of insufficient quality to facilitate detections, the RedLook System will automatically raise a flag indicating this. Periodic screening can only be conducted when this flag is not raised. This flag will be raised in situations where the lens has dust accumulation.
Installation Height	The Mileva 33F OGI cameras must be installed at a minimum height of 30 feet above ground level and tilted slightly downward to ensure unobstructed views of monitored equipment.	The Mileva 33F OGI camera will be mounted above all potential fugitive components.
Installation Stability	The Mileva 33F OGI camera performance may be compromised by vibration or instability at the mounting point. The Mileva 33F OGI camera must be installed on	Ensure the Mileva 33F OGI camera is installed on rigid, vibration-resistant structures or secure pan and tilt mounts. Employ guy-wires for stabilization on masts or

Condition	Summary	Mitigation
	stable structures or certified pan and tilt units.	trailers in windy environments, if necessary. The stability of the mounting structure can be evaluated during the commissioning phases and after severe weather events.
Camera Visual Line of Sight	The Mileva 33F OGI camera must maintain an unobstructed visual line of sight to the monitored equipment to detect emissions. Visual obstructions that interfere with camera visual line of sight include equipment or facility infrastructure.	During camera deployment engineering, the Mileva 33F OGI camera must achieve direct line of sight of all sources of interest for emissions monitoring. If visual obstructions are present, adjust placement or add additional cameras to maintain full visual coverage.
Distance between camera and monitored sources	The Mileva 33F OGI camera must be placed within certain distances from the monitored sources to perform emission detections effectively. If the cameras are placed too close to equipment (i.e. within the lens hyperfocal distances), the camera image is out of focus. If the cameras are placed too far from equipment, the emissions plumes fall below detection thresholds.	The Mileva 33F OGI camera must be placed away from the monitored equipment at a distance beyond the hyperfocal distance of the lens selected during operation to ensure accurate detections. See Appendix A for more information on lens hyperfocal distances.
On-site Moving Objects	Movement from vehicles, machinery, or personnel within the FoV of the Mileva 33F OGI camera can interfere with plume detection and trigger false positives.	Position the Mileva 33F OGI camera to avoid areas with frequent movement or traffic. Use SBT to adapt the detection algorithm to expected motion patterns and reduce false alarms. Additional tuning can be performed if site conditions change.

5. Safety

5.1 This method may not address all potential safety scenarios associated with its use. It is the responsibility of the operator of this method to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to performing this method.

5.2 Emissions detected by this method may contain compounds that are irritating or corrosive to tissues (e.g., heptane) or may be toxic (e.g., benzene, methyl alcohol). Nearly all are fire hazards. Compounds in emissions must be determined through familiarity with the source. Operation of the Mileva 33F OGI camera in an oil and gas facility requires compliance with Hot Work Permit and other safety standards as defined by the facility operator.

5.3 All personnel responsible for deploying the Mileva 33F OGI camera must be trained in relevant field safety protocols, including working at heights, electrical safety, and hazard recognition in oil and gas environments. Additionally, personnel should be trained and competent to work with the hazards of the emissions to which the Mileva 33F monitors and wear appropriate personal protective equipment (PPE) as defined by the facility's safety protocols.

5.4 The Mileva 33F OGI camera is certified for use in potentially explosive environments. It holds ATEX certification (EN 60079:2013; II 3 G Ex nA IIB T6 Gc), which permits deployment in Zone 2 hazardous areas where flammable gas atmospheres are not likely to occur in normal operation but may exist for short periods. The system is also EMC-compliant (EN 61326:2013), ensuring it does not interfere with other electronic equipment and remains resilient to electromagnetic disturbances on site.

5.5 The Mileva 33F OGI camera is a ground-based, autonomous, permanently installed OGI system that requires site access, equipment setup on elevated structures, and power supply integration. As such, it introduces specific safety concerns beyond routine field practices. Table 2 lists the safety considerations to be made when deploying the Mileva 33F OGI camera component of the SENSIA RedLook System MATM.

Table 2: Summary of Safety Considerations Applicable to the On-Site Deployment of the Mileva 33F OGI Camera

Safety Item	Summary
Proximity to Equipment	Mileva 33F installation must consider minimum safe distances from pressurized systems, flammable equipment, heat-generating equipment, or emission sources as defined by the site operator. Operation near live equipment must comply with site-specific hazard controls.
Working at Heights	The Mileva 33F is typically installed at minimum heights of 30 feet. Personnel must use approved fall protection and follow all elevated work procedures.
Stability of Installation	The Mileva 33F OGI camera must be installed on a certified pan and tilt unit or a stable platform. Structures must not introduce vibration or

Safety Item	Summary
	movement during operation. Guy-wires should be used for mast-mounted system. The Mileva 33F OGI camera must be installed following correct protocol to ensure it is safely fixed to its mounting structure.
Electricity Safety	Power supply setup must follow electrical safety standards. Lockout/tagout (LOTO) procedures apply when integrating with external sources.
Weather Exposure	Extreme weather conditions, such as strong winds or heavy precipitation, can provide hazards to worker safety. Weather conditions should be reviewed before field deployment.
Moving Objects	Install Mileva 33F OGI cameras away from high-traffic zones to minimize the risk of collisions between the cameras and vehicles or moving equipment.
Site Personnel Hazards	The setup and operation of the physical, onsite components of the SENSIA RedLook System MATM must not interfere with the safe movement or focus of site personnel. Equipment must be clearly marked and stabilized.
Hazardous Atmospheres	Many hydrocarbon emissions may be toxic, flammable, or corrosive. Operators should identify potential emissions from sources and wear appropriate PPE.

6. Equipment and Supplies

6.1 The equipment and supplies necessary for the SENSIA RedLook System MATM are best described through the methods System Architecture. The System Architecture breaks the necessary components down into the Field Block, and the Control Block.

6.2 The Field Block encompasses the physical hardware present at the site requiring monitoring. The field block includes:

6.2.1 Mileva 33F OGI Camera: A fixed, automated OGI camera designed for continuous methane monitoring. It uses a cooled infrared sensor to detect hydrocarbon gas plumes by capturing thermal contrast in the scene. Subcomponents of the Mileva 33F OGI camera include the lens, which directs infrared radiation onto the infrared sensor, and the onboard electronic boards which facilitate OGI camera operation as outlined by §60.5397c.

6.2.2 Camera Housing: A durable, weatherproof enclosure that protects the internal components of the Mileva 33F OGI camera from environmental factors such as dust, moisture, and temperature extremes. This housing ensures that the camera can operate effectively in various outdoor conditions.

6.2.3 Pan and Tilt Device: A device capable of both horizontal (pan) and vertical (tilt) movement, designed to perform pre-programmed Tours through various positions. As per this method, it is used in conjunction with the Mileva 33F OGI Camera to capture different fields of view of the site, pointing at different equipment from multiple angles for comprehensive monitoring.

6.2.4 Power Supply: A reliable source of power that ensures the proper functioning of the Mileva 33F OGI camera and the Pan and Tilt device. It can include a battery, external connection, or solar panel, depending on the site's requirements and deployment configuration.

6.2.5 Termination boxes: Used to transmit power to the Mileva 33F OGI camera and communicate with the Control Block (eventually integrating an edge computer to run the analytics locally). The termination boxes communicate with the Mileva 33F OGI camera(s) via Gigabit power over ethernet (POE) switches and communicate with the Control Block via fiber optic cables, ethernet, or wireless 4G connections, depending on deployment architecture. As with the Mileva 33F OGI camera(s), the number of required termination boxes varies based on the deployment site.

6.3 Control Block: encompasses the physical hardware and associated software necessary for data processing, autonomous emissions detection, and communication with the OGI camera(s) and can be present either on or off site. The control block includes:

6.3.1 Control Computer: Runs the RedLook Software. The Control Computer also includes the user interface and dashboards, allowing for direct observation of the method's real-time monitoring data and facilitating communication of alerts and system status.

6.3.2 Server Rack Cabinet: Contains power over ethernet switch, wiring, electric protections, and all other required communication equipment for communication between the Field Block, the Control Block, and the Operator if located offsite.

6.4 The SENSIA RedLook System MATAM system architecture can be arranged in two orientations based on whether the site is manned or unmanned (i.e. whether field personnel are present on-site during operations). The core differentiator is how the Field Block communicates with the Control Block. In a System Architecture for Manned Sites, the Field Block communicates with the Control Block via fiber optics or ethernet cables. In this architecture scheme, RedLook Software analytics are run on the Control Computer in the Control Block. In a System Architecture for Unmanned Sites, the Field Block communicates with the offsite Control Block via a 4G wireless connection. In this architecture scheme, RedLook Software analytics are run on the edge computer inside the termination box. Figure 4 and Figure 5 present simplified overviews of the Manned and Unmanned System Architecture, respectively.

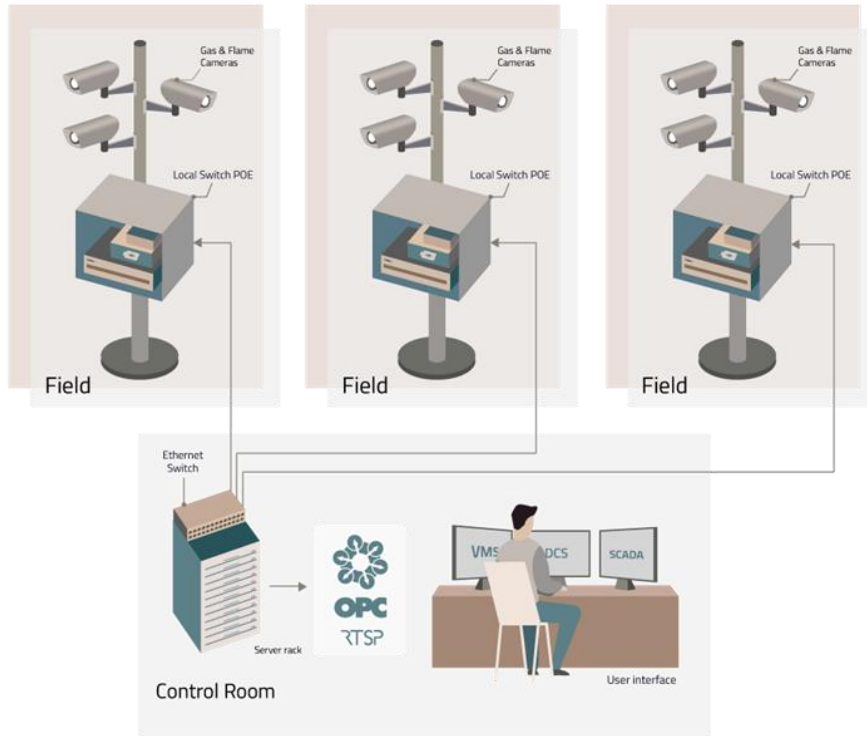


Figure 4: High-level overview of the System Architecture for Manned Sites.

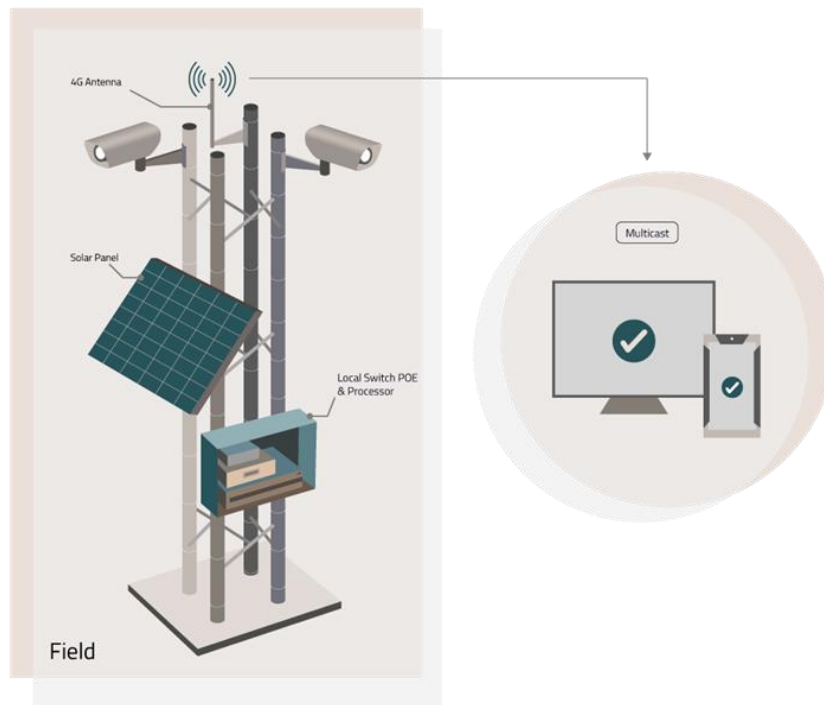


Figure 5: High-level overview of the System Architecture for Unmanned Sites.

7. Reagents and Standards

This method uses instrumentation that does not require laboratory reagents or standards.

8. Data Collection and Method Input Sourcing

8.1 Overview of Instrumentation and Data Sources

Table 3 summarizes the instruments and data sources used by the SENSIA RedLook System MATM, along with the key variables collected and their roles within the detection method. Refer to Appendix B for further details on how these data sources are used in the detection workflow.

Table 3: Summary of Instruments and Sources used in Data Collection

Instrument/Source	Variables	Use
Mileva 33F OGI Camera	Thermal image and video footage of the monitored area.	Primary instrument for collecting emission plume data.
RedLook Software	Video and still images, thermal contrast, plume geometry, time-stamped alarm data, and image metadata	The RedLook Software employs detection algorithms onto the thermal image and video footage collected by the Mileva 33F OGI camera. The RedLook Software presents the video footage to the operator on the user interface of the control computer for review, localization and repair, and reporting purposes.
Proprietary Training Dataset	Annotated infrared images of emission plumes from previous field deployments.	Enables training of RedLook Software's detection algorithms for the detection of emissions under a wide range of field scenarios. This method's detection performance has been developed using an extensive a-priori dataset containing hundreds of thousands of infrared images collected under a wide range of environmental conditions.
Meteorological Data	Wind speed, direction, temperature	The SENSIA RedLook System MATM does not directly collect

		or integrate meteorological measurements such as wind speed, direction, or temperature during standard operation.
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8.2 Camera Deployment Engineering

When the SENSIA RedLook System MATM is first deployed on site, siting is carried out via what is referred to by SENSIA as camera deployment engineering. Camera deployment engineering ensures all equipment requiring monitoring is observed via a direct line of sight by a Mileva 33F OGI camera. This process is site dependent, typically requires specific tour stops accomplished via the autonomous pan and tilt system, and occasionally multiple Mileva 33F OGI cameras. Additional camera deployment engineering considerations for are provided in Appendix A.

9. Quality Control

This section describes the quality-control measures implemented throughout the SENSIA RedLook System MATM to ensure quality results. Quality-control checks for Mileva 33F OGI camera via the RedLook software autonomous data quality checks, the auxiliary equipment (pan and tilt unit, control block, and termination boxes), the data transmission, and the manufacturing process (adhering to all quality and compliance requirements). Table 4 presents the quality assurance and quality control measures to ensure successful operation of the SENSIA RedLook System MATM.

Table 4: Quality Assurance and Quality Control Metrics

Instrument	Measurement	Acceptance Criteria	Frequency Checked	Corrective Action
Mileva 33F OGI Camera	Lens quality – lens integrity (scratches or cracks)	Passes autonomous flagging criteria in the RedLook Software	Prior to each periodic screening window and continuously during the duration of the screening window	Replacement of lens by SENSIA
Mileva 33F OGI Camera	Lens quality – build up of material on lens (dirt, dust, condensation, precipitation)	Passes autonomous flagging criteria in the RedLook Software	Prior to each periodic screening window and continuously during the duration of the screening window	Clean lens with wet wipes designed for optical device maintenance
Mileva 33F	Seals and	No leaks visible during	Each Mileva 33F OGI Camera during	Repair or replace by

Instrument	Measurement	Acceptance Criteria	Frequency Checked	Corrective Action
OGI Camera	enclosure	inspection	manufacturing	SENSIA
Mileva 33F OGI Camera	Distance between camera and fugitive components	Maximum hyperfocal distance of the lens	Initial siting and siting re-evaluation as required	Siting re-evaluation
Mileva 33F OGI Camera	Camera height above fugitive components	Camera is positioned above all fugitive components	Initial siting and siting re-evaluation as required	Siting re-evaluation
Mileva 33F OGI Camera	Clear line of sight between camera and fugitive components	Camera has direct line of site to all component with fugitive potential	Initial siting and siting re-evaluation as required	Siting re-evaluation
Mileva 33F OGI Camera	Ambient Temperature	-20C to +50C	Prior to each periodic screening window and continuously during the duration of the screening window	Suspend periodic screening
Mileva 33F OGI Camera	Precipitation	Passes autonomous flagging criteria in the RedLook Software	Prior to each periodic screening window and continuously during the duration of the screening window	Suspend periodic screening
Mileva 33F OGI Camera	Internal humidity	<95%	Prior to each periodic screening window and continuously during the duration of the screening window	Repair or replacement of camera
Pan and Tilt Unit	Pan and tilt moving through all programmed	Passes autonomous flagging criteria in the	Prior to each periodic screening window and continuously during the duration of the	Repair or replacement by SENSIA

Instrument	Measurement	Acceptance Criteria	Frequency Checked	Corrective Action
	tour stops	RedLook software checking that all tour stops are visited for the correct dwell time.	screening window	
Termination Box	Termination box power supply	Passes autonomous flagging criteria in the RedLook software checking that power is being supplied (alert will be generated in the case of power failure)	Prior to each periodic screening window and continuously during the duration of the screening window	Repair or replace termination box by SENSIA
Control Computer	Control Computer power supply	Passes autonomous flagging criteria in the RedLook software checking that power is being supplied (alert will be generated in the case of power failure)	Prior to each periodic screening window and continuously during the duration of the screening window	Repair or replace control computer by SENSIA
Server Rack	Server rack power supply	Passes autonomous flagging criteria in the RedLook software checking that	Prior to each periodic screening window and continuously during the duration of the screening window	Repair or replace control computer by SENSIA

Instrument	Measurement	Acceptance Criteria	Frequency Checked	Corrective Action
		power is being supplied (alert will be generated in the case of power failure)		

10. Calibration and Standardization

10.1 Calibration Procedures

The SENSIA RedLook System MATM requires pre-deployment calibration of the Mileva 33F OGI camera and a series of initial calibration steps carried out prior to any periodic screenings.

10.1.1 Pre-Deployment Calibration

Prior to field deployment, the Mileva 33F OGI camera undergoes the Camera Specification Confirmation requirements of Appendix K to Part 60, Title 40 Section 7 to ensure the requirements of Appendix K to Part 60, Title 40 Section 6 are met.

10.1.2 Deployment Calibration: Commissioning

During the Commissioning phase, the system is prepared for emissions monitoring through the configuration of key parameters that facilitate the detection, recording, and alarm notification processes of the SENSIA RedLook System MATM. These parameters are configured using the RedLook Software via the user interface on the control computer by trained SENSIA personnel. The following steps comprise the Commissioning phase:

1. **Establish monitoring presets (FoVs):** The operator and SENSIA will collaboratively define the FoVs for the Mileva 33F OGI camera. In situations where the Mileva 33F OGI camera is not installed on a pan and tilt unit, the FoV is the default view from the camera. In situations where the camera is installed on a pan and tilt unit and is capable of moving autonomously through various tour stops, SENSIA defines these tour stops, and their associated FoVs with the RedLook Software.
2. **Establish Regions of Interest (ROIs) within each FoV:** Using the RedLook Software's user interface, regions of interest (ROIs) are established. This process involves SENSIA, in collaboration with the operator, "drawing" polygon shapes onto the FoV displayed on the RedLook Software's user interface. Each polygon shape, or ROI, defines the area within the FoV to be monitored and has a unique identifier. By default, the RedLook Software employs a "full screen" ROI to enable detections and alarm events from the entire FoV. The RedLook Software also allows for a "stacking" of ROIs, allowing for both a full screen ROI to cover detections from the entire FoV and multiple other ROIs to be established to cover smaller subsections of the FoV. Effectively, this allows emission events to be detected from any region within the entire FoV.

while additionally enabling emission events to be isolated to a smaller subsection of the FoV, if an ROI has been established on that area. In the scenarios where an emission event is detected within a particular ROI, alarm events are triggered from that specific ROI. This allows the operator to quickly identify and localize the specific region within the entire FoV where an emission event originated. Crucially, the alerting protocol defined by this method is such that any detection in the FoV constitutes an alert, and the “stacking” of more granular ROIs is to aid operators in localizing emissions. When a pan and tilt is used, ROIs can be drawn onto the FoVs of each tour stop position that the Mileva 33F OGI camera uses. See Section 12.2 for additional information on alarm events. **Error! Reference source not found.** is an example of the polygon-shaped ROIs drawn onto the RedLook Software’s user interface.

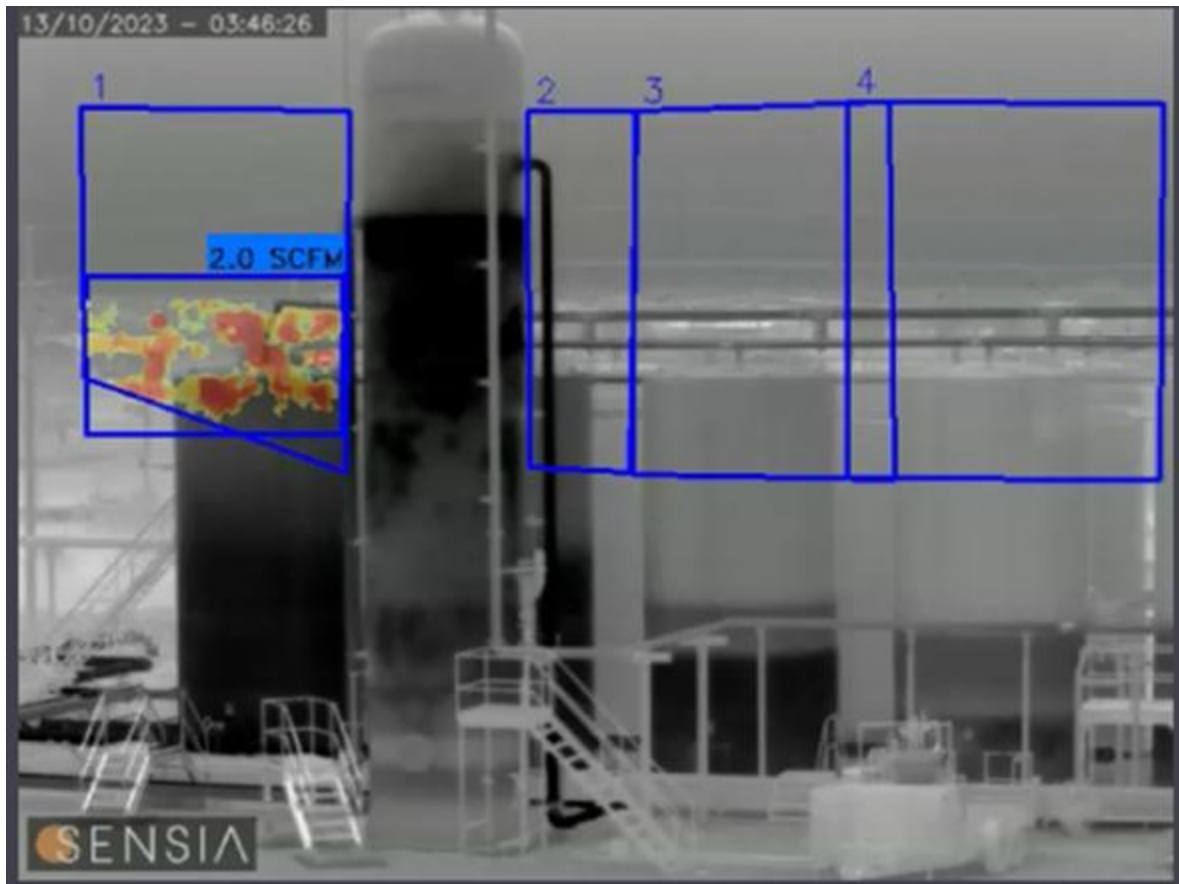


Figure 6: Example of ROI polygons drawn onto the FoV of the RedLook Software’s user interface.

3. **Finalize the monitoring plan:** In situations where a pan and tilt unit are used, the order of tour stops is set after establishing the camera FoVs and ROIs. The default/minimum tour stop time of the SENSIA RedLook System MATM is 2 minutes per tour stop. This 2-minute duration was used during the METEC testing.
4. **Establish alarm protocols:** Alarm notification settings include how the alarm is transmitted to the operator: email, sound/visual alarms at the control computer, annotations on the user interface of

the RedLook Software, and other preferred methods of notification. Alarm notifications are issued in any event where the method detects an emission.

5. **Setting the communications and integration with third-party systems:** In situations where the RedLook Software is integrated with third party systems, alarms can additionally be communicated in different ways such as through the Modbus TCP, OPC UA and hot relay to analog devices.

10.1.3 Deployment Calibration: Scenario-Based Tuning (SBT)

Following the completion of the Commissioning phase, SBT is conducted to allow for optimal performance of the SENSIA RedLook System MATM. SBT involves training the RedLook Software's detection algorithm on OGI footage collected by the Mileva 33F OGI camera from the site to be monitored. The primary goal of SBT is to collect real-world site data to allow filtering-out of ambient methane concentrations, reducing false positives. SBT is conducted by a certified SENSIA technician and takes multiple days to complete with the duration depending on the complexity of the site features and scenarios to evaluate. In situations where the camera operates with a pan and tilt unit, SBT must be done at every tour stop position.

During SBT, the following tasks can be performed:

1. **Event acquisitions:** The SENSIA RedLook System MATM is set to acquire emission detection events and identify potential sources of false alarms for 24 hours. Event acquisition is completely different than the normal operation mode of the SENSIA RedLook System MATM as its goal is to maximize the number of site-specific events to be then trained.
2. **False positive labeling:** Elements in the Mileva 33F OGI camera feed which may potentially result in false positive detections can be identified and labeled. This includes moving equipment parts, reflections, site personnel, and vehicles.
3. **Real detection labeling:** When permitted, controlled and pre-existing emission releases can be used to label accurate detections and increase the detection probability.

10.2 Ongoing Calibration

The SENSIA RedLook System MATM does not require periodic calibration for emission detection as per Appendix K to Part 60, Title 40 Section 7, the Mileva 33F OGI camera does not require ongoing calibration as the OGI camera is being used for leak detection.

10.3 Standardization: Training Requirements

Only specialized and trained SENSIA personnel or contractors are allowed to manufacture and calibrate any aspect of the SENSIA RedLook System MATM. The training procedures, requirements, and standard operating procedures are held by SENSIA.

10.4 Maintenance

SENSIA recommends the operator adheres to a collection of maintenance requirements as outlined in Table 5.

Table 5: SENSIA RedLook System MATM Maintenance Requirements

Subsystem	Item	Frequency	Performer	Location	Time
Mileva 33F OGI Camera	Lenses visual inspection	Monthly	Operator	On site	<1 hour
Mileva 33F OGI Camera	Lenses manual cleaning	Monthly	Operator	On site	< 1 hour
Mileva 33F OGI Camera	Lenses replacement	5 years	Operator	On site	< 1 hour
RedLook Software	Alarm system verification	Monthly	Operator	On site	1 hour
RedLook Software	RedLook performance self-diagnose	Monthly	Operator	On site	1 hour
RedLook Software	RedLook remote verification (under contract after first year)	Monthly	SENSIA	Remotely	4 hours
RedLook Software	Records and events verification	Monthly	Operator	On site	2 hours
RedLook Software	Storage verification	Monthly	Operator	On site	< 1 hour
RedLook Software	Recording back up	Monthly	Operator	On site	5 hours
RedLook Software	System general inspection	Annually	Operator	On site	1 day

11. Analytical Procedure

[Reserved]

12. Detection and Alerting

12.1 Detection

12.1.1 The SENSIA RedLook System MATM detects fugitive emissions by applying the method's computer vision and machine learning algorithms to OGI video footage collected by the Mileva 33F OGI camera. These algorithms autonomously process the incoming OGI video footage into data which can be interpreted by the detection algorithms. This process involves quantifying the color (digital levels) and rate of color change of the pixels in the OGI video footage. The algorithms then scan the processed OGI video footage for emissions by evaluating the thermal contrast between the emission plume and the background to identify occurrences where gas plumes are present. These algorithms have been extensively trained on emissions data and are additionally trained on OGI video footage of the deployment site prior to official monitoring during the commissioning phase. The emissions data used for training the algorithms consist of hundreds of thousands of labelled images collected from historical OGI deployments, encompassing a wide variety of environmental conditions and background types. Each pixel is classified as a true positive or false negative, allowing the algorithms to incrementally improve and reduce reliance on background uniformity. While not every possible condition has been explicitly characterized, the detection model has been built to generalize based on the thermal contrast, not the background itself. This robust model training drastically reduces the occurrences of false positives. Once emission plumes are identified by the algorithms, the emission plumes are colorized and labelled on the infrared image displayed on the RedLook Software's user interface on the control computer to allow operators to easily view the emission events in real-time during review. All processes conducted by the algorithms occur autonomously.

12.1.2 Detections due to ambient methane concentrations are considered during the SBT phase. SBT allows SENSIA to observe the site in its natural state such that the detection algorithm of the RedLook software can "learn" which equipment have baseline ambient emissions. These baseline ambient emissions are logged as such and only OGI video footage anomalous above these baseline ambient conditions are alerted on.

12.2 Alerting

12.2.1 Once the SENSIA RedLook System MATM's algorithms detect an emission event, alarm events are generated instantaneously and transmitted to the operator via communication channels, including email, sound/visual alarms or annotations on RedLook Software's user interface on the control computer, or other preferred methods of notification. These communication channels are established during the Commissioning phase of setting up the SENSIA RedLook System MATM.

12.2.2 Alarm events are generated whenever anomalous emissions patterns in the OGI video footage are detected in a given FoV. Optionally, more granular RoIs can be established in the FoV which each receive individual alerts. For example, consider a FoV which encompasses two storage tanks surrounded by areas of "non-equipment" (i.e., the ground, or background sky). If there is a detection anywhere in this FoV, the operator receives an alert. However, if the operator and SENSIA chose to "draw" RoIs around each individual tank as "RoI_1", "RoI_2" (or any descriptive naming scheme), the operator could receive two alerts; one from the overall FoV, and one associated with the more granular RoI allowing them to more quickly localize the emission and facilitate repairs. Again, RoIs are optional as alerts are tied to the overall FoV.

12.2.3 For the purposes of this ATM, detections are not subject to filtering based on emission rate or any other attribute. As such, all confirmed detections result in alarm alerts. Therefore, any emission events detected by the SENSIA RedLook System MATM require follow-up actions by the operator.

12.2.4 See Appendix B for an overview of the alerting work practice and how it relates to the periodic screening window.

13. Method Performance

13.1 METEC Testing Background

The SENSIA RedLook System MATM underwent testing at the Methane Emissions Test and Evaluation Center (METEC), a controlled release testing facility located at the Colorado State University, from June 17, 2024 to June 28, 2024 to evaluate this method's performance. The testing was carried out by GTC Analytics who also led the post-testing analysis. The testing followed the METEC Advancing Development of Emissions Detection (ADED) protocol. The SENSIA RedLook System MATM was tested under conditions and parameters which are encompassed within those outlined in the envelope of operation in Section 4. During the METEC testing, the performance of the SENSIA RedLook System MATM was evaluated based on detecting emissions from fixed release points on site. This testing procedure was not conducted comparably as it did not test relative to a reference method.

13.2 METEC Test Parameters

13.2.1 Table 6 lists the testing parameters which applied during the METEC testing campaign in June 2024.

Table 6: Summary of METEC Testing Parameters

Testing Parameter	Specification
Blinding	The testing was blinded to SENSIA, but not to GTC Analytics.
Controlled Releases	During the testing, there were 202 distinct controlled releases, ranging in duration from 14 to 18 minutes.
Release Locations	Releases originated from two groups of equipment: wellheads (5W) and tanks (4T). Both groups of equipment had 3 sources from which emissions originated.
Emission Release Rates	0.016 kg CH ₄ /hr to 155.8 kg CH ₄ /hr.
Ambient Temperature Ranges	11.70°C to 34.4°C, with a mean temperature of 24.6°C.
Ambient Wind Speed Ranges	0.808 m/s to 11.12 m/s, with a mean of 3.96 m/s.
Camera Placement	The Mileva 33F OGI camera was placed on a pan and tilt unit at a height of 35 feet above ground.

Testing Parameter	Specification
Pan and Tilt Tour Operations	The pan and tilt unit was set up to move the Mileva 33F OGI camera to view two preset positions, or tour stops, where each tour stop positioned the Mileva 33F OGI camera to capture one of the two equipment groups (5W and 4T) with the equipment group occupying the entire FoV of the Mileva 33F OGI camera. The pan and tilt unit would stop for 2 minutes at each tour stop and alternate between the two tour stops for the entire duration of testing.
Lenses	The Mileva 33F OGI camera was equipped with a 35 mm lens during the METEC testing campaign, with an approximate FoV of 18° x 13°.

13.2.2 Figure 7 and Figure 8 below present aerial imagery of the METEC facility during the testing procedures from June 17, 2024 to June 28, 2024.



Figure 7: Aerial photo of the METEC facility during testing of the SENSIA RedLook System MATM during the testing campaign in June 2024. The yellow star indicates the location where the Mileva 33F OGI camera was positioned.



Figure 8: Aerial and thermal imagery of the wellheads (5W) and tanks (4T) release points from the METEC testing campaign.

13.3 METEC Testing Results

13.3.1 This method achieved a 90% PoD of 0.32 kg/hr when corrected for wind speed (i.e. the emission rate variable was normalized for wind speed) and a 90% PoD of 0.85 kg/hr when corrections for wind speed were not made (i.e. the emission rate variable was not adjusted for wind speed). These values of the 90% PoD were obtained from testing conditions where all testing parameters fell within the acceptable operating ranges described in the envelope of operation described in Section 4. Figure 9 and Figure 10 present the PoD curves derived from the classified detection and controlled release records. These PoD curves show a logistic regression performed against true positive and false negative results.

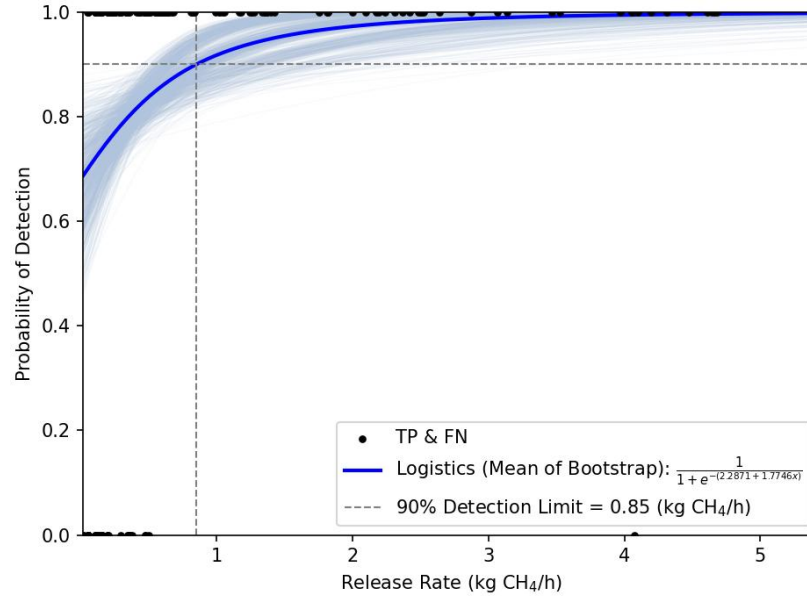


Figure 9: PoD versus emission rate (kg CH₄/hr) assessed with logistic regression including all true positives (equipment unit-, equipment group-, and facility-levels). True positives and false negative detections are shown with markers at y=1 and y=0, respectively. The regression is performed on bootstrapped results to show a cloud of curves to illustrate uncertainty in the result.

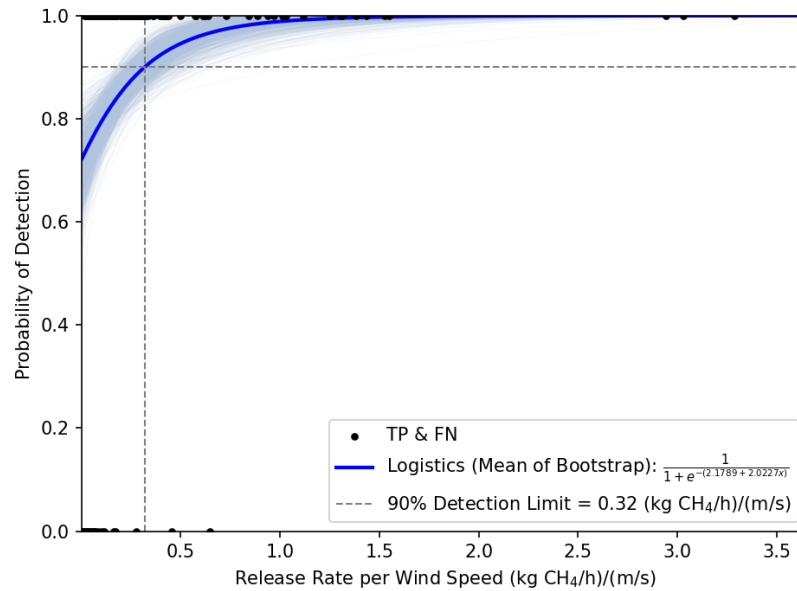


Figure 10: PoD versus wind normalized emission rate (kg CH₄/hr)/(m/s) assessed with logistic regression including all true positives (equipment unit-, equipment group-, and facility-levels). True positive and false negative detections are shown with markers at y=1 and y=0, respectively.

13.3.2 Table 7 presents the results of the SENSIA RedLook System MATM in detecting controlled releases during the METEC testing campaign in June 2024. Table 8 presents the SENSIA RedLook System MATM's performance in localization precision by listing the number of true positive detections it was able to identify at the equipment unit, equipment group, and facility-level during the METEC testing campaign in June 2024. Furthermore, Table 9 presents the localization accuracy (i.e. the fraction of reports identified as true positive) at each level of precision. The precision levels are equipment unit, equipment group or better (i.e. equipment unit and equipment group), and facility or better (i.e. equipment unit and equipment group and facility).

Table 7: Classification of Controlled Releases and Detection Reports from the SENSIA RedLook System MATM

Level	True Positive	False Negative	False Positive	Excluded from Analysis	Total
Controlled Releases	171	31	-	36	238
Detection Reports	171	-	3	6	180

Table 8: SENSIA RedLook System MATM METEC Localization Precision Performance

Level	True Positive Count
Equipment Unit	148
Equipment Group	23
Facility	0

Table 9: SENSIA RedLook System MATM METEC Localization Accuracy Performance

Level	Localization Accuracy
Equipment Unit	0.851
Equipment Group	0.983
Facility	0.983
False Positive Fraction	0.017

13.4 TADI Testing Background

Over four weeks in June and September 2024, participants participated in controlled release testing at the TotalEnergies Anomalies Detection Initiatives (TADI) site in Pau, France. 15 commercial and academic measurement systems were evaluated including the SENSIA RedLook System utilizing the Mileva 33F as described in this method.

Testing followed a single-blind format, in which participants were not told the true release rates, nor the location of the release points, nor whether the emission rate was non-zero in each time slot (participants were aware of the release start and stop time as a structured time format with announcement was used). For ease of coordination and planning among the teams on site, a pre-determined schedule was followed. Each release occurred for approximately 45 minutes, followed with a 15 minute break for plume dispersion, ensuring a return to background levels of methane concentration between tests.

13.5 TADI Testing Results

Table 10 is a summary of true positive (TP), false positive (FP), true negative (TN), and false negative (FN) releases by the SENSIA RedLook System MATM using the Mileva 33F camera. Figure 11 is a probability of detection curve for emissions below 30 kg/hr.

Table 10: SENSIA RedLook System MATM TADI testing results

TP	FP	TN	FN	TP (%)	FP (%)	TN (%)	FN (%)	Max Release Rate Detected (kg/hr)	Minimum Release Rate Detected (kg/hr)
67	0	3	1	95	0	4	1	308.2	0.02

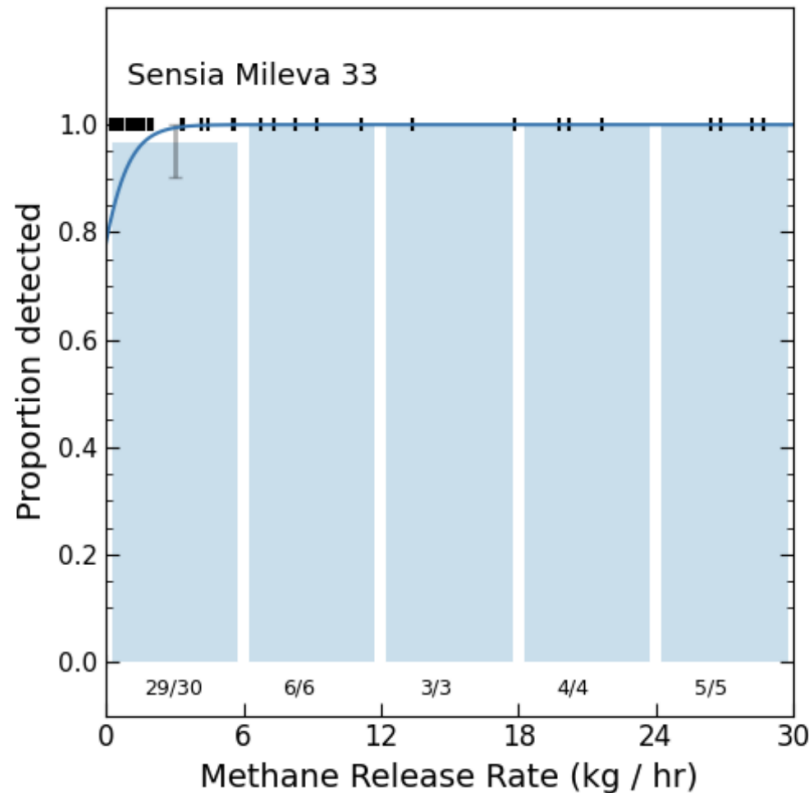


Figure 11 SENSIA RedLook System using the Mileva 33F camera. Each release is marked by a vertical line at $y = 0$ if not detected and $y = 1$ if detected, ordered along the x-axis by release volume.

14. Pollution Prevention

[Reserved]

15. Data Management

15.1 Raw Video Collection

Radiometric information generated from the Mileva 33F OGI camera is saved in “.raw” and “.rlk” formats. The .raw video format does not undergo any data loss through compression and is a standardized raw image/video format that stores each video frame as a matrix showing the digital level value (13-14 bits) on each pixel of the camera detector array. This video format can be opened by both the RedLook Software and third-party applications. The .rlk video format is SENSIA’s proprietary radiometric video format which includes all the information of the .raw files and additional metadata, including information about the Mileva 33F OGI camera serial number and hardware/software configuration and calibration file. The .rlk video format can only be opened within the RedLook Software.

15.2 Compressed Video Processing

15.2.1 The RedLook Software also saves videos in the compressed “.mp4” video formats. These videos cannot be reopened or re-processed by the RedLook Software. The RedLook Software can produce

compressed videos in two ways: alarm videos and continuous recording footage. Both modes can be independently activated/deactivated and configured according to the operator needs, however, as per this method, alarm videos are always created.

15.2.2 Alarms videos provide visual evidence of the detection events which triggered an alarm generation. Alarm event videos include video footage of the alarm event and include instants preceding the event. These videos are used for the review of alarm events and reporting purposes and can be generated manually or automatically. The RedLook Software also offers a video recovery tool to allow the operator to search past detection events and filter by date or alarm type.

15.3 Data Storage

15.3.1 Within the RedLook Software, the raw videos and associated metadata are saved into separate folders on the control computer, where a new folder is automatically generated for every 900 frames. Like the raw videos, the RedLook Software saves the compressed video recordings into separated 2-minute long videos and stores them onto the control computer. If an autonomous tour is used, these 2-minute long videos correspond to the 2-minute dwell time at each tour stop FoV.

15.3.2 The RedLook Software must store raw video footage for a minimum of 5 years. In cases where extended storage capacity is necessary, the hard disk drive (HDD) capacity of the control computer can be scaled accordingly to accommodate larger volumes of video data without impacting system performance.

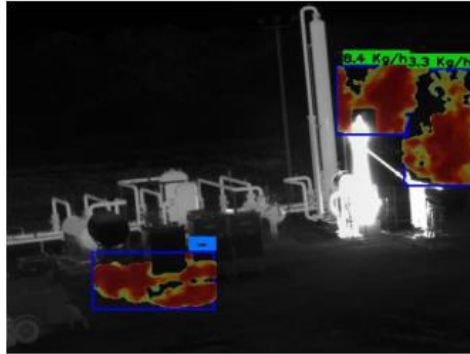
15.3.3 All metadata generated by the RedLook Software is saved into a local PostgreSQL database. This database contains the following metadata:

- Identification information of Mileva 33F OGI cameras: Includes serial numbers as well as latitudes and longitudes obtained during operation.
- Tour stop information: All information associated with the tour stop configurations used during operation of each Mileva 33F OGI camera.
- ROIs: All identifying information associated with the selected ROIs during the commissioning stage.
- Alarms identification information: All identifying information associated with each alarm events.

15.4 Data Delivery to Operators

The RedLook Software offers the end-user the function to generate automated reports containing a summary of the alarms triggered over a period selected by the operator, a default setting where this period corresponds to the 24-hour periodic screening window is available. The operator has the ability to search for old alarm events with the option to filter for alarms based on date or alarm type. These reports are generated in a Microsoft Word “.docx” format and include the camera snapshots. Figure presents an example of an alarm report generated by the RedLook Software.

2023/05/05 00:11



Device Name:

Camera 01 - Preset 01

S/N:

Model:

Event Name:

AGA_DET: Gas detection

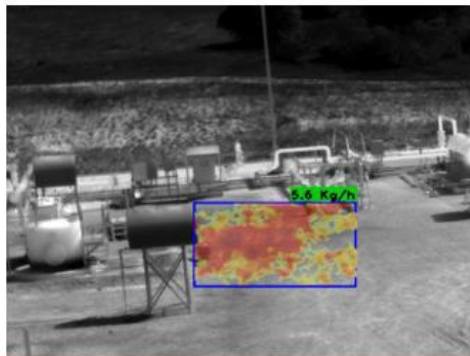
Sensitivity: Medium; ~~FileName:~~

192.168.1.53 2023/05/05 00:11

Event Data:

~~AverageFlowRate:~~ 7.178

2023/05/05 13:37



Device Name:

Camera 01 - Preset 02

S/N:

Model:

Event Name:

AGA_DET: Gas detection

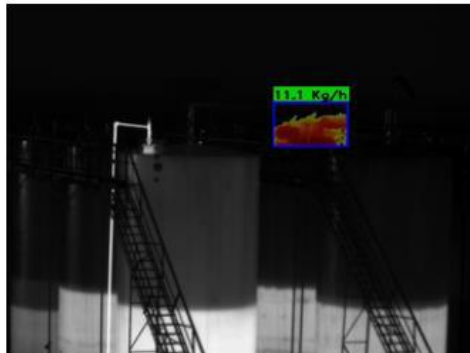
Sensitivity: Medium; ~~FileName:~~

192.168.1.53 2023/05/05 13:37

Event Data:

~~AverageFlowRate:~~ 12.859

2023/05/06 00:34



Device Name:

Camera 01 - Preset 07

S/N:

Model:

Event Name:

AGA_DET: Gas detection

Sensitivity: Medium; ~~FileName:~~

192.168.1.53 2023/05/06 00:34

Event Data:

~~AverageFlowRate:~~ 7.652



Figure 12: An example of an alarm report generated by the RedLook Software.

16. References

[Reserved]

17. Appendix

17.1 Appendix A: Additional Camera Deployment Engineering Considerations

17.1.1 The deployment engineering of the Mileva 33F OGI camera involves the decision making around the placement and positioning of the Mileva 33F OGI camera(s) on site and choice of lens. The Mileva 33F OGI camera needs to be installed such that all monitored equipment are captured within a dedicated FoV, meaning that monitored equipment must be within direct line of sight of a Mileva 33F OGI camera. In situations where the Mileva 33F OGI camera monitors multiple units of equipment via the pan and tilt device and multiple tour stops, but not all of them can be fully captured within the Mileva 33F OGI's FoV, additional cameras are deployed to fully capture all equipment in direct line of sight. Figure 12 and Figure 13 provide a case study example of a deployment in which an SO₂ process gas pipe required multiple OGI cameras placed at different locations to provide full visual coverage of the monitored equipment due to obstructions in the direct line of sight with a single OGI camera. While this case study did not see deployment of the Mileva 33F camera, siting principles are consistent with Mileva 33F deployment. Figure 14 presents a representative schematic diagram illustrating the visual coverage from the multiple OGI cameras on site.

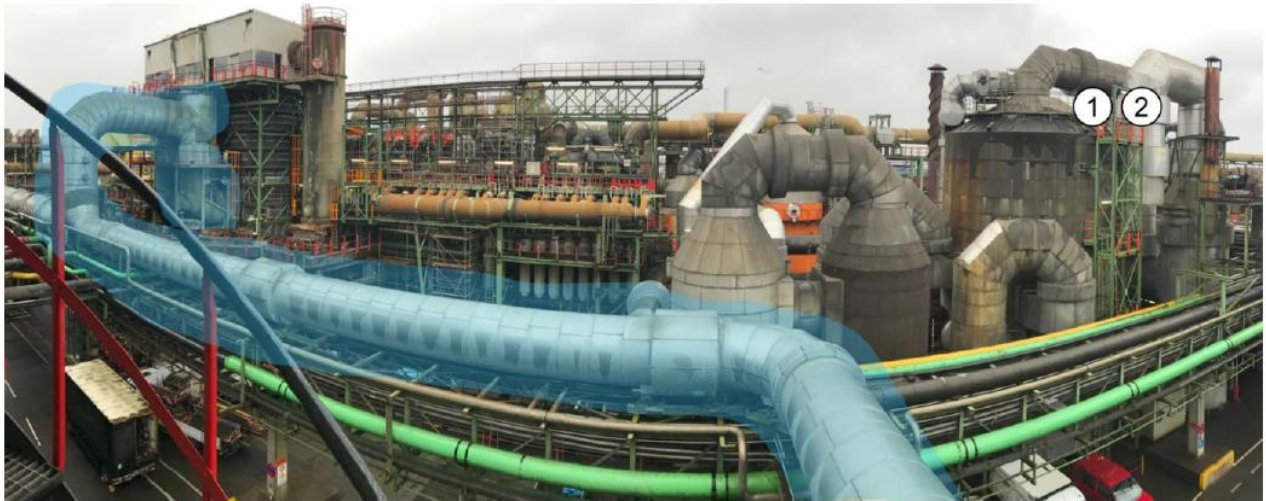


Figure 12: The SO₂ process gas pipe (highlighted in blue) which requires monitoring as well as the locations of 2 of the 3 OGI camera installations, indicated by the "1" and "2".



Figure 13: A second angle of the SO₂ process gas pipe (highlighted in blue) showing the required third OGI camera installation point, indicated with the “3”.

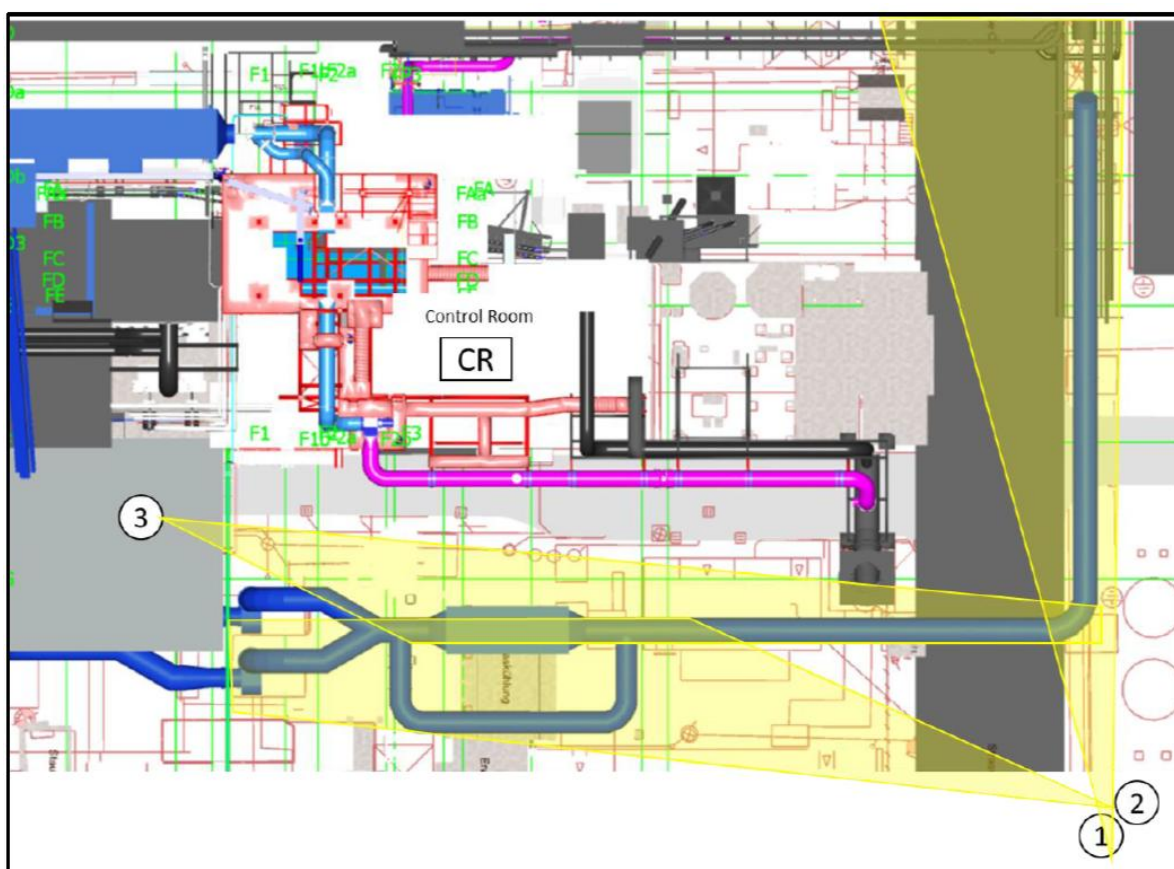


Figure 14: A schematic coverage diagram of the site requiring monitoring with a focus on the SO₂ process gas pipe and the OGI camera installations.

17.1.2 In addition to understanding the number of, and placement of Mileva 33F OGI cameras, further assurance of effective deployment is accomplished through an interplay between the distance of the Caorline FY OGI camera and the equipment requiring monitoring, and the selection of the camera lens. The Mileva 33F OGI camera is designed to accommodate multiple different sized lenses, each with a specific FoV. In general, lenses with smaller FoVs allow for longer effective distances between the camera and observed objects but capture a narrower area than lenses with larger FoVs which capture a wider area but acquire less detail per image unit area and are therefore required to be closer to the equipment requiring monitoring. Table presents the lens options for the Mileva 33F OGI camera and their associated FoVs:

Table 11: Lens Options and FoVs for the Mileva 33F OGI camera.

Lens Options	FoV Orientation	FoV
25mm	Horizontal FoV	21.8°
	Vertical FoV	17.6°
35mm	Horizontal FoV	15.7°
	Vertical FoV	12.6°
50mm	Horizontal FoV	11°
	Vertical FoV	8.8°

17.1.3 With each lens selection, there is a recommended detection range (i.e. maximum distance between the Mileva 33F OGI camera and the monitored equipment) based on empirical observations from past field deployments and testing. Table 10 summarizes the recommended detection ranges corresponding to each lens choice.

Table 10: Recommended Detection range for each camera using different lens choices

Lens Choice	Recommended Detection Range
25 mm	60 m
35 mm	100 m
50 mm	150 m

17.1.4 To ensure proper focus and reliable detection, the Mileva 33F OGI camera must be installed at a distance from the equipment being monitored greater than the hyperfocal threshold distance. At distances shorter than the hyperfocal threshold, the Mileva 33F OGI camera cannot achieve visual focus, which may compromise image clarity and detection performance. As such, the hyperfocal threshold distance represents the minimum distance to which the Mileva 33F OGI camera must be placed from monitored equipment. Table 11 lists the hyperfocal threshold distances for each lens option available with the Mileva 33F OGI camera.

Table 11: Hyperfocal Distances for Mileva 33F OGI camera lenses.

Lens	Hyperfocal Distance
25 mm	10 m
35 mm	15 m
50 mm	22 m

17.2 Appendix B: Periodic Screening Window Alerting Work Practice

17.2.1 Monitoring from the SENSIA RedLook System MATM takes place during the Periodic Screening Window. The periodic screening window is a 24-hour window where the method continuously and autonomously screens all equipment requiring monitoring at a site for leaks (in cases where an autonomous tour has been established leveraging a pan and tilt unit, the method passes through all FoVs within the periodic screening window. The periodic screening window begins on the 1st day of the periodic screening interval defined by the site type and the method's 1 kg/hr 90% PoD. The annual occurrences of the periodic screening windows for the site types in scope of the method are:

- Single Wellhead Only: At the start of each 6-month interval (2 times per year).
- Multi Wellhead Only Sites: At the start of each 6-month interval (2 times per year).
- Small Well Sites: At the start of each 6-month interval (2 times per year).
- Compressor Stations: At the start of each quarter (4 times per year).
- Major Well Sites or Centralized Production Facilities: At the start of each quarter (4 times per year).

17.2.2 During the periodic screening window, the autonomous screening work practice is followed. Figure 15 is an overview of the autonomous screening work practice.

Definitions:

Commissioning Phase: The RedLook System installation phase where all monitoring parameters are set. Notably, this is where the fields of view (FoVs) and regions of interest (Rols) are established:

Fields of View (FoVs): The views the Mileva 33F OGI camera will dwell on and collect OGI video footage from.

Regions of Interest (Rols): Annotated equipment requiring monitoring at each FoV. SENSIA and the operator may collaboratively establish Rols by drawing polygons around equipment in the RedLook System software.

Control Computer: A computer installed at each site requiring monitoring which runs the RedLook System software. It is here that machine learning algorithms are run and the operator can interact with alarms.

Detection Event: A detection event is any anomalous behavior of OGI video footage, as identified by the RedLook System detection algorithm, indicating an emission. The commissioning and SBT phases inform what is a detection event at a given site.

Alarm: The response to a detection event. The alarm is results in a notification on the control computer, as well as a defined alarm video which can be later accessed. The alarm video contains details on the detection event which caused the alarm (date, time, associated FoV and Rol).

RedLook System Software: The software installed on the control computer which runs the machine learning algorithms and allows the operator to interact with the method by viewing live OGI video and assessing past alarms.

SENSIA RedLook System MATM Monitoring Work Practice: Autonomous Screening Work Practice

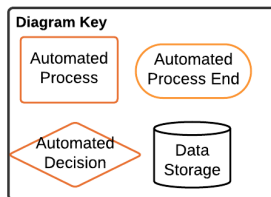
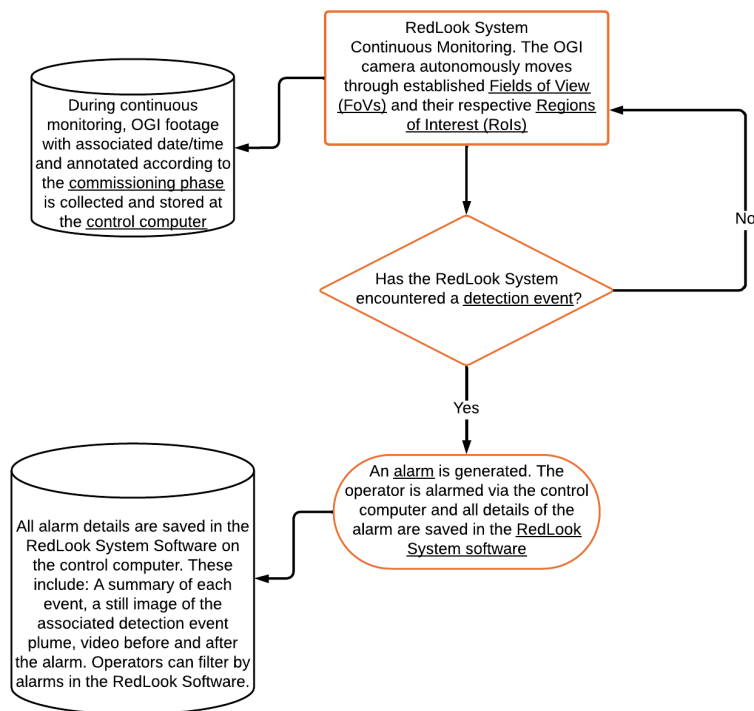


Figure 15 The RedLook System MATM Autonomous Screening Work Practice. This work practice takes place autonomously during the 24-hour periodic screening window.