



SENSIA RedLook System Mileva 33F OGI Camera

Alternative Test Method Application Description of Technology

Focus: This document is part of the SENSIA RedLook System (utilizing the Mileva 33F OGI camera) application package for regulatory approval as periodic screening alternative test method as per NSPS OOOO Rules Section §60.5398b(d).



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1. Alternative Test Method Desired Approval Details

SENSIA Solutions, S.L. (hereafter referred to as “SENSIA”) is seeking approval of the RedLook System (hereafter referred to as “RedLook”) as an Alternative Test Method (ATM), with the details outlined in Table 1:

Table 1: ATM Desired Approval Details

Application Category	Desired Approval Detail
Company Name	SENSIA Solutions, S.L.
Product Name	RedLook System (Mileva 33F OGI)
Applicability	Broadly applicable
Work Practice	Periodic Screening
Measurement Type	Remote
Emission Rate Threshold	≤ 1 kg CH ₄ /hr
Spatial Resolution	Component-level
Technology Type	Fixed (in-situ measurements)
Request numbers of any connected submitted Requests	N/A

2. SENSIA RedLook System Description

2.1. Overview of the Technology and Underlying Scientific Theory

Source Documents:

- CBI-01: Brochure Mileva 33F 14.06.22
- CBI-04: DOC-SEN-PRS-0033 v6.1 Introduction to RedLook Technology
- CBI-05: DOC-SEN-PRS-0064 v2.0 Quantification of VOC emission sources application case
- CBI-07: Introduction to SENSIA
- CBI-10: DOC-SEN-TN-0114 v1.0 RedLook OGI White Paper
- CBI-13: DOC-SEN-PRO-0008 v1.0 Technical proposal template

SENSIA is seeking approval for RedLook as a broadly applicable, fixed ATM for periodic screening. RedLook is an autonomous, continuous monitoring solution that uses artificial intelligence-based detection algorithms to detect and quantify emissions in Optical Gas Imaging (OGI) video footage collected by the RedLook OGI camera, the Mileva 33F. RedLook has been deployed for a wide range of application cases, but this ATM application focuses on its use for leak detection and repair (LDAR) and monitoring operational emissions. This overview of the technology will be broken down into data collection, data manipulation and interpretation, and data reporting - all of which will be expanded upon in further sections.

The data collection of RedLook, as per this application, is facilitated by the Mileva 33F OGI camera(s). Briefly, OGI cameras are infrared cameras which can visualize methane and various other organic gases that are inherently invisible to the human eye. SENSIA OGI cameras create images of a narrow range of the mid-infrared spectrum (3.2– 3.4 μm wavelength) which methane and other light hydrocarbons actively emit/absorb. As a result, methane plumes become visible in the OGI camera footage. As such, RedLook collects the same data (OGI video footage) a “traditional” OGI operator would, using a handheld OGI camera. The Mileva 33F OGI camera is mounted on a pan and tilt device which autonomously moves the camera through a “tour” of operator and SENSIA defined field of views which encompass all equipment requiring monitoring.

Within the scope of this application is the SENSIA Mileva 33F OGI camera. The Mileva 33F is a cooled OGI camera which means it contains a cooling system which maintains the camera’s detectors at low temperatures to function effectively. RedLook can function with a range of proprietary SENSIA OGI cameras, but will functionally work identically regardless of the camera. The performance of RedLook using the Mileva 33F OGI camera, established under blinded controlled release testing, is expanded upon in Section 8.

Data manipulation and interpretation is carried out by RedLook’s artificial intelligence 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 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. 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. This robust model training drastically reduces the occurrences of false positives and increases detection probability. Thirdly, the algorithms will identify emission plumes in the OGI video footage by coloring them, making them easier to detect for operators reviewing the OGI video footage. All these processes happen autonomously, and they lead to 3 key outcomes of monitoring: emissions detection, localization, and quantification.

RedLook works as a complete video management system (VMS) and autonomously handles data reporting. Data reporting primarily focuses on alerting the operator of detection events, or flagged emissions. Alarms will be communicated on a workstation in the Control Block (further details in Section 2.3.1) both via an on-screen alert and an audible signal, as well as via email to operators. The operator can use the workstation (potentially accessed via the cloud depending on deployment architecture) to review all previous alarm events and generate reports of the alarm events containing the necessary material for reporting purposes.

RedLook operates as an unattended system, requiring no human supervision besides responding to alarms from emission detection events.

2.2. Emissions Detection, Localization, and Quantification

Source Documents:

- CBI-05: DOC-SEN-PRS-0064 v2.0 Quantification of VOC emission sources application case
- CBI-09: DOC-SEN-TN-0080 v1.0 Quantitative Optical Gas Imaging (QOGI)
- CBI-10: DOC-SEN-TN-0114 v1.0 RedLook OGI White Paper
- CBI-16: DOC-SEN-MA-0006 RedLook User Manual
- CBI-19: DOC-SEN-MA-0042 v2.1 Semi-portable RedLook System Hardware and Maintenance manual
- CBI-21: DOC-SEN-MA-0045 v2.1 Scenario Based Tuning User Manual

Emissions Detection

RedLook's artificial intelligence algorithms are used to detect emissions in the incoming OGI video footage collected by the Mileva 33F. While specific details of the detection algorithms remain proprietary, at a high-level detection of emissions works via computer vision and machine learning models which have been trained (training in this context refers to feeding OGI video footage of known emissions to the model so it can "learn" what emissions look like in OGI video footage) to "see" emissions in the OGI video footage via the behavior of the pixels. Namely, the opacity of the pixels and how quickly this opacity is changing from one frame of video to the next.

A final key step of emissions detection is that the machine learning algorithm will colorize the plume in the black and white OGI video footage so that operators viewing the OGI video footage via RedLook software can more easily localize and diagnose detected emissions.

For the purposes of this application, any anomalous behavior which RedLook identifies as an emission will generate an alarm to which the operator must respond. When setting up the system, SENSIA technicians, leveraging their knowledge of the site requiring monitoring, will establish parameters like "minimum leak size" in pixels, used exclusively to minimize false positives. See Figure 1 for a screenshot of the detection settings in the RedLook software.

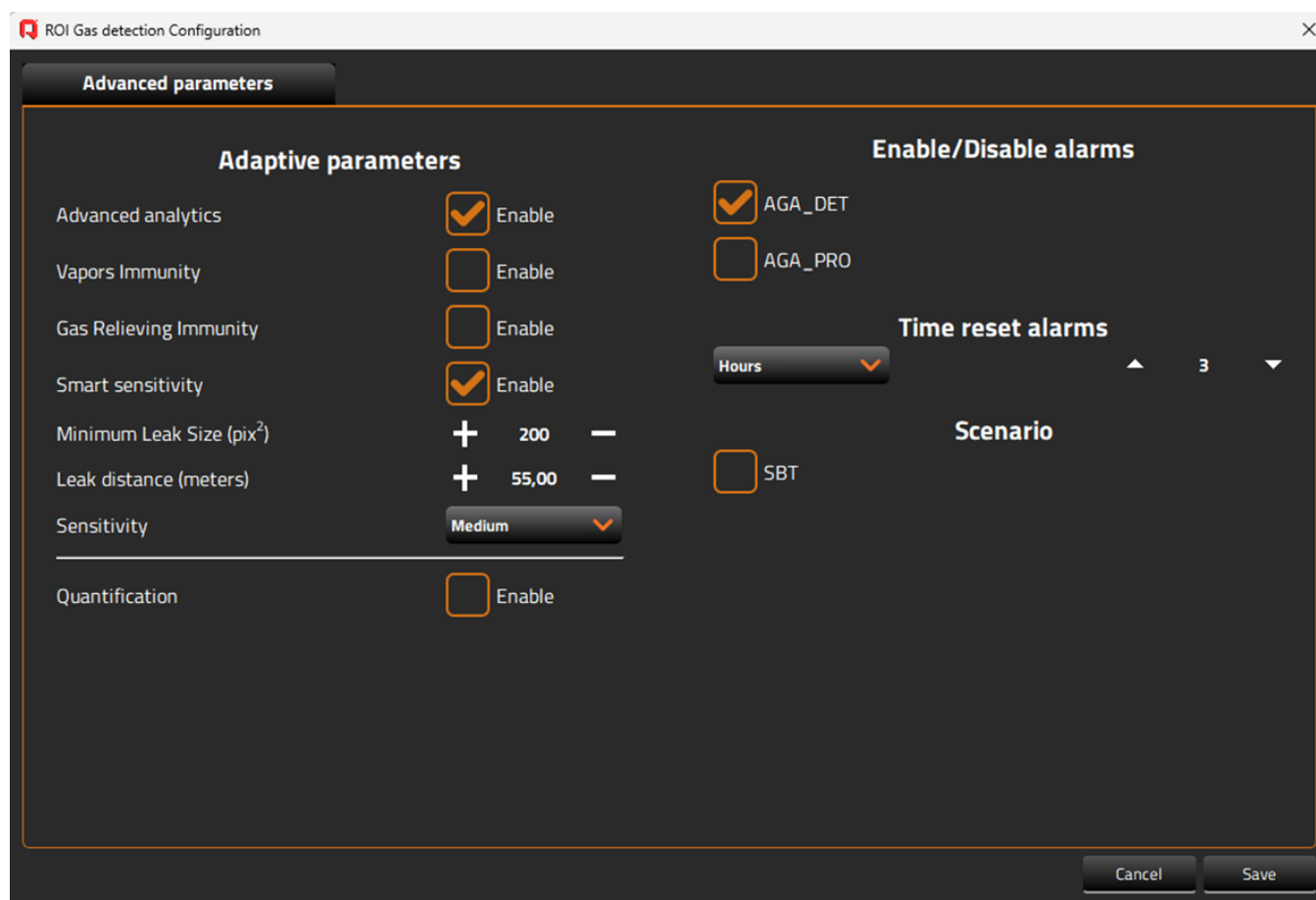


Figure 1: Advanced Parameters of the RedLook software used when establishing RedLook to define bounds on detection events and minimize false positives.

Emissions Localization

As RedLook's operations are visual-based, the principles of detection and localization are synonymous. If RedLook detects an emission, it does so via visual OGI video feed and it is therefore possible to localize the emission via this video feed. The colorization of emissions plumes via RedLook software aids in the localization process, and is absent in typical handheld OGI surveys. Figure 2 presents examples of colorized emissions plumes (one of which has been quantified) shown in the RedLook software.

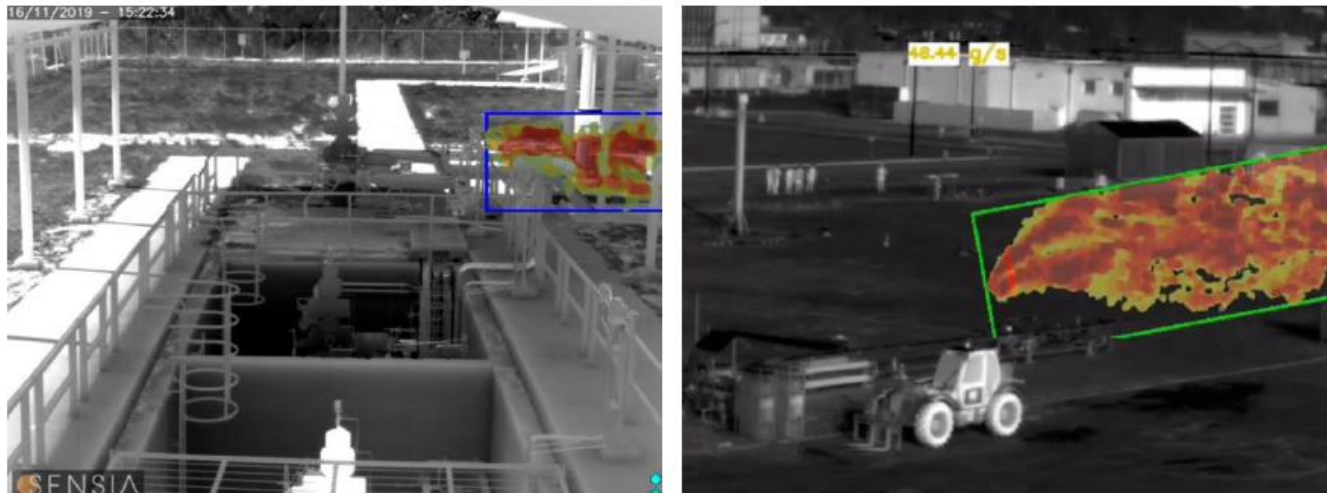


Figure 2: Example of the colorization of detected emissions plumes carried out by RedLook's artificial intelligence algorithms.

Emissions Quantification

Quantifying emissions refers to assigning a release rate of the emissions plumes detected by RedLook. As this is based on detection, the following discussion on quantification is included for informational purposes as operators may elect to use quantification features for their own tracking and root cause analysis.

Quantification is done via RedLook's artificial intelligence algorithms which use correlation factors to relate the imaging of detected emissions with a quantified leak rate. The correlation factors are based on visual imaging features from the detected emission events and are obtained through frame-by-frame image processing. These features serve as the input variables for RedLook's quantification machine learning algorithm and include thermal contrast, plume geometric factors, pixel velocity, column density (ppm-m), and other factors. Plume geometric factors refer to the diameter, size, shape, and other geometric properties contained within RedLook gas imaging. In general, the larger the size of the detected gas plume on RedLook's gas imaging display, the larger the emission leak rate. Pixel velocity refers to the changes in pixel pitch, which is the distance between the center of adjacent pixels on a digital display, from one frame to another on RedLook's gas imaging display. Similarly, the larger the pixel velocity, or the faster the plume is displaced, the larger the emission leak rate. RedLook's AI processes the data in several iterations and produces emission quantification results after data variability has reached a certain threshold of consistency.

According to the physics involved in infrared imaging, OGI cameras cannot distinguish hydrocarbon molecules that absorb infrared radiation within the same integration band (3.2-3.4 microns). An emission plume composed of different molecules results in an effective absorption coefficient. When the proportion of each molecule is known, it can be considered in the calculations. When the composition is unknown, a gas will be manually selected by RedLook technicians for an absorption coefficient. In many cases, hexane is used as it has proven to be the most representative gas to characterize unknown hydrocarbon gas mixtures.

2.3. Description of the Physical Instrumentation

2.3.1. System Architecture

Source Documents:

- CBI-05: DOC-SEN-PRS-0064 v2.0 Quantification of VOC emission sources application case
- CBI-06: DOC-SEN-PRS-0078 v2.0 Introduction to RedLook Technology System Selection & Design
- CBI-11: Sensia-Catalog-2024
- CBI-13: DOC-SEN-PRO-0008 v1.0 Technical proposal template

The infrastructure of SENSIA's RedLook System is divided into two main segments, or "blocks": the field block and control block. The components of the Field and Control block, and how they communicate amongst each vary across deployments.

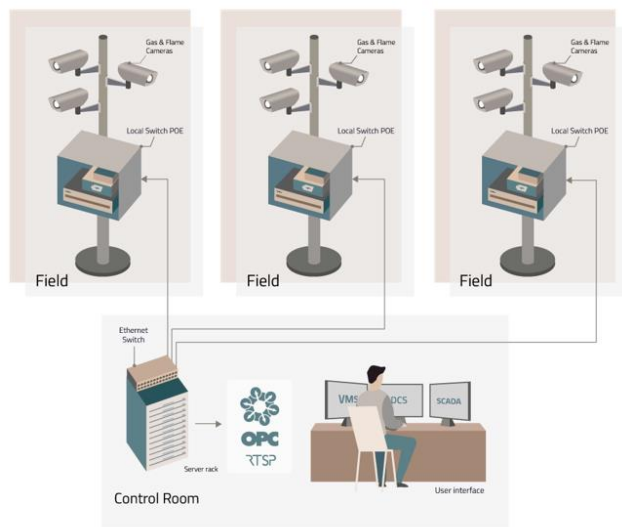
- **The Field Block:** The field block encompasses the physical hardware present at the site requiring monitoring. The field block includes.
 - Mileva 33F mounted at fixed, elevated positions.
 - Termination boxes: Used to power the OGI camera(s) and communicate with the Control Block. The termination boxes communicate with OGI camera(s) via ethernet switches and a dedicated 24 VDC power source, and communicate with the Control Block via fiber optic cables, ethernet, or wireless 4G connections, depending on deployment architecture. As with the OGI camera(s), the number of required termination boxes varies based on the deployment site.
 - The pan and tilt device which moves the camera through a tour of all equipment groups requiring monitoring.
 - 4G Antenna for deployments at unmanned sites, or sites where a hardwired connection is not feasible or preferred by the operator.
 - Power source for all components, such as the on-site electrical network or solar panels.
- **The Control Block:** The 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:
 - Control computer: Contains RedLook software. It is here that the artificial intelligence algorithms are applied to the incoming OGI video footage. Including transforming of the data and detection of emissions. In addition, the computer can be used to visualize OGI video footage and set RedLook System parameters
 - Server rack: Contains a switch, wiring, and the electric protections (if necessary).

Furthermore, RedLook's architecture can also 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:

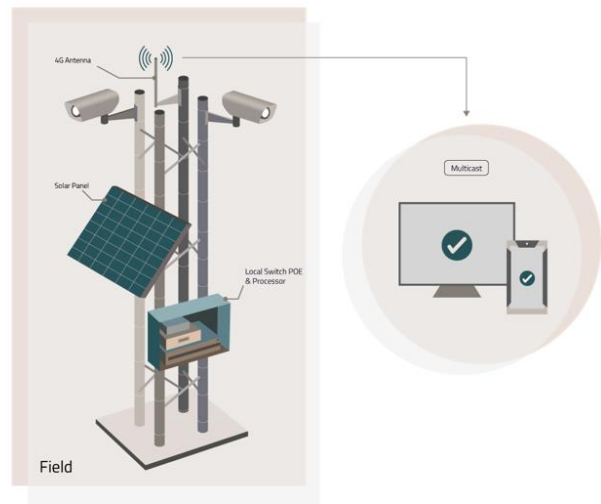
- **System Architecture for Manned Sites:** Referred to as the "Control Room Architecture". Here, the Field Block communicates with the Control Block via fiber optics or ethernet cables.

- **System Architecture for Unmanned Sites:** Referred to as the “Edge Computing Architecture”. Here, the Field Block communicates with the offsite Control Block via a wireless connection.

Figure 3 is a simplified overview of the two types of system architecture while Figures 4 and 5 are more detailed schematics of the system architecture for manned and unmanned sites respectively.



Control Room Architecture



Edge Computing Architecture

Figure 3: High-level overview of the manned (left) and unmanned (right) system architectures

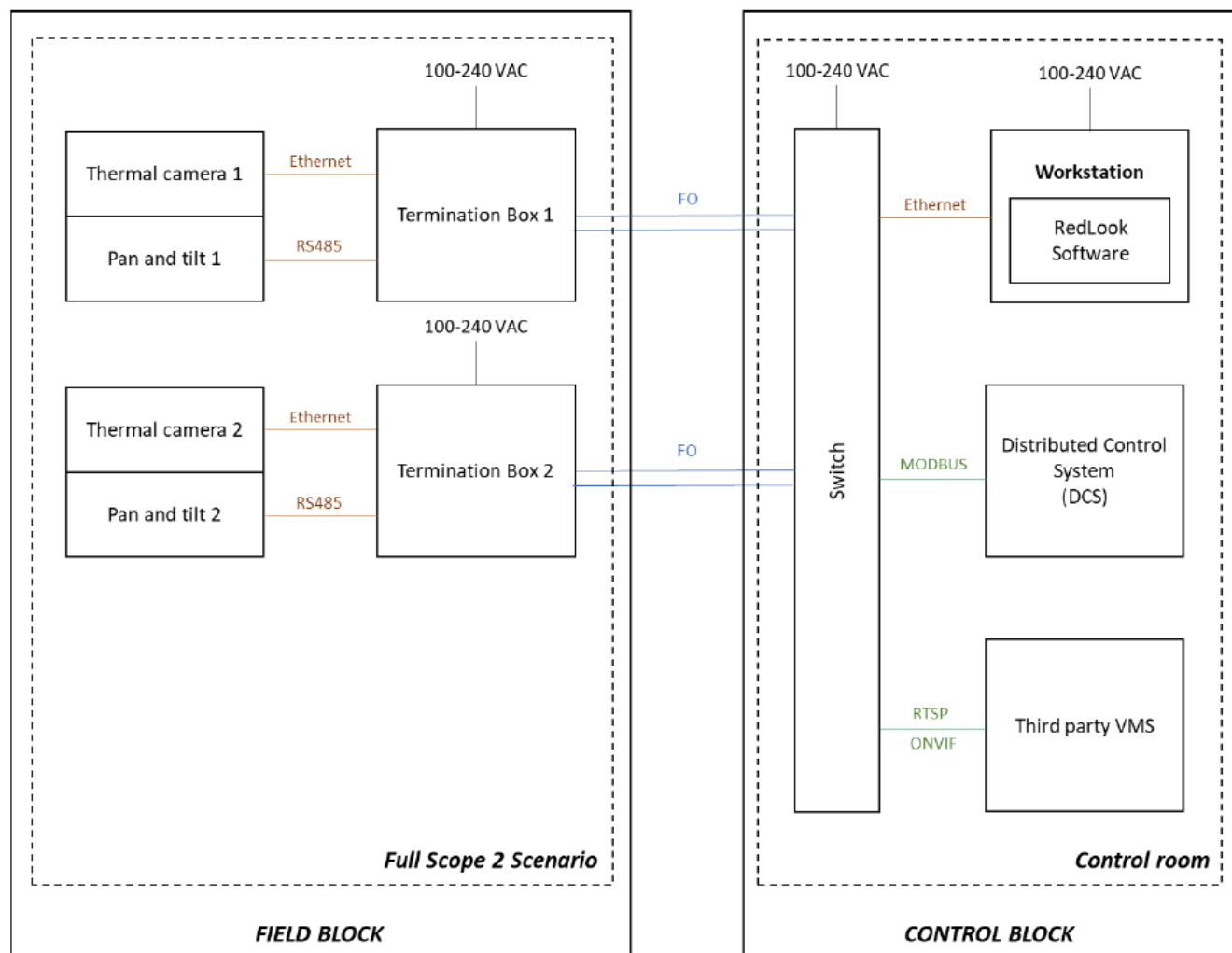


Figure 4: RedLook System architecture for manned sites (Control Room Architecture).

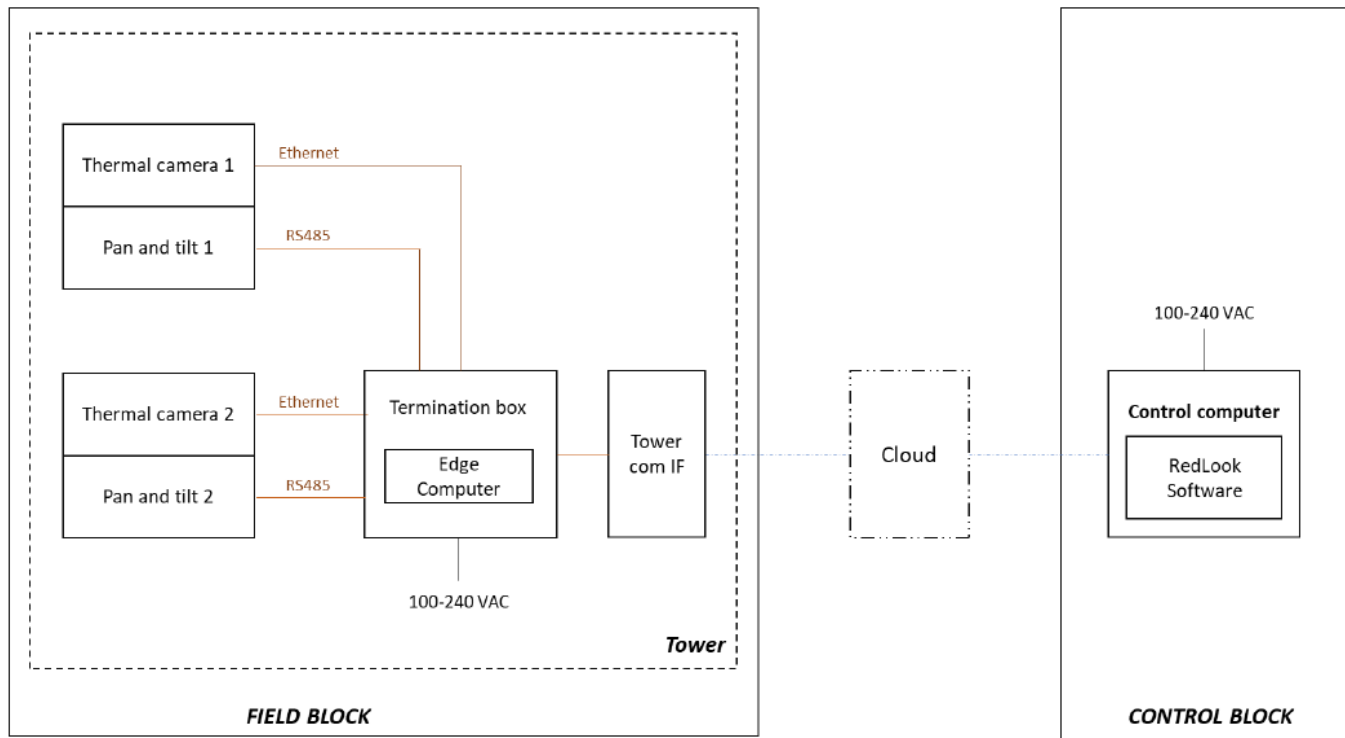


Figure 5: RedLook architecture for unmanned sites (Edge Computing Architecture).

2.3.2. Control Computer and RedLook Software

Supporting Documents:

- CBI-06: DOC-SEN-PRS-0078 v2.0 Introduction to RedLook Technology System Selection & Design
- CBI-11: Sensia-Catalog-2024
- CBI-13: DOC-SEN-PRO-0008 v1.0 Technical proposal template

A workstation (the Control Computer) running the RedLook software will be installed in the control room. This workstation is where the artificial intelligence algorithms necessary in emissions detection are run (detection algorithms are run in the control room). In addition, RedLook software provides a user interface in which settings can be adjusted, and OGI video footage can be viewed. Figure 6 is an example of the main view of RedLook software as an operator would see it.

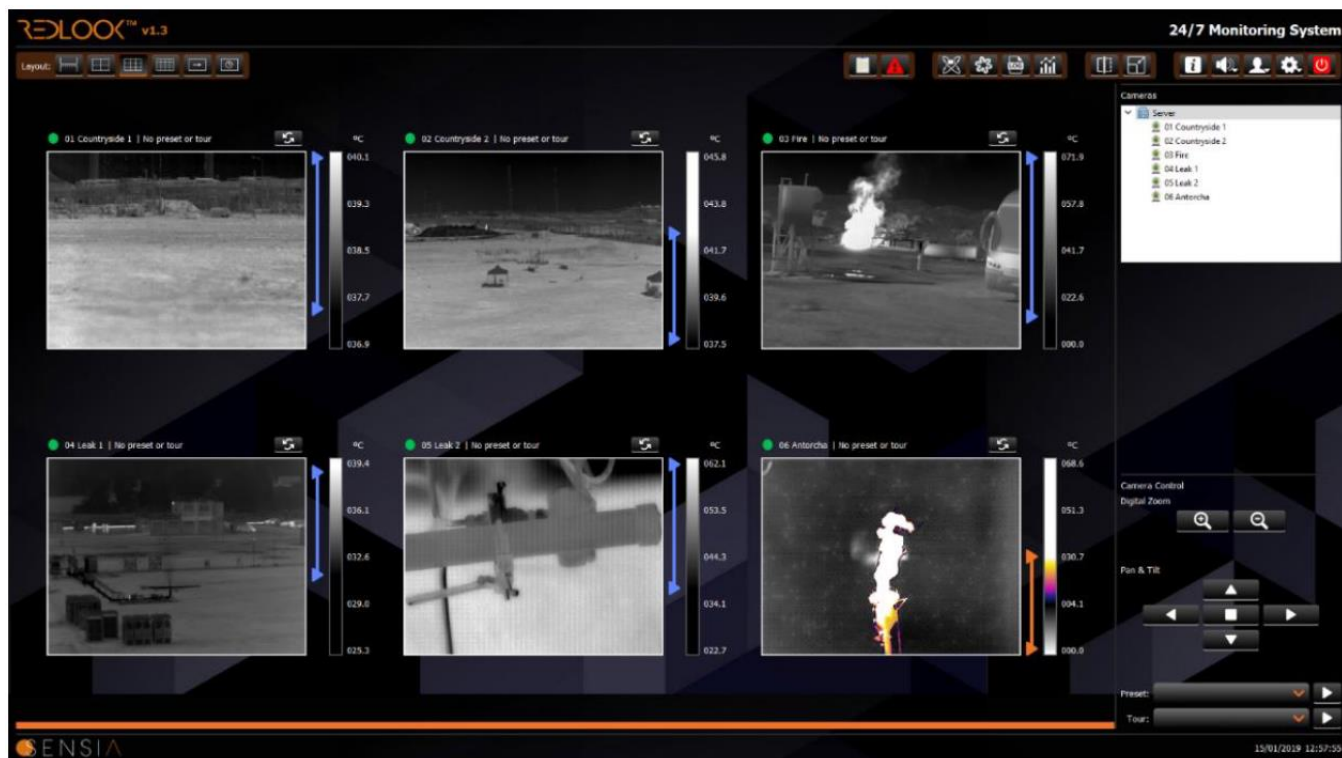


Figure 6: The main interface of the SENSIA RedLook software, accessible via the workstation in the control room.

SENSIA will provide detailed specifications of the computer according to the project requirements. SENSIA can deliver this computer but strongly recommends the customer to acquire it from a local supplier for quicker and easier warranty management in case of incidents.

2.3.3. OGI Camera Components and Sensors

Source Documents:

- CBI-01: Brochure Mileva 33F 14.06.22
- CBI-11: Sensia-Catalog-2024
- CBI-13: DOC-SEN-PRO-0008 v1.0 Technical proposal template
- CBI-18: DOC-SEN-MA-0039 Mileva 33 F Installation Manual

The Mileva 33F consists of several key components to detect and visualize gas emissions. Within the Mileva 33F is an infrared sensor which detects infrared radiation emitted or absorbed by gasses, typically sensitive to specific wavelengths where the target gas emits/absorbs radiation. A specialized lens focuses the infrared radiation onto the sensor, and spectral filters isolate the specific wavelengths corresponding to the gas of interest, enhancing detection sensitivity. As previously mentioned, the Mileva 33F contains a cooling system. Figure 7 is an image of the Mileva 33F cameras.

The Mileva 33F contains a stack of electronic boards which converts the infrared radiation signals captured by the sensor into visual images or videos, using algorithms to enhance the visual representation of gas plumes. The visual output is displayed on the interface screen of the Control Computer, enabling real-time monitoring and analysis by the operator. A reliable power supply ensures the camera functions effectively in various conditions. All these components are housed in a durable, weatherproof enclosure, thus protecting the internal parts from environmental factors such as dust, moisture, and temperature extremes.



Figure 7: Mileva 33F OGI camera

The gases the Mileva 33F OGI cameras is capable of detecting are detailed in Table 2.

Table 2: Detected Gasses of the Mileva 33F OGI Cameras

OGI Camera Model	Detectable Gasses
Mileva 33F	1,3-butadiene, acetic acid, benzene, butane, ethane, ethanol, ethyl hexyl acrylate, ethylbenzene, ethylene, ethylene glycol, ethylene oxide, heptane, hexane, methyl ethyl ketone (MEK), methanal, methane, methanol, octane, pentane, phenol, propane, propylene, toluene, turpentine.

Table 3 details equipment specifications of the Mileva 33F camera.

Table 3: Specifications of the and Mileva 33F OGI Cameras

Parameter	Mileva 33F
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Detector	
Technology	Cooled InSb – 3.3 cold filter
Detector Size	640 x 512 pixels
Spectral Region	3.2 to 3.4 μm
Pixel Pitch	15 μm
Noise Equivalent Temperature Difference (NETD)	<15 mK @ +50°C
Electrical	
Power	< 10 W
Voltage	24 V
Mechanical	
Material (enclosure/sunshield)	6082 Aluminum / AISI316L Stainless Steel
Dimensions	350 mm x 121 mm x 111 mm
Weight	< 4 kg
Mechanical Interface	2 x 1/4" UNC
Environmental	

Operating Temperature Range	-20 °C to +60 °C
Storage Temperature Range	-40 °C to +71 °C
Maximum Relative Humidity	95%
Certifications	
ATEX (EN 60079:2013)	II 2 G Ex db op pr IIC T6 Gb (Optional)
EMC (EN 61326:2013)	Yes

2.3.4. Pan and Tilt Mount

Source documents:

- CBI-02: EXPT Series Pan & Tilt Brochure
- CBI-13: DOC-SEN-PRO-0008 v1.0 Technical proposal template
- CBI-18: DOC-SEN-MA-0062 v1.0 Mileva 33F Installation Manual
- CBI-20: DOC-SEN-MA-0043 v1.0 Mileva 33F & PT ATEX RedLook System Hardware and Maintenance Manual
- CBI-22: Accupoint-Positioner-Product-Manual

The Mileva 33F is compatible with the pan & tilt mount which allows for the Mileva 33F to be placed on site at fixed, stationary positions. Pan & tilt mounts are electromechanical devices which precisely rotate horizontally and incline vertically. This rotation capability allows the OGI camera to obtain optimal viewing angles towards the on-site equipment requiring monitoring.

The EXPT pan & tilt mount is an example of a pan & tilt mount compatible with the Mileva 33F. The EXPT pan & tilt mount consists of a cylindrical body and mounting bracket constructed in AISI 316L stainless steel and, as well as the Mileva 33F OGI camera, it is suitable for installations in inclement environments and ATEX certified for its use in explosive atmospheres. The EXPT series pan & tilt unit uses the Pelco-D communication protocol, which allows for remote control of camera movements such as panning and tilting. This control is facilitated through RS485, a serial communication standard that supports long-distance data transmission and multiple device connectivity.

Crucially for this application, RedLook allows the operator and SENSIA to collaboratively program automated sequences (tours) of the pan and tilt mount, meaning it will move from one monitoring position (preset) to another autonomously. Viewing time at a given tour stop is programmable and can be determined by the operator based on the site-specific attributes.

Figure 8 provides an image of the EXPT pan and tilt device.



Pan & Tilt unit.

Figure 8: (left) the EXPT Pan & Tilt unit without any mounted camera.

Table 4 lists the equipment specifications of the EXPT pan & tilt mount.

Table 4: EXPT Pan & Tilt Mount Specifications

Parameter	EXPT Pan & Tilt Mount Specifications
Housing Material	AISI316L S Stainless Steel
Dimensions	L 423 x W 215 x H 428 (mm)
Total Weight	29 kg

Supply Voltage	220 - 230 VAC
Power Consumption	70W
Ingress Protection Rating Certifications	EN 60529 (IP66/IP67) II 2 G Ex dp op pr IIC T6 Gb -40°C < Tamb < +60°C II 2 D Ex tb IIIC T85°C Db -40°C < Tamb < +60°C IP66/IP67 II 2 G Ex db op pr IIB T5 Gb -40°C < Tamb < +75°C II 2 D Ex tb IIIC T100°C Db -40°C < Tamb < +75°C IP66/IP67
ATEX Standards Certifications	EN 60079-0:2012; EN 60079-1:2014; EN 60079-28:2015; EN 60079-31:2014
IECEX Standards Certifications	IEC 60079-0:2011; IEC 60079-1:2014-06; IEC 60079-28:2015; IEC 60079-31:2013
EMC Certifications	EN 61000-6-3:2007; EN 50130-4:1995 + A1:1998 + A2:2003
LVD Certifications	EN 60950-1:2006 + A11:2009
RoHS Certifications	2011/65/EU
WEEE Certifications	2012/19/EU

Another example of a pan & tilt unit to which the Mileva 33F is compatible is the Will-Burt Accupoint AP-8 pan & tilt mount, a non-ATEX option. The Accupoint AP-8 functions as an “over the top mount”, as pictured in Figure 9. Similar to the EXPT pan & tilt mount, the Accupoint AP-8 rotates horizontally and vertically, allowing for the Mileva 33F to pan from one preset position to another. The Accupoint AP-8 pan & tilt unit can be controlled using any Pelco D compatible controller over an RS485 data line that supports the appropriate command set. The Accupoint AP-8 consists of a die-cast aluminum casing and uses stainless steel fasteners. The Accupoint AP-8 is designed and tested to an IP68 ingress protection rating.

The components of the Accupoint AP-8 pan & tilt mount include:

- Payload platform and base mounting ring
- Power/Data Connector
- Power/Data Cable

AP-8 Over the Top (OTT) Mount
(P/N LF2/51/TX/XXX/RX2-00)



Figure 9: The Accupoint AP-8 Pan & Tilt Unit with the over the top mounting orientation.

Table 5 presents the specifications for the Accupoint AP-8 pan & tilt unit.

Table 5: Accupoint AP-8 Pan & Tilt Specifications

Parameter	Specification – Over the Top Mount
Payload Capacity	50 ft-lb (67.8 Nm)
Approximate Weight	13 kg (28.7 lb)
Tilt Axis	360° ($\pm 180^\circ$)
Pan Speed	0 to 30° / second
Tilt Speed	0 to 10° / second
Backlash	<0.15°
Repeatability	<0.3°

Maximum Continuous Power	44 W
Maximum Continuous Current (@ 24 VDC)	1.85 A
Input Voltage	24 VDC (12 VDC Optional)
Operating Temperature	-4° to 122°(-21° to 50°C)
Ingress Protection Rating	IP68
Protocol	Pelco D
Baud Rate	Selectable 2,400, 4,800, and 9,600
Absolute Positioning	Yes
Positional Feedback	Yes
Application	Static Mount

The Mileva 33F can also be installed on masts, towers, or other pre-existing similar structures which are not pan and tilt units, provided that the cameras' installation points are not affected by vibrations from the structures. Guy-wires can be utilized to provide stabilization in windy environments. Likewise, the Mileva 33F and accessory devices (power, pan and tilt, etc.) can be deployed on a trailer-mounted basis, with a mast and the corresponding support wires. The Mileva 33F must be installed above ground and must be pointed slightly downwards so that the FOVs are focused on the equipment to be monitored with less interference from obstructions on site.

2.4. Best Practices

2.4.1. Requirements of Use

Supporting Documents:

- CBI-05: DOC-SEN-PRS-0064 v2.0 Quantification of VOC emission sources application case
- CBI-06: DOC-SEN-PRS-0078 v2.0 Introduction to RedLook Technology System Selection & Design
- CBI-10: DOC-SEN-TN-0114 v1.0 RedLook OGI White Paper

The following items describe the environmental factors to consider when deploying the Mileva 33F on site:

- Indoor and Outdoor Setting: The Mileva 33F can operate indoors and outdoors.
- Daytime and Nighttime Operation: RedLook OGI cameras can operate during the daytime and nighttime.
- Weather Conditions: The Mileva 33F camera is designed to operate in a wide range of weather conditions. It can operate within a temperature range of -20°C to +60°C. The Mileva 33F can withstand aggressive environments and have ingress protection ratings against dust and water of IP65 or better. In general, however, the performance of the OGI cameras worsens with increasing severity of environmental conditions, such as wind, fog, snow, rain, or dust, increases. Of the environmental factors mentioned, wind speed is the factor which has the largest effect on the detection performance of the Mileva 33F. The Mileva 33F's weather-resistance performance allows for minimal required maintenance activities in environments subject to large variations in temperature and weather conditions. The Mileva 33F is designed to be spectrally tuned to detect certain hydrocarbon compounds and it is barely affected by clouds, fog, rain, and other compounds outside of the camera's spectral range.

2.4.2. Training, Certification, and User Competence

Supporting Documents:

- CBI-16: DOC-SEN-MA-0006 RedLook User Manual
- CBI-18: DOC-SEN-MA-0062 v1.0 Mileva 33F Installation Manual

User Training

RedLook installation contains a “commissioning phase” during which the Mileva 33F, Field Block, and Control Block are set up on site. During this commissioning phase, SENSIA provides operators with comprehensive training which includes, but is not limited to:

1. An introduction to infrared imaging technology and the general physics principles surrounding the technology.
2. A presentation on RedLook.
3. Training on using RedLook's hardware and software.
4. Training on alarm and communication management with the Mileva 33F.

Certification

The operation of RedLook requires the installation, configuration, and commissioning processes to be conducted by certified SENSIA personnel and operators, or qualified partners. As such, SENSIA technicians are required to assist operators in stages of setting the Mileva 33F cameras on site and configuring the RedLook software. Additionally, after RedLook (cameras and software) have been installed and configured on site, Scenario-Based Tuning (SBT) is performed as part of the commissioning phase. SBT allows for the optimal performance of RedLook. SBT is carried out by a SENSIA technician (see Section 4.2.3 for more information on SBT). Once the cameras are set up on site, they operate autonomously, allowing the operator to manage operations independently.

User Competence

SENSIA imposes some restrictions on the administrative user (operator) when using RedLook OGI cameras and software. For example, only certain non-SENSIA operators are granted limited permissions for RedLook system configuration, including camera setting customization, alarm management, and data management.

2.4.3. Calibration and Maintenance

Supporting Documents:

- CBI-13: DOC-SEN-PRO-0008 v1.0 Technical proposal template
- CBI-17: DOC-SEN-MA-0062 v1.0 Mileva 33F Installation Manual

Calibration

SENSIA OGI cameras do not require periodic calibration.

Maintenance

Table 6 summarizes the required maintenance of the Mileva 33F camera and RedLook software.

Table 6: RedLook System Maintenance Requirements

Subsystem	Item	Frequency	Performer	Location	Calibration / Maintenance Time Requirement
OGI Camera	Lenses visual inspection	Monthly	Operator	On site	<1 hour
OGI Camera	Lenses manual cleaning	Monthly	Operator	On site	< 1 hour
Software	Alarm system verification	Monthly	Operator	On site	1 hour

Software	RedLook performance self-diagnose	Monthly	Operator	On site	1 hour
Software	RedLook remote verification (under contract after first year)	Monthly	SENSIA	Remotely, or as otherwise specified in the contract	4 hours/camera
Software	Records and events verification	Monthly	Operator	On site	2 hours
Software	Storage verification	Monthly	Operator	On site	< 1 hour
Software	Recording back up	Monthly	Operator	On site	5 hours
Software	System general inspection	Annually	Operator	On site	1 day

2.4.4. Known Limitations

Supporting Documents:

- CBI-05: DOC-SEN-PRS-0064 v2.0 Quantification of VOC emission sources application case
- CBI-10: DOC-SEN-TN-0114 v1.0 RedLook OGI White Paper

This section outlines the known limitations of the Mileva 33F and RedLook System when deployed on site. The limitations are factors which inhibit or lower the performance of the Mileva 33F and RedLook in detecting and quantifying emissions during operations. Some of these limitations have been introduced in previous sections of the report and are as follows:

- **Weather conditions:** As previously described, the Mileva 33F's detection functionality slightly decreases in effectiveness with increasing severity of environmental conditions, such as wind, fog, snow, rain, or dust. Wind speed has the largest effect of the environmental conditions.
- **Physical on-site obstructions:** Physical obstructions from equipment or other objects placed on site diminish the effectiveness of the Mileva 33F to detect emissions. For the Mileva 33F to be most effective, it should be placed in direct line of sight of emission sources to detect emissions radiating from the sources. In situations where there are physical obstructions in the Mileva 33F camera's field of view, the camera can be relocated, or additional cameras can be installed on site to better capture line of sight of the obstructed equipment.

- Moving on-site objects: Moving objects, such as vehicles, heavy machinery, and field personnel can limit the effectiveness of the Mileva 33F camera in detecting emissions. Moving objects can result in RedLook detection algorithm producing false positive detections. This effect is minimized to zero, or close to zero, false alarms after Scenario Based Tuning has been completed. Additional Scenario Based Tuning can be conducted by SENSIA technicians to improve performance, when necessary.

3. Complete Visual Workflow

Figure 10 is a visual workflow of RedLook work practices with the Mileva 33F camera.

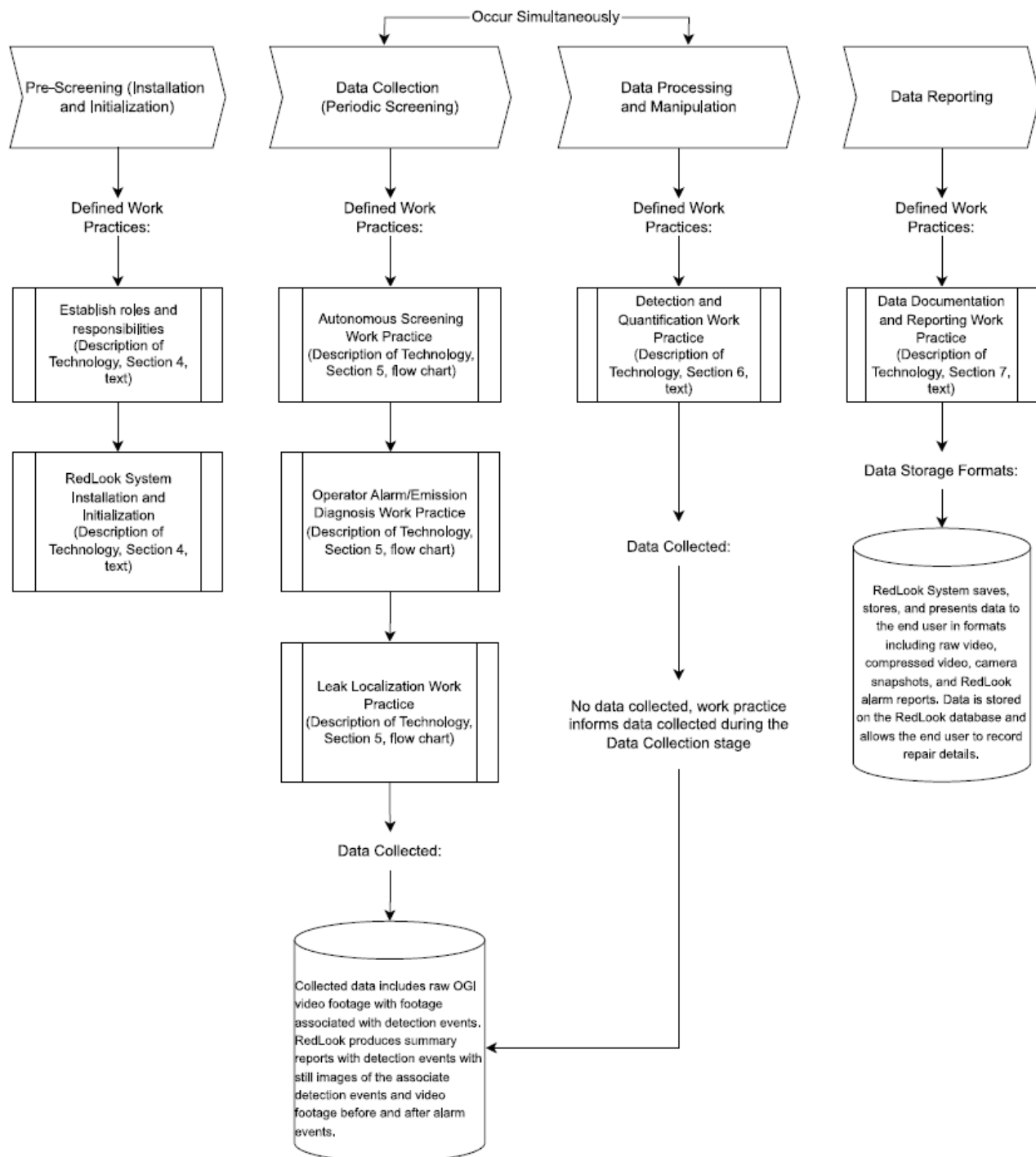


Figure 10: Visual workflow of RedLook with the Mileva 33F OGI camera. References to other work practices are detailed in the following sections.

4. Pre-Screening (Installation and Initialization) Work Practice

This section will detail the required work practice prior to commencing the proposed periodic screening.

4.1. Roles and Responsibilities

Prior to on-site installation of the physical components of the Mileva 33F camera and RedLook System and the commencement of periodic screening, roles and responsibilities are established. Parties with responsibilities in the proposed RedLook alternative test method are SENSIA and the owner/operator of the site at which RedLook is installed (this may be an oil and gas operator for well production facilities, or the company that owns/operates a natural gas compressor station). The roles and responsibilities of each party are as follows:

SENSIA

SENSIA will be responsible for conducting emissions monitoring via RedLook, specifically with the Mileva 33F camera. SENSIA is responsible for providing operators with the hardware and software used to monitor emissions, as well as maintenance services, depending on the contracts established with customers. Specifically, SENSIA will:

- Work collaboratively with the operator to identify the optimal number of Mileva 33F camera installations and location selections as well as the field of views and defined regions of interest (further described in Sections 4.2.1 and 4.2.2) on a per-site basis. Collaboration is necessary as the logistics of site monitoring (i.e. number of Mileva 33F on-site installations, accessory equipment needed to support the camera installations, installation locations, number of fields of view, etc.) are highly variable across different sites, and operator expertise on their site is required. Although the installation and initialization process is collaborative, the responsibility to ensure on-site equipment and components are adequately monitored with RedLook ultimately belongs to the operator.
- Install the RedLook hardware and software.
- Ensure RedLook autonomously begins the 24-hour periodic screening window at the cadence required by the site being monitored.
- Continuously monitor incoming video footage from the Mileva 33F cameras in operation and all other collected data for emissions during the periodic screening window.
- Continuously monitor all incoming data for quality assurance and quality control during the periodic screening window.
- Perform periodic inspections of RedLook to guarantee functionality, if a maintenance contract is in place.
- Maintain a dashboard which will allow the site operator to observe all data collected by RedLook, if a dashboard servicing contract is in place.
- Autonomously generate screening reports upon completion of the 24-hour periodic screening window which can be used by the operator to fulfill the reporting requirements of Title 40 CFR

60.5424b including: date of screening, results (detection events, emitting equipment, etc.), and method and technology used.

- Notify the site operator when RedLook has detected an emission. Further details around detection events and alarm notifications are provided in Section 5.2.

Site Operator

The operator will be responsible for providing SENSIA with a list of monitored sites, performing close-range follow-up OGI surveys, when required, conducting repairs when leaks are identified, and reporting LDAR details annually to regulators. To elaborate, the operator will:

- Work collaboratively with SENSIA to ensure RedLook installation utilizes a sufficient number of Mileva 33F cameras as well as preset tours with programmed fields of view to effectively screen the site.
- Schedule close-range follow-up inspections as required.
- Classify emissions flagged by RedLook as either allowable emissions, or leaks (and therefore requiring repair).
- Localize, diagnose, and tag for repair emissions flagged by RedLook deemed to be fugitive. Facilitate and supervise close-range surveys as required if RedLook OGI video footage and supporting data is insufficient for localization and diagnoses.
- Ensure all leaks tagged for repair are repaired within the timelines outlined in Regulation 7 and that proper repair confirmation is performed.
- Keep a database of follow-ups, tagged leaks, and repairs. Details include follow-up date, equipment surveyed, monitoring method used to identify the leak, leaking equipment, leak identification, the timeline of repair, the method used for repair, and proof of successful repair through re-monitoring of the leaking component with an approved close-range method. This ATM proposes that RedLook can initially be used as a follow-up method, if it is successfully used, the operator will record it as such.
- Submit reports as per 40 CFR 60.5424b leveraging RedLook screening reports.

4.2. Installation and Initialization Work Practice

The installation work practice of RedLook consists of the following phases, which will each be described in Sections 4.2.1 to 4.2.3:

1. Camera deployment engineering.
2. Commissioning.
3. Scenario-Based Tuning for performance optimization.

RedLook requires qualified personnel to conduct the installation, configuration, and commissioning activities when bringing a Mileva 33F camera online at a site. As such, operators need to be certified by SENSIA to guarantee the expected level of performance from RedLook for each camera configuration and scenario. RedLook certified technicians are involved in many of the processes outlined in the following sections.

4.2.1. Camera Deployment Engineering

Supporting Documents:

- CBI-12: DOC-SEN-PRO-0007 v1.0 Technical proposal template
- CBI-18: DOC-SEN-MA-0062 v1.0 Mileva 33F Installation Manual

Camera deployment engineering involves the decisions regarding placement of Mileva 33F camera(s) on site and lens choices. Installation of Mileva 33F cameras should be conducted in a manner such that all equipment requiring monitoring falls within the cameras' fields of views.

As previously described in Section 2, Mileva 33F cameras can be installed on a dedicated mast or tower, or in other pre-existing similar structures, provided that the installation point is not affected by strong vibrations. The use of guy wires will allow a successful installation even in windy environments. Likewise, Mileva 33F cameras can be deployed on a mobile trailer-mounted basis, with a mast and corresponding support wires. The Mileva 33F cameras are installed above ground and pointing slightly downwards so the fields of view are focused on the equipment to be monitored, with fewer interferences and a better perspective that will facilitate discriminating the different potential leaking points.

Ensuring effective deployment is accomplished through an interplay between camera placement and OGI camera lens. The Mileva 33F cameras are designed to accommodate multiple different sized lenses, each with a specific field of view. In general, lenses with smaller fields of view allow for longer effective distances between the camera and observed objects but capture a narrower area than lenses with larger fields of view 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 7 presents the lens options for the Mileva 33F and their associated Fields of View:

Table 7: Lenses Options for the Mileva 33F camera

Camera	Lens Options	Field of View Orientation	Field of View
Mileva 33F	25 mm	Horizontal FoV	21.8°
		Vertical FoV	17.6°
	35 mm	Horizontal FoV	15.7°
		Vertical FoV	12.6°
	50 mm	Horizontal FoV	11°
		Vertical FoV	8.8°

On-site placement of the Mileva 33F cameras and their associated lenses to effectively monitor all required equipment will vastly vary from site to site. SENSIA and the operator will work collaboratively to ensure

effective monitoring coverage and cost effectiveness (such as avoiding installing unnecessary OGI cameras).

RedLook will leverage as many cameras installations as required to ensure maximum spatial coverage of the equipment requiring monitoring. Figure 11 presents an example of a site schematic with OGI camera installations distributed on site with tours to obtain the required visual monitoring coverage of equipment.

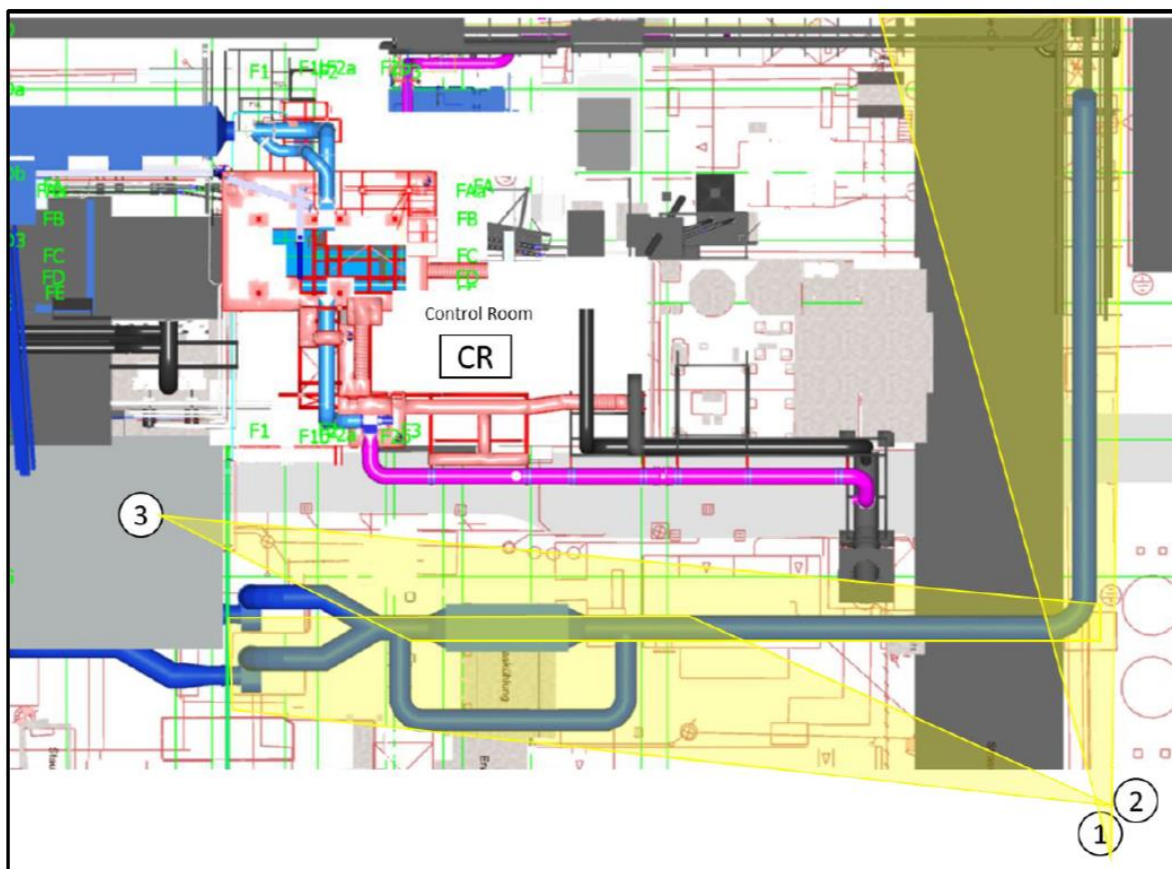


Figure 11: A schematic coverage diagram of the site requiring monitoring with a focus on the SO₂ process gas pipe and the camera installations.

SENSIA also considers small emissions when considering spatial coverage during installation. For scenarios where the methane emission rates are often below 1 g/s, SENSIA has defined maximum detection distances from the Mileva 33F camera to emissions sources to ensure effective detection. In general, the distance between the OGI cameras and emission sources grows exponentially as the leak rate increases, find a more detailed discussion of RedLook System performance in Section 4. Table 8, below, presents the effective detection distances for scenarios where the methane leak rates are below 1 g/s.

Table 8: Maximum Detection Distances of the Mileva 33F

Maximum Detection Distance from the Mileva 33F Camera to the Emission Source	Minimum CH ₄ Mass Flow Rate for Detection
--	--

125 m	0.3 g/s
250 m	0.5 g/s

4.2.2. Commissioning

Supporting documents:

- CBI-04: DOC-SEN-PRS-0033 v6.1 Introduction to RedLook Technology
- CBI-13: DOC-SEN-PRO-0008 v1.0 Technical proposal template
- CBI-16: DOC-SEN-MA-0006 RedLook User Manual

During this phase RedLook will be fully configured and customized according to the demands of the site to be monitored. Commissioning is accomplished through RedLook software at the control computer (refer to Section 2.3.2). Steps are as follows:

1. **Establish monitoring presets (Fields of View):** The operator and SENSIA will establish each of the necessary fields of view (what the OGI cameras are “looking” at). This step is more involved if a pan and tilt device is required, as the pan and tilt device will need to be programmed to autonomously stop at each defined preset and monitor for a set amount of time.
2. **Establish Regions of Interest within each Field of View:** Using RedLook software, regions of interest are drawn on RedLook user interface by SENSIA technicians using polygon shapes to define the areas, or specific equipment, to be monitored. Each region of interest has a unique identifier allowing the operator to know from which monitored region of the facility the leaks originate when detection events occur. Figure 12 is an example of the drawn polygon shapes representing regions of interest. This functionality is used to manually remove areas being monitored to reduce false positives, and to help operators more quickly constrain the likely source of detected emissions.

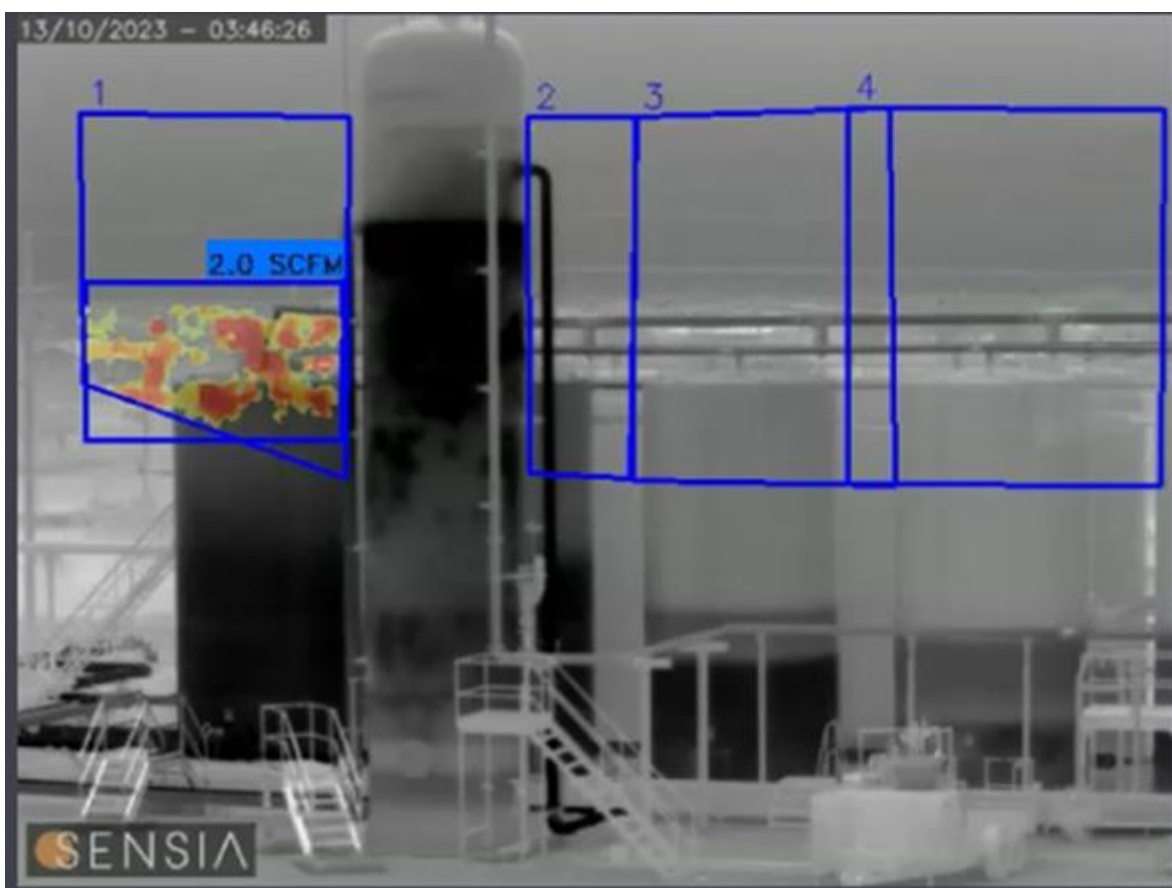


Figure 12: Example of “Regions of Interest” polygons drawn onto the display screen during the commissioning phase of setting up the Mileva 33F cameras.

5. **Finalize the monitoring plan:** With the monitoring presets and regions of interest established, the operator will finalize the monitoring plan by defining the order the camera(s) move through each monitoring preset and how long it monitors at each preset.
6. **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 RedLook software, and other preferred methods of notification. In addition, alarm protocols can be uniquely specified for the individual regions of interest. Note, SENSIA restricts some alarm management functionalities from the operator and administrative assistance from SENSIA personnel may be required in certain situations
7. **Setting the communications and integration with third-party systems:** In situations where 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.
8. **Set Advanced Parameters:** The final commissioning stage is adjusting the more granular alarm settings. Details of these advanced parameters are as follows:
 - Advanced Analytics: for detecting gas leaks using machine learning capabilities.

- Vapors Immunity: Allows the user to set the system to disregard diffuse vapor detections.
- Gas Relieving Immunity: Allows the user to set if the system will defer alarms until detected emissions reach a specified duration of time (i.e., a “relief duration”).
- Sensitivity: Affects the magnitude and number of leaks detected and determines the number of confirmed detections that the analytics need to perform before triggering a detection. By default, the sensitivity is set to medium.
- Smart Sensitivity: Used to adjust the sensitivity of detections by considering the background image clutter to reduce the number of false positive alarms.
- Minimum Leak Size (pix²): Defines minimum areas for emissions to be detected. Emissions with areas below the defined leak area do not trigger alarms.
- Leak Distance: Defines the distance from the camera to the areas where leaks can be detected. This parameter is used for quantification purposes.

SENSIA selects these optional parameters according to the specific knowledge acquired from the site of interest, and SENSIA’s expertise built upon past deployments to ensure the Mileva 33F and RedLook system performs at its maximum emission detection capabilities. Additionally, during this phase the incremental artificial intelligence training to adapt the analytics to the final scenario will be carried out to maximize the performance at each specific site.

4.2.3. Scenario Based Tuning

Supporting Documents:

- CBI-12: DOC-SEN-PRO-0007 v1.0 Technical proposal template
- CBI-13: DOC-SEN-PRO-0008 v1.0 Technical proposal template
- CBI-21: DOC-SEN-MA-0045 v2.1 Scenario Based Tuning User Manual

Scenario Based Tuning (SBT) is the final part of the commissioning process and is conducted to allow for optimal performance by RedLook. SBT collects and uses site-specific data specific to train RedLook’s neural network to improve the gas detection probability and reduce/eliminate the occurrences of false positive detections.

SBT is conducted by a RedLook certified technician and typically takes one week to complete with the duration depending on the complexity of the site features and scenarios to evaluate. In situations where the Mileva 33F operates with a pan & tilt unit for full site coverage, SBT should be done at every monitoring preset.

During SBT, the following tasks can be performed:

1. **False positive labeling:** Elements in the OGI camera feed(s) which may result in false positive detections can be identified and labeled (allowable emissions, moving parts, etc.).
2. **Real detection labeling:** When possible, controlled gas releases or pre-existing leaks can be used to label accurate detections and increase the detection probability.

3. **Quantification adjustments:** controlled quantitative gas releases can be used to finely adapt RedLook quantification correlation factors specific to the scenario conditions.

Past deployments have also shown that after SBT has been conducted, RedLook's uncertainty on emissions quantification significantly decreases.

5. Data Collection (Periodic Screening) Work Practice

RedLook periodic screening takes place during what is from here on referred to as “the periodic screening window”. The periodic screening window is a 24-hour window where RedLook continuously and autonomously screens all equipment requiring monitoring at a site for leaks (the system passes through all fields of view and their respective regions of interest). 24 hours was chosen as it is an ample window of time for environmental conditions, like wind and temperature, to be favorable when screening for emissions, and it enough time to sufficiently screen all components for emissions.

The 24-hour screening window begins on the 1st day of the periodic screening interval defined by the site type and RedLook's 1 kg/hr 90% PoD (refer to Section 8). The annual occurrences of the periodic screening windows for the site types in scope of RedLook alternative test 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).

RedLook periodic screening work practice is broken down into 3 interconnected work practices:

1. Autonomous Screening Work Practice
2. Operator Alarm / Emission Diagnosis Work Practice
3. Leak Localization Work Practice

Each work practice is shown visually with an associated flowchart. Within each flowchart, there are indicators of the connection to the other work practice flowcharts.

5.1. Autonomous Screening Work Practice

The Autonomous Screening Work Practice defines the autonomous processes of RedLook continuous monitoring. This work practice is described in Figure 13.

Definitions:

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

Fields of View (FoVs): The views the RedLook OGI camera will dwell on and collect OGI video during a tour), and regions of interest.

Regions of Interest (ROIs): Annotated equipment requiring monitoring at each FoV. SENSIA and the operator will collaboratively establish ROIs by drawing polygons around equipment in the RedLook System software. If used, only detected emissions within the ROIs can generate alarms).

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 detected emission based on the the parameters established during the commissioning phase.

Alarm: The response to a detection event. The alarm 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 ROI).

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

**SENSIA RedLook System Continuous Monitoring Work Practice:
Autonomous Screening Work Practice**

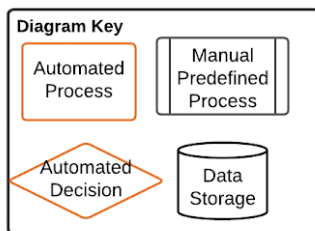
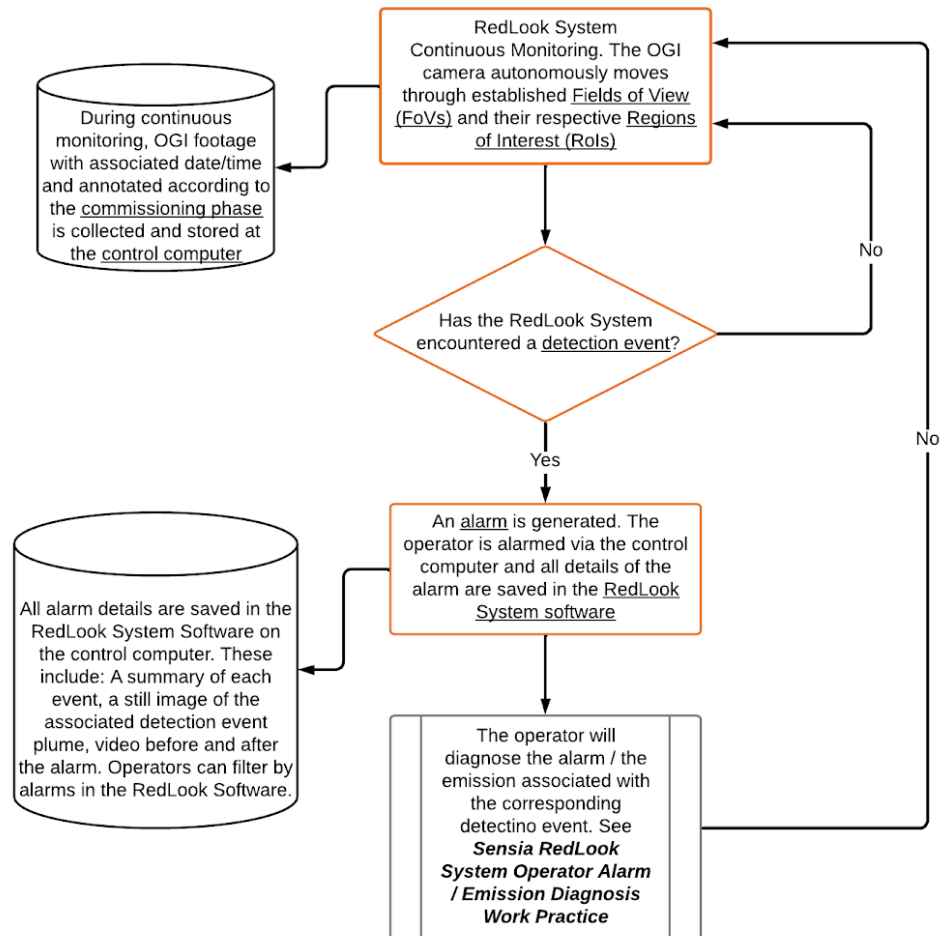


Figure 13: RedLook continuous monitoring work practice: Autonomous Screening

5.2. Operator Alarm / Emission Diagnosis Work Practice

The Operator Alarm/Emission Diagnosis Work Practice commences after an emission is detected and an alarm is generated during the autonomous screening work practice. This work practice is described in Figure 14.

**SENSIA RedLook System Continuous Monitoring Work Practice:
Operator Alarm / Emission Diagnosis Work Practice**

Definitions:

Trained and qualified: The operator(s) conducting the emission classification must be trained in the use of the RedLook System software as well as qualified to understand all routine operations at the monitored site. SENSIA and the operator will work collaboratively to ensure there is at least one established trained and qualified operator who takes ownership of emissions diagnosis.

Existing data: This includes all details associated with the alarm accessed via the RedLook System Software (Annotated OGI video of the plume at a given RoI, OGI video from directly prior to the alarm, etc.), SCADA data if available, knowledge of known allowed process emissions or emissions from regulated sources (e.g., blowdowns), etc. Often, the operator can diagnose the emission associated with an alarm with only existing data. Furthermore, the RedLook System Software alone is often sufficient material for an operator to diagnose an emission as a leak or a known allowable emission.

Additional data: Data collected by the operator to aid in emission event diagnosis. This could include an investigation into activities at the site the operator is not immediately aware of (e.g., vacuum/pumping truck operations).

Close Range Survey: An OGI or Method 21 inspection following EPA CFR 60.5397b. A close range inspection may be necessary in cases where the RedLook System OGI footage of an alarm shows the emission plume but not the source.

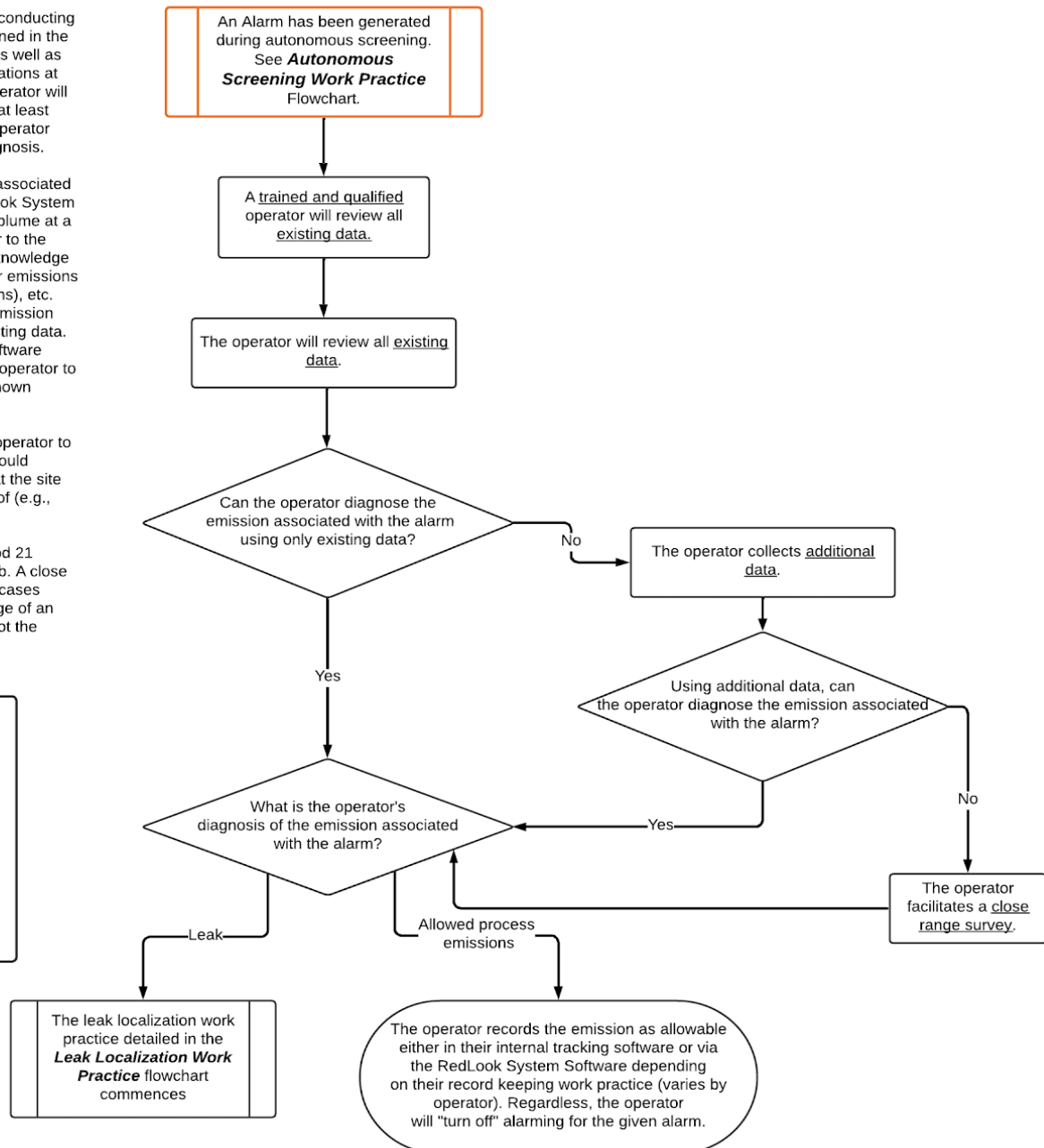
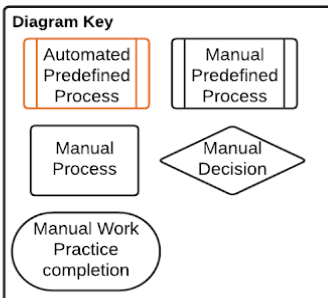


Figure 14: RedLook continuous monitoring work practice: Operator alarm/emissions diagnosis work practice.

5.3. Leak Localization Work Practice

The Leak Localization Work Practice commences after an alarm and its associated emission have been diagnosed as a leak during the Operator Alarm / Emission Diagnosis work practice. A key component of this application is that the operator can attempt to carry out follow-up of alarms using RedLook, but is required to conduct an alternative survey method (e.g. handheld OGI, Method 21, etc.) should they not be able to localize emission source with RedLook. This work practice is described in Figure 15.

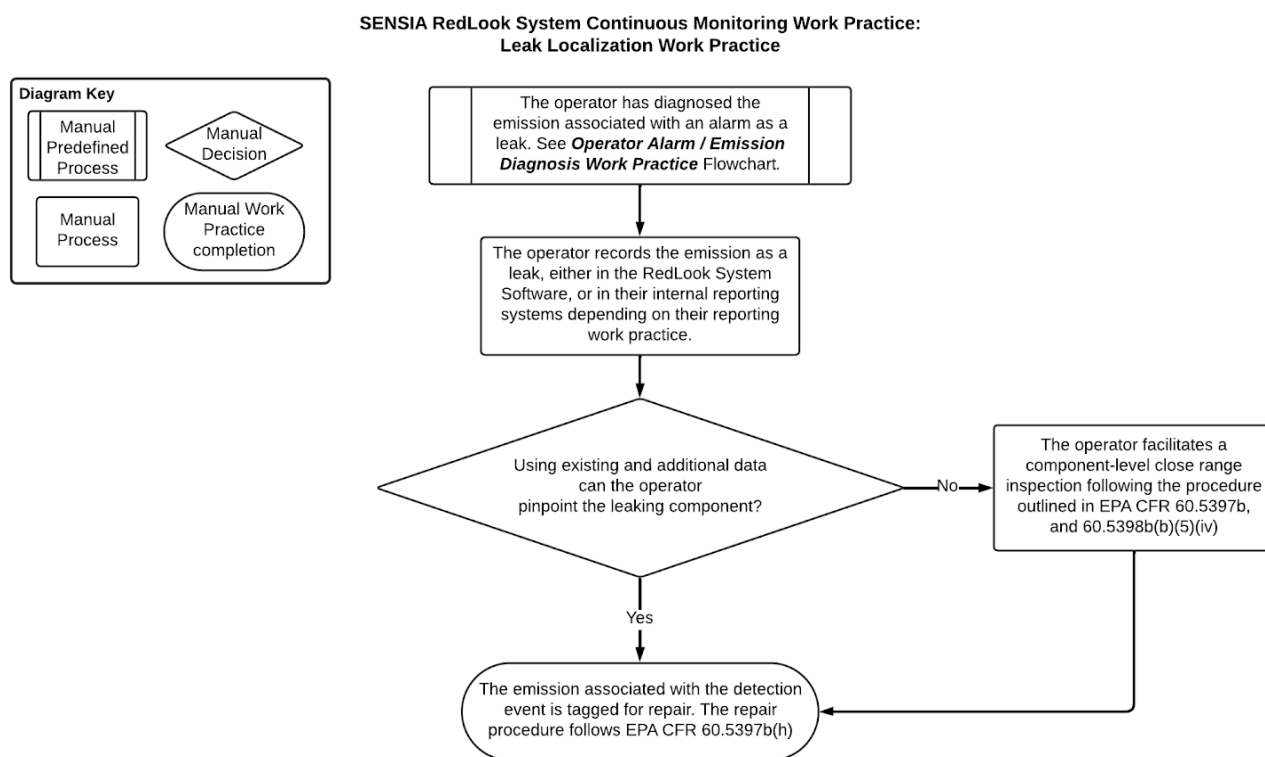


Figure 15: RedLook continuous monitoring work practice: Leak localization work practice.

6. Data Processing and Manipulation (Detection and Quantification Algorithms) Work Practice

RedLook presents a cutting-edge solution for gas detection and quantification by combining OGI technology with proprietary computer vision and artificial intelligence algorithms. When video footage is collected by the RedLook OGI cameras, RedLook employs a suite of artificial intelligence-powered algorithms to detect gas emissions. The gas detection process is divided into two key stages:

1. **Neural Network Detection:** RedLook utilizes convolutional neural networks (CNNs) to analyze the raw OGI video footage to identify potential gas regions. These networks are trained on labeled

datasets containing hundreds of thousands of images, representing a diverse range of scenarios and environmental conditions, to ensure high accuracy and robustness in detections.

2. Computer Vision Confirmation: After potential gas plumes have been identified by RedLook's CNNs, the computer vision algorithms perform additional checks using background subtraction, motion analysis, and other image processing techniques to confirm the detection.

RedLook CNNs

RedLook's CNNs are tailored for gas detection tasks and consist of multiple convolutional layers that extract features from infrared images, followed by fully connected layers that classify and localize gas emissions. These networks are trained using supervised learning techniques, where labeled datasets are employed to minimize prediction errors and optimize detection performance.

When RedLook is operating, the raw video footage collected from the OGI cameras undergo pre-processing to enhance their suitability for neural network training. The key pre-processing steps carried out by RedLook include:

1. Background subtraction: Moving elements within the raw OGI video footage are isolated from static background features which are suppressed.
2. Dynamic Range Adjustment: RedLook adjusts the image contrast to focus on relevant temperature ranges.
3. Noise filtering: RedLook reduces sensor-related noise to improve the clarity of data.
4. Colour Mapping: RedLook applies a colour scale to enhance the visual interpretation of gas movement.

7. Data Documentation and Reporting Work Practice

RedLook automatically saves and stores data in different formats. The following sections provide background on the video, image, and data formats and data storage capabilities of RedLook.

7.1. Raw Video Formats

Supporting Documents:

- CBI-03: DOC-SEN-TN-0118 v1.1 RedLook Data Outputs
- CBI-16: DOC-SEN-MA-0006 RedLook User Manual

Radiometric information generated by the Mileva 33F cameras are saved as ".raw" and ".rlk" formats which are the "raw" video formats that do not undergo any data loss through compression. The .raw video format is a standardized raw image/video format that stores each video frame as a matrix showing the digital level value (13 bits) on each pixel of the camera detector array. This video format can be opened by both RedLook 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 information about the camera serial number and hardware/software configuration and calibration file. The .rlk video format can only be opened by RedLook software.

These raw video formats can be used in situations where it is desired to re-run analytics. For easier data management, the raw videos recorded by RedLook are saved into separated files where a new file is automatically generated for every 900 frames.

7.2. Compressed Video Formats

Supporting Documents:

- CBI-03: DOC-SEN-TN-0118 v1.1 RedLook Data Outputs
- CBI-16: DOC-SEN-MA-0006 RedLook User Manual

RedLook also saves videos in the compressed “.mp4” video formats. These videos cannot be reopened or re-processed by RedLook. RedLook can record compressed videos in two ways: alarm videos and continuous recording footage. Both modes can be independently activated/deactivated and configured according to the user needs.

Alarms videos provide visual evidence of 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. These videos can be generated manually and automatically. RedLook offers a video recovery tool to filter detection events by date or alarm type.

RedLook’s continuous recording footage allows for uninterrupted recording of all video footage displayed by the cameras for as long as the cameras are connected. The purpose of these videos is to provide a complete video archive. Similar to the raw videos, the continuous recording videos are divided into separated 2-minute videos for easier data management.

7.3. Camera Snapshots

Supporting Documents:

- CBI-03: DOC-SEN-TN-0118 v1.1 RedLook Data Outputs
- CBI-16: DOC-SEN-MA-0006 RedLook User Manual

RedLook allows the end-user to take snapshots of the camera view. These snapshots can be performed manually and automatically. Additionally, snapshots are taken every time an alarm is triggered, as presented below in Figure 16. Snapshots are saved to the control computer’s hard drive in a “.jpg” format.

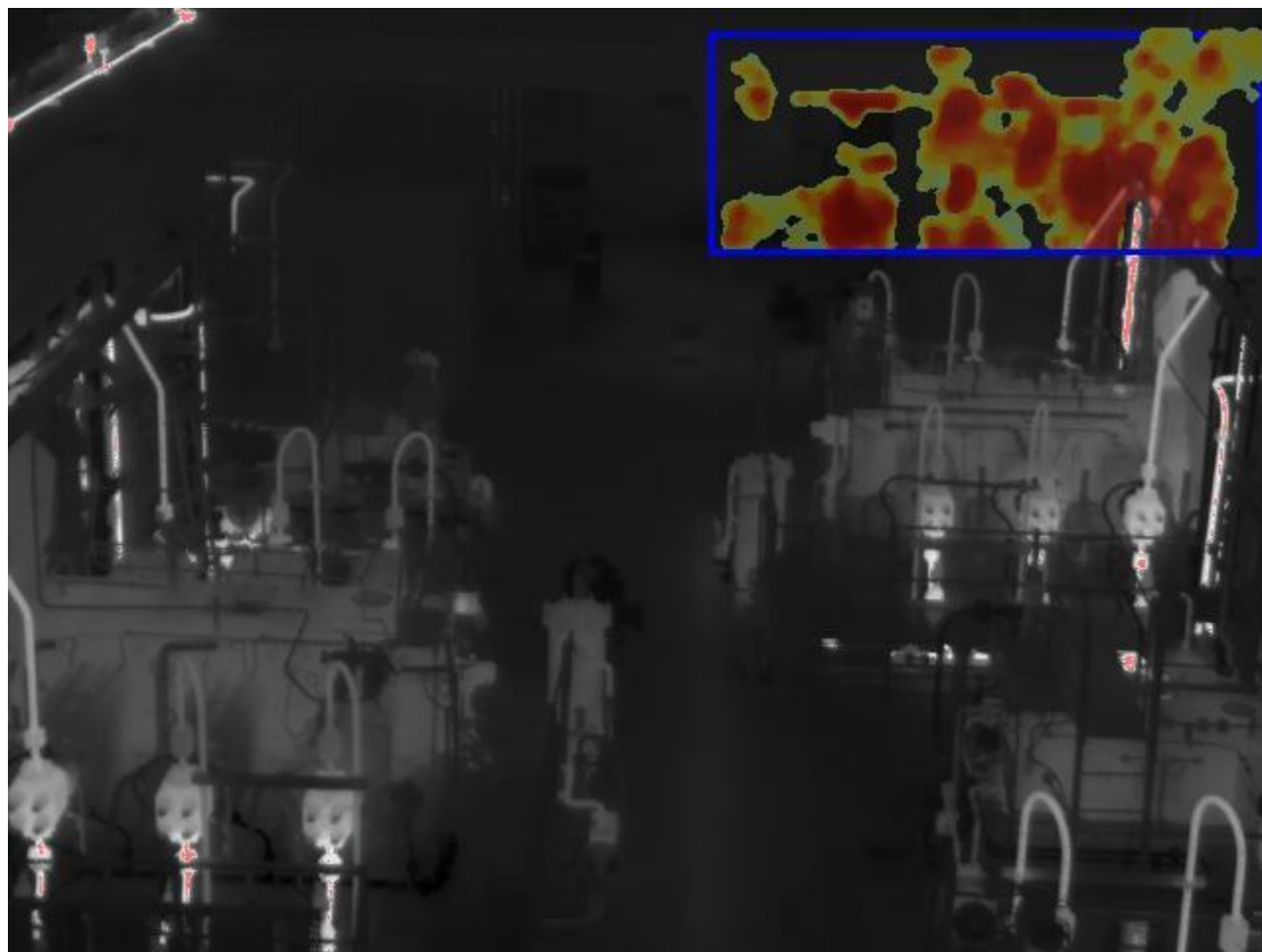


Figure 16: An example of a RedLook snapshot from an alarm event.

7.4. RedLook Alarm Reports

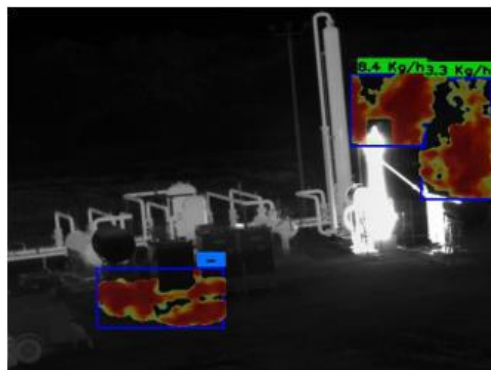
Supporting Documents:

- CBI-03: DOC-SEN-TN-0118 v1.1 RedLook Data Outputs
- CBI-16: DOC-SEN-MA-0006 RedLook User Manual

RedLook offers the function to generate automated reports containing the alarms triggered over a period of time. These reports are generated in an editable Microsoft Word “.docx” format and include the camera snapshots discussed in Section 7.3. Figure 17, below, presents an example of a RedLook alarm report.

SENSIA Alarms report
Page 2 of 2

2023/05/05 00:11



Device Name:

Camera 01 - Preset 01

S/N:

Model:

Event Name:

AGA_DET: Gas detection

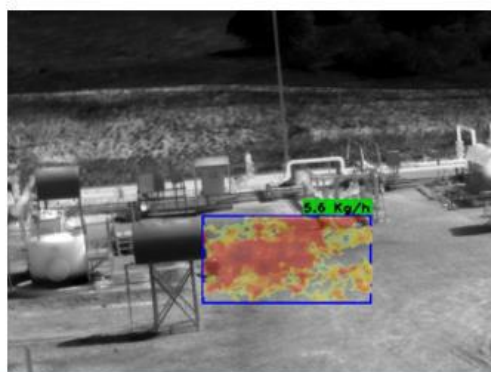
Sensitivity: Medium; FileName:

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

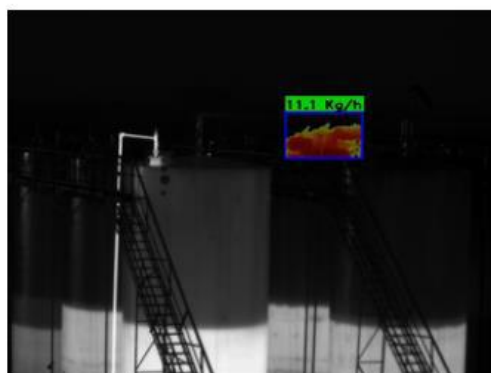
Sensitivity: Medium; FileName:

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

Report created by RedLook TM



WWW.SENSIA-SOLUTIONS.COM

Figure 17: An example of a RedLook alarm report.

RedLook also records all values corresponding to the quantification measurements performed when running real-time analytics in plain text “.txt” files. These files are automatically generated for each connected camera, preset, and ROI. These files present time-stamped quantification data in 5 second increments.

7.5. RedLook Database

Supporting Documents:

- CBI-03: DOC-SEN-TN-0118 v1.1 RedLook Data Outputs
- CBI-16: DOC-SEN-MA-0006 RedLook User Manual

All information generated by RedLook is saved into its local PostgreSQL Database. This database contains information pertaining to:

1. Mileva 33F cameras: all identifying information specific to each camera as well as latitudes and longitudes during operation.
2. Presets: all information associated with a given preset.
3. Regions of Interest: All information associated with an OGI camera's regions of interests.
4. Alarms: all identifying information associated with alarm events.
5. Data: all information associated with the data provided by the active regions of interest.

7.6. Repair Details Record Keeping

Records will be kept of the date of first repair attempt, and if necessary, any additional repair attempts. Records of the date of leak repair, and the repair method applied will also be kept. Any records pertaining to delays in leak repair, including dates, duration, and cause of delay will be kept. Upon completion of the repair, dates and results of re-monitoring with RedLook will be kept. All records will be maintained by the operator and can be made available for a minimum of 5 years.

8. Aggregate Detection Threshold

Supporting Documents:

- CBI-15: CMReport SENSIA Mileva Sep 2024

The Mileva 33F and RedLook System underwent testing at METEC between 2024-06-17 and 2024-06-28. The testing, which was blinded to SENSIA, was carried out by GTC Analytics who also led the post-testing results analysis. The full results of this testing can be provided upon request, here, we will focus on the results of the probability of detection analysis.

8.1. Methodology

The following are the key testing parameters applying to the Mileva 33F:

- 202 releases were set off between 2024-06-17 18:00 and 2024-06-28 19:00.
- Emission rates ranged from 6.39e-4 kg CH₄/hour to 6.34 kg CH₄/hour.
- Releases originated from two pieces of equipment, both of which had three equipment units (components) from which releases could originate.
- The distance from RedLook OGI Cameras to the equipment groups is as follows:
 - 4T1: 42.7 m
 - 4T-2: 45.8 m
 - 4T-3: 48.5 m
 - 5W-1: 36.0 m
 - 5W-2: 39.3 m
 - 5W-3: 42.5 m

During testing, RedLook continuously and autonomously screened the METEC facility for emissions, located at the Colorado State University in Fort Collins, Colorado, US. Detection reports containing all required data to compile the results were autonomously sent to GTC Analytics.

8.2. Results

Figure 18 presents the classification of all controlled releases from the Mileva 33F. Releases “Excluded from Analysis” were excluded from classification as they may indicate an emission from the test center during a maintenance period or another test conducted at the test center that was not following the continuous monitoring protocol.

Level	True Positive	False Negative	False Positive	Excluded from Analysis	Total
Controlled Releases	189	13	–	36	238
Detection Reports	189	–	1	7	197

Figure 18: Classification of controlled release and detection reports for the Mileva 33F.

Figure 19 is the probability of detection curves created using the true positive and false negative results from the testing for the Mileva 33F. Figure 19 show the probability of detection versus emission rate (kg CH₄/hour), assessed with logistic regression. True positive and false negative detections are shown with markers at $y = 1$ and $y = 0$ respectively. The logistic regression is performed on bootstrapped results to show a cloud of curves illustrating the uncertainty of the result. Figure 19 are the results of assessing the probability of detection without normalizing the release rates against wind speed. While this normalization assessment was carried out by GTC analytics and is contained in the full reports, here, we have elected to focus on the non-normalized results as they provide a more conservative probability of detection assessment (higher release rates at 90% probability of detection).

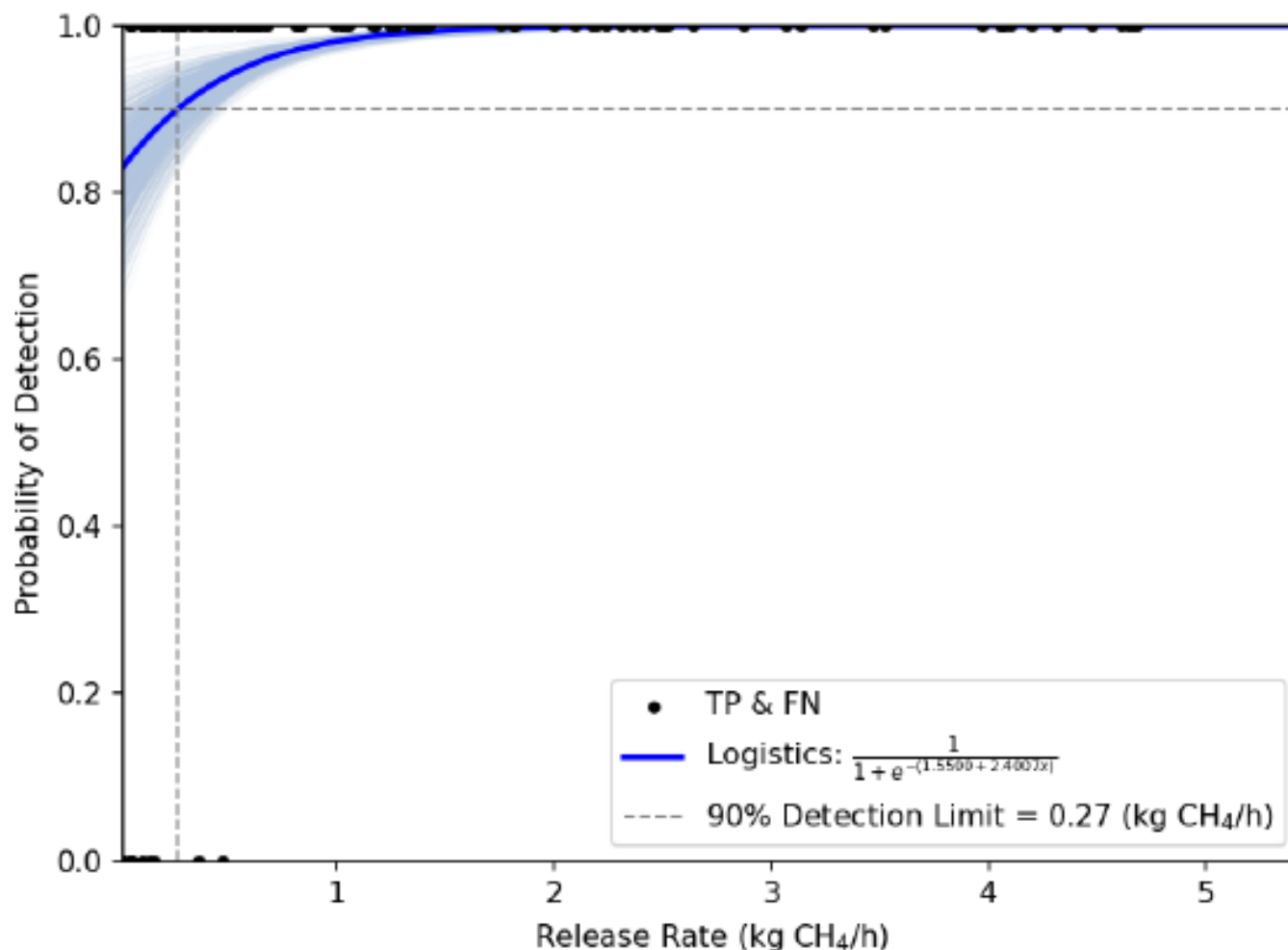


Figure 19: probability of detection versus emission rate (kg CH₄ / hr), assessed with logistic regression for the Mileva 33F. True positive and false negative detections are shown with markers at $y = 1$ and $y = 0$ respectively. The logistic regression is performed on bootstrapped results to show a cloud of curves illustrating the uncertainty of the result.

9. Spatial Resolution

Supporting Documents:

- CBI-04: DOC-SEN-PRS-0033 v6.1 Introduction to RedLook Technology
- CBI-05: DOC-SEN-PRS-0064 v2.0 Quantification of VOC emission sources application case
- CBI-07: Introduction to SENSIA
- CBI-08: DOC-SEN-LT-0179 v1.0 SENSIA physics-guided quantification AI
- CBI-11: Sensia-Catalog-2024

- CBI-12: DOC-SEN-PRO-0007 v1.0 Technical proposal template
- CBI-13: DOC-SEN-PRO-0008 v1.0 Technical proposal template
- CBI-19: DOC-SEN-MA-0042 v2.1 Semi-portable RedLook System Hardware and Maintenance manual

RedLook with the Mileva 33F OGI camera is seeking alternative test method approval as a system with component-level spatial resolution. Using OGI video footage collected by the Mileva 33F, RedLook can establish component-scale spatial resolution by localizing identified emissions to specific components of equipment. As previously described in Section 2.2, when emissions are detected, RedLook colorizes the plumes in the black and white OGI video footage of the user interface and marks the space to which the plume occupies with blue boxes. Illustrative examples of RedLook localizing emissions at a component scale are presented in this section.



Figure 20: An example of RedLook identifying emissions at a component level.

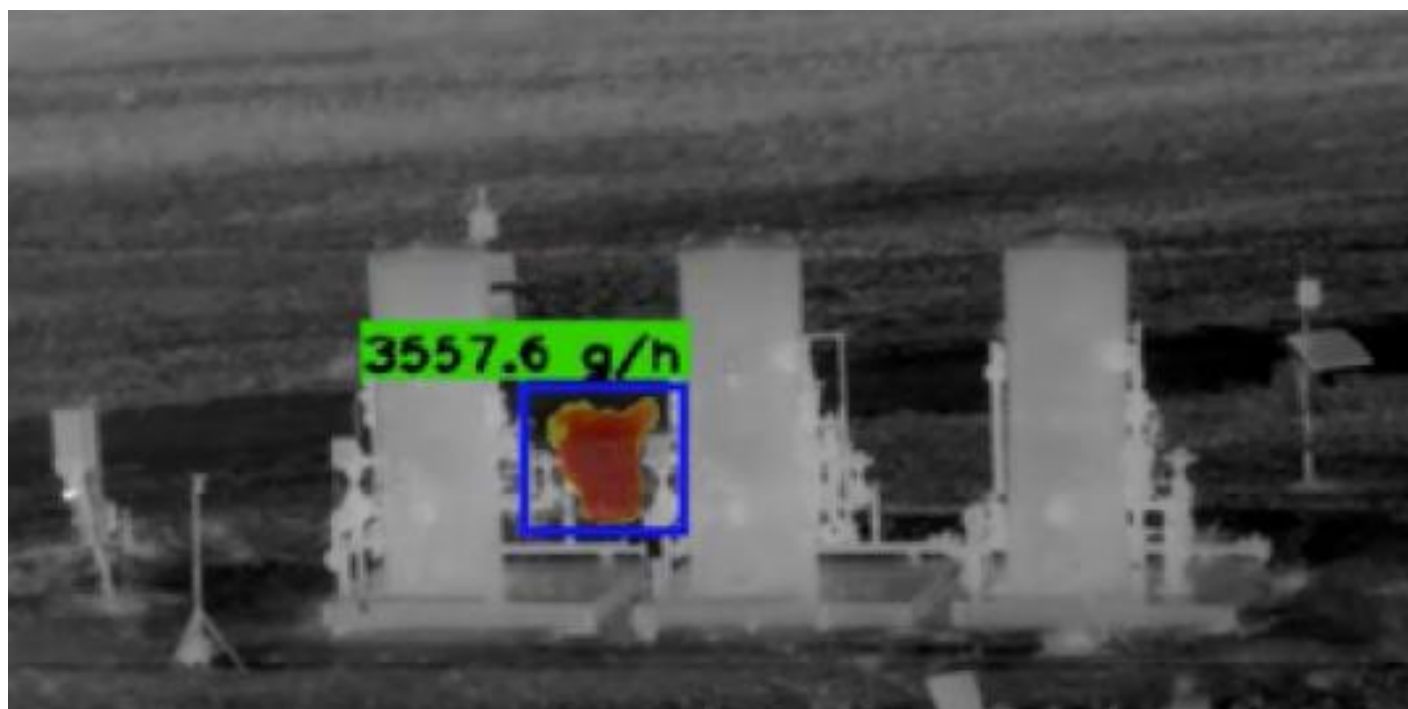


Figure 21: An example of RedLook identifying emissions at a component level.



Figure 22: An example of RedLook identifying emissions at a component level from on-site tanks.

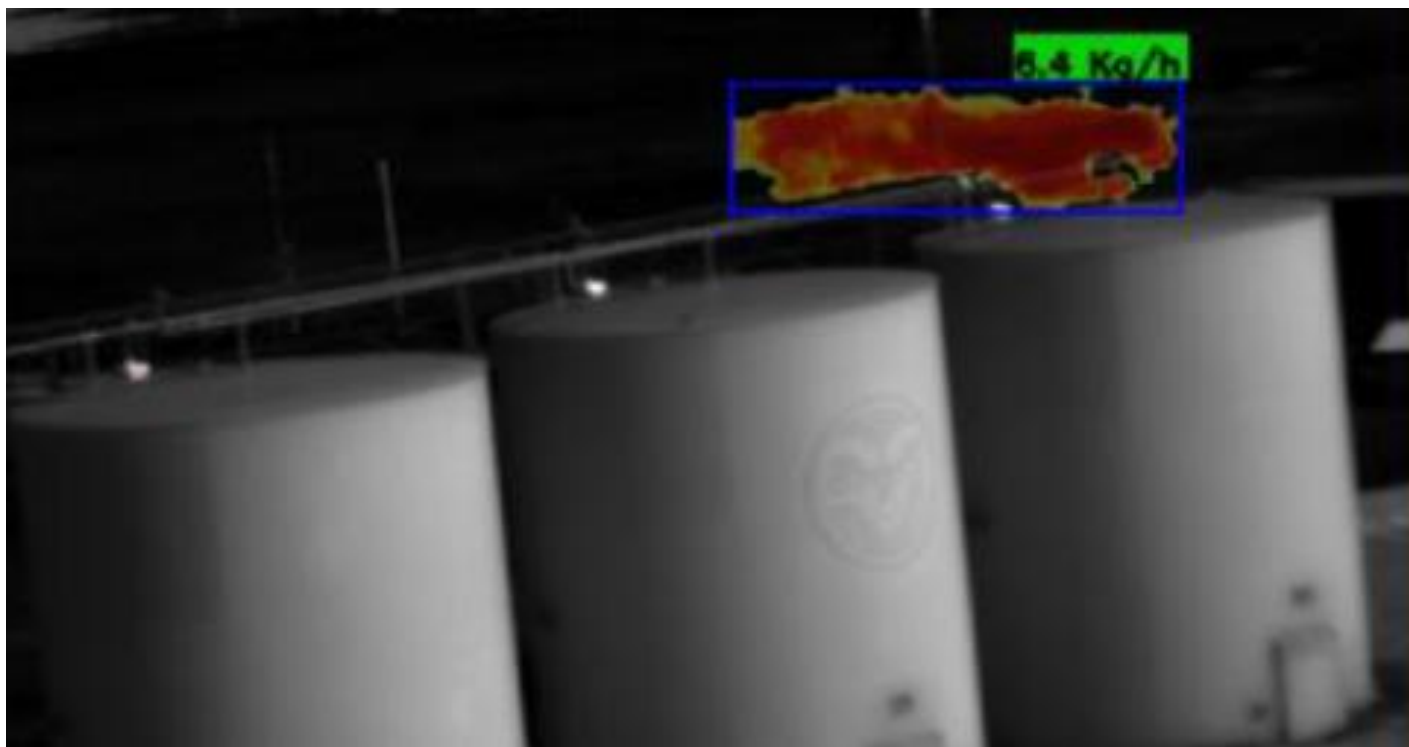


Figure 23: An example of RedLook identifying emissions at a component level from on-site tanks.

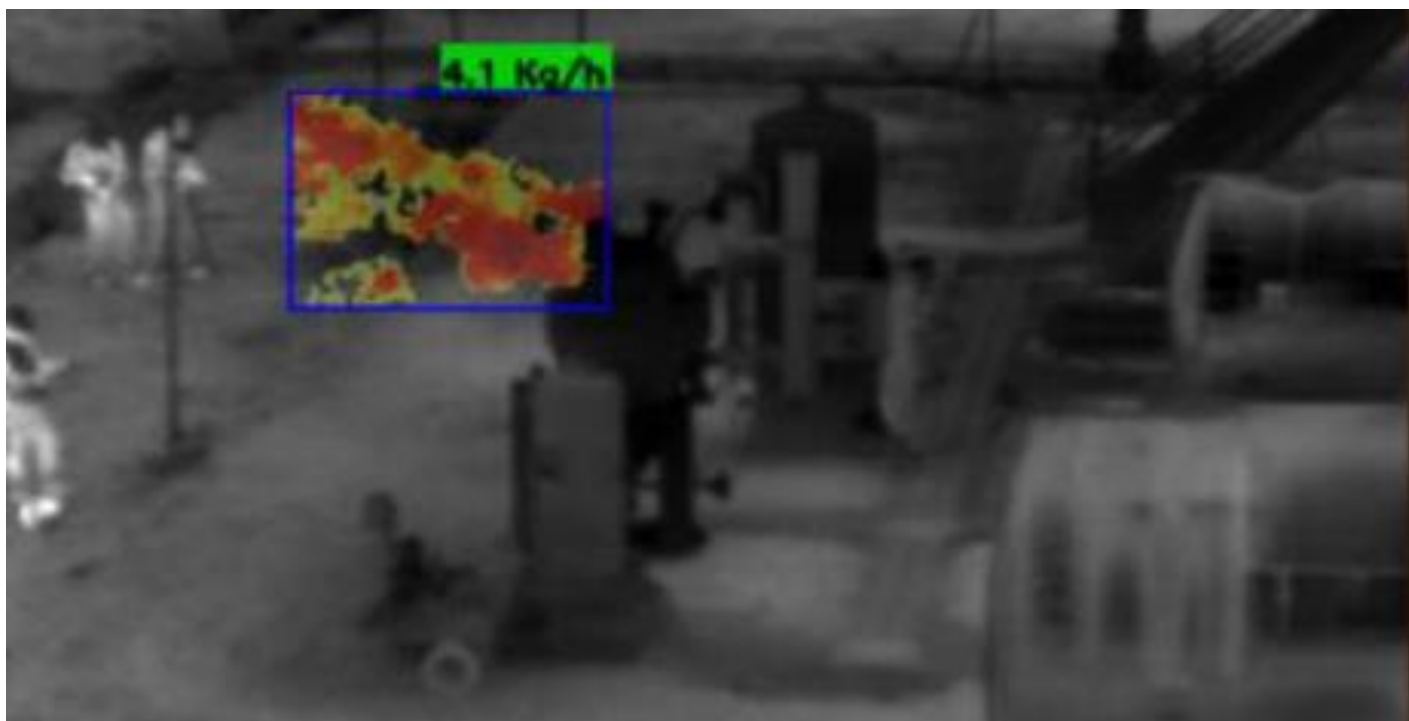


Figure 24: An example of RedLook identifying emissions at a component level.



Figure 25: An example of RedLook identifying emissions at a component level from an on-site flare.

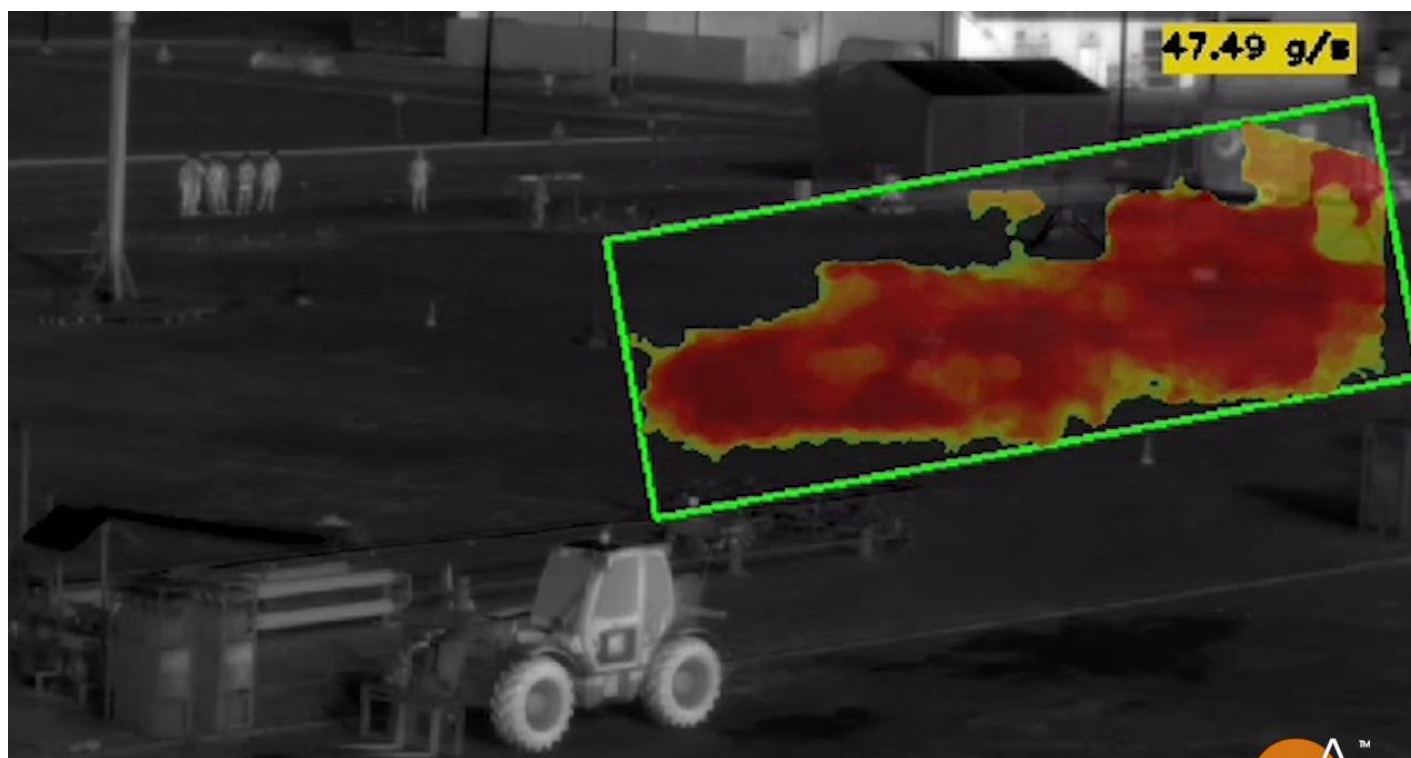


Figure 26: An example of RedLook identifying emissions at a component level.

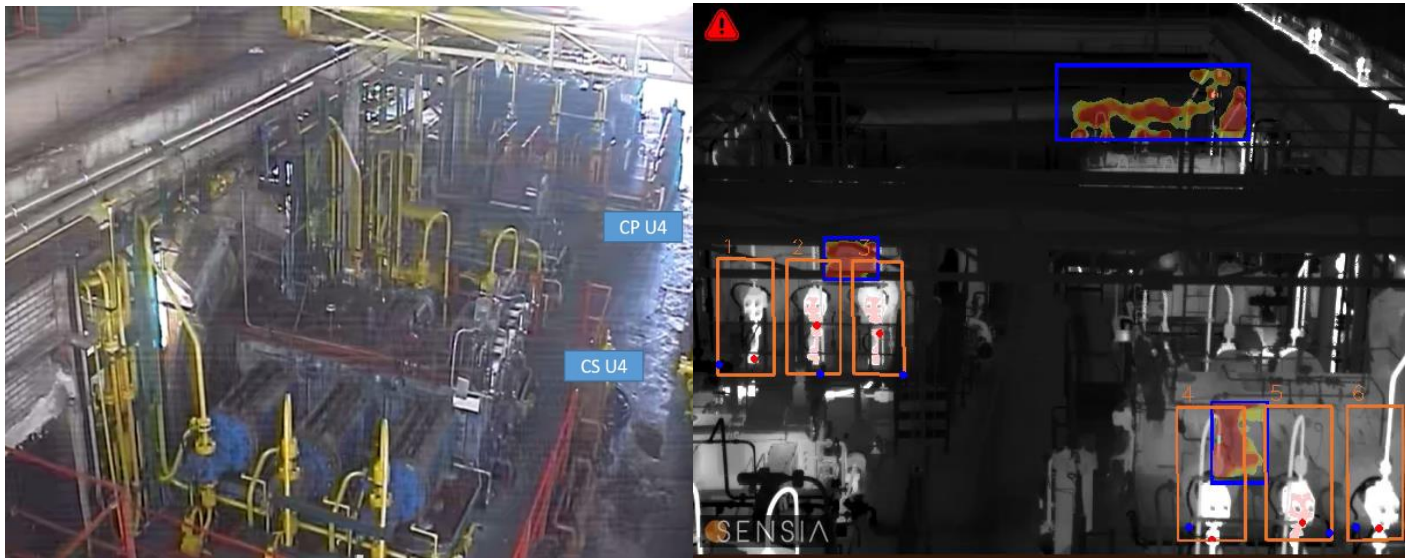


Figure 27: An image of a site under normal camera settings (left) and thermal images of the same site with emissions detected by RedLook at the component level (right).

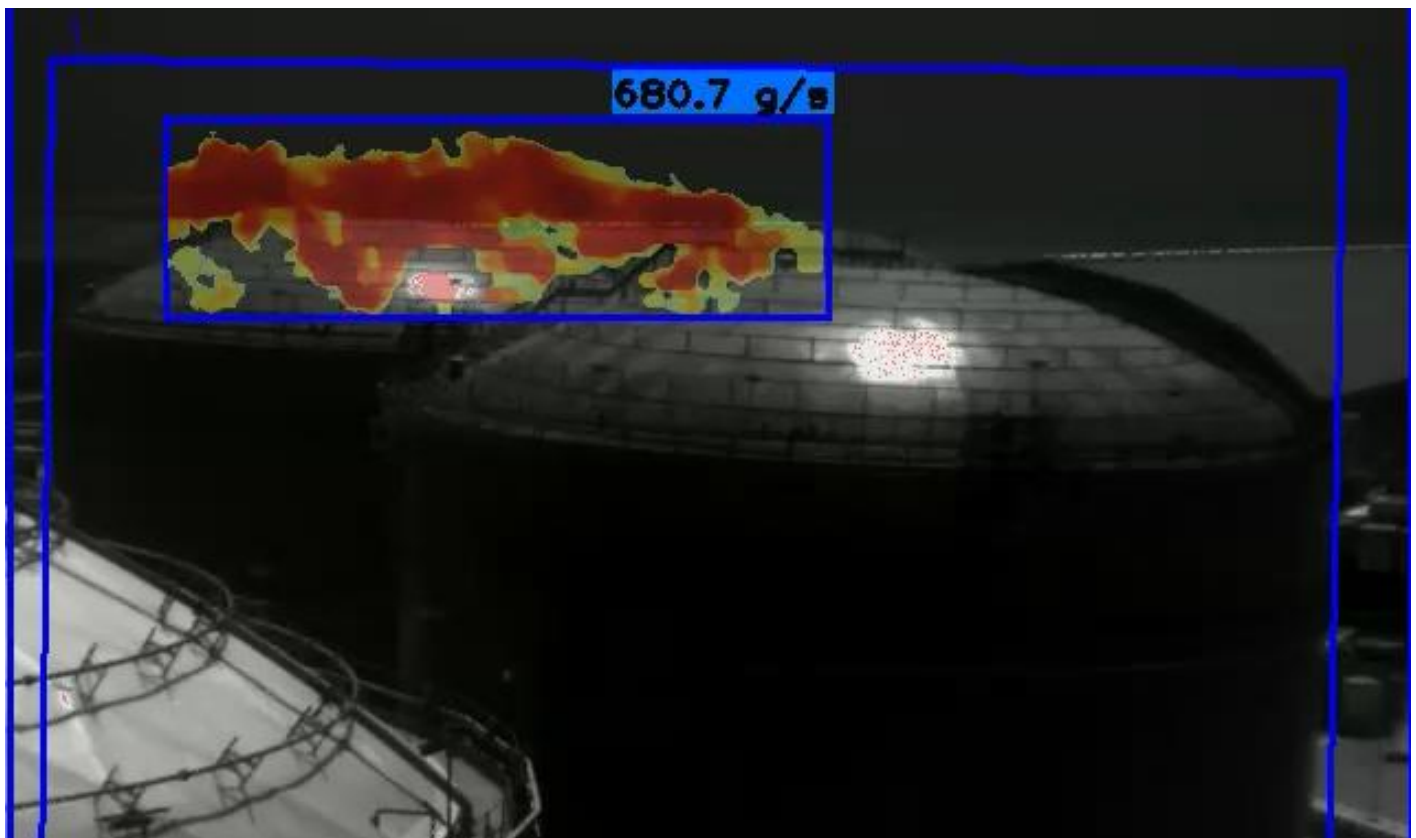


Figure 28: An example of RedLook identifying emissions at a component level from on-site tanks.

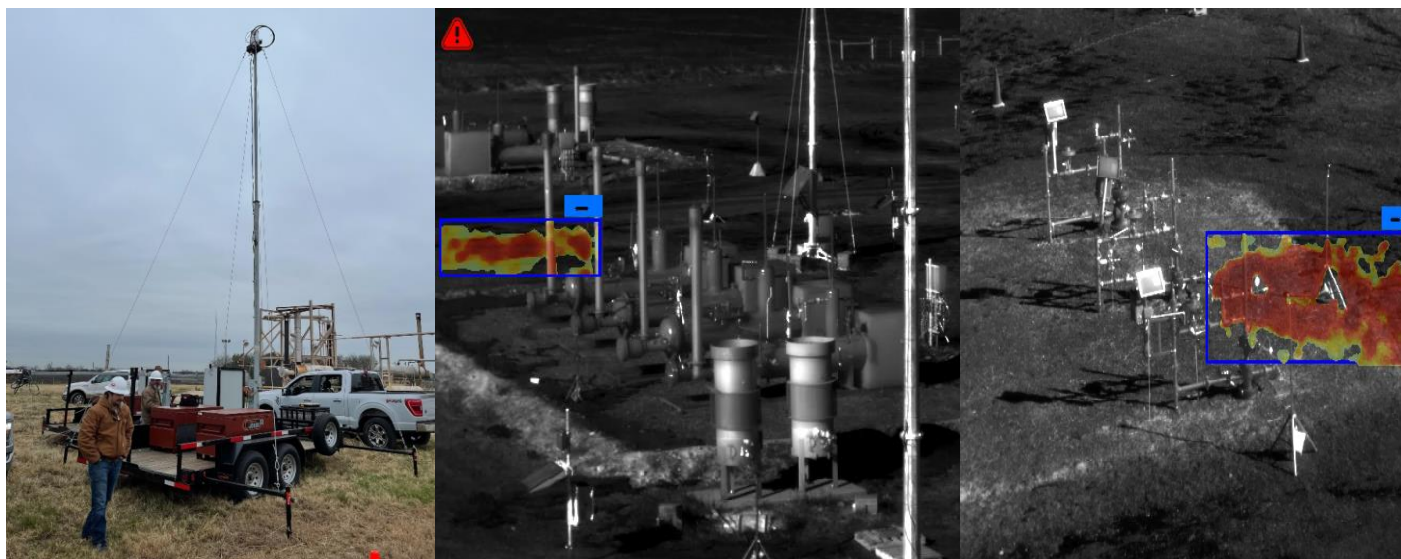


Figure 29: An example of RedLook installed on site (left) and thermal images of the site (middle, right) with emissions detected by RedLook at a component level.