Martinez Refining Company
Regulation 12, Rule 15 Air Monitoring Plan

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List of Acronyms

APCO – Air Pollution Control Officer for the BAAQMD.

BAAQMD – Bay Area Air Quality Management District

BTEX – Benzene, Toluene, Ethylbenzene, Xylenes

DCU – Delayed Coker Unit

EPA- Environmental Protection Agency

FTIR – Fourier Transform Infrared Spectrometer

H2S – Hydrogen Sulfide

LDL – Lower Detection Limit LOP – Light Oil Processing

MBC – Martinez Refining Company Business Center

MET – Meteorological Station

MFO – Marine Fuel Oil

MRC – Martinez Refining Company

OEHHA – Office of Environmental Health Hazard Assessment

OPCEN – Operations Central

PPB – Parts Per Billion

QAPP – Quality Assurance Project Plan

QA/QC – Quality Assurance / Quality Control

SO2 – Sulfur Dioxide

TDL – Tunable Diode Laser

TRI – Toxic Release Inventory

UV-DOAS – Ultraviolet Differential Optical Absorption Spectroscopy

UDL – Upper Detection Limit

WWTP – Wastewater Treatment Plant

Section 1 - Overview

On April 20, 2016, the Bay Area Air Quality Management District (BAAQMD) adopted Regulation 12, Rule 15 (Rule 12-15) which requires Bay Area refineries to develop and submit an Air Monitoring Plan (AMP) for APCO approval to establish and operate a fence-line monitoring system. The BAAQMD also published guidelines for refineries to meet the fence-line monitoring requirements. The Martinez Refining Company (MRC) has followed these guidelines to generate this Air Monitoring Plan for submission to BAAQMD. As presented in "Air Monitoring Guidelines for Petroleum Refineries, AIR DISTRICT REGULATION 12, RULE 15: PETROLEUM REFINING EMISSIONS TRACKING", the key elements of the BAAQMD rule and guidelines are as follows:

Requirement #1 – Gases Requiring Open-path Measurements

Refinery operators must measure benzene, toluene, ethyl benzene, and xylenes (BTEX) and hydrogen sulfide (H_2S) concentrations at refinery fence-lines with open path technology capable of measuring in the parts per billion (ppb) range regardless of path length.

Requirement #2 - Other Gases to be Considered for Measurements

Measurement of sulfur dioxide (SO_2), alkanes or other organic compound indicators, 1,3-butadiene, and ammonia concentrations are to be considered in the Air Monitoring Plan. Refinery operators must provide a rationale in the Air Monitoring Plan for not measuring all the above compounds. The rationale must address why these compounds are not contained in the compositional matrix of emissions; are not at expected concentrations measured by available equipment; and/or address the technical or other considerations that make specific measurements inappropriate or unavailable.

Requirement #3 – Fence-line Coverage

Measurements must cover populated areas within 1 mile of the refinery fence-line likely to be affected when the annual mean wind direction lies in an arc within 22.5 degrees of a direct line from source to receptors 10% of the time, or greater, based on the most representative meteorological measurements for sources likely to emit the compounds listed above at the refinery. In addition, the monitoring plan should take into consideration seasonal and short-term meteorological events.

Requirement #4 – Sample Time Resolution and Data Completeness/Retention

Fence-line measurements must be continuously measured with a time resolution of five minutes. If this is not the case, refinery operators must provide rationale in the Air Monitoring Plan for lesser time resolution based on equipment or other operational limitations. Instrumentation must meet a minimum of 75% completeness on an hourly basis 90% of the time based on annual quarters. This is further defined as:

Quarterly % Completeness = ([Hours in the calendar quarter with hour complete % ≥ 75%] / [Total hours in the calendar quarter]) × 100.

Here, an "hour" represents a distinct clock hour (0 - 23) on any given day, as opposed to a rolling 60-minute period.

Atmospheric conditions beyond the control of the refinery that affect accurate measurements, such as dense fog shall not be counted against data completeness calculations. The owner must maintain records of all information required under this rule for a period of five years after the date of the records and records must be made available to the APCO upon request.

Requirement #5– Data Presentation to the Public

Measurements must be provided to the public on a real-time basis, with appropriate Quality Assurance/Quality Control (QA/QC) measures taken to provide assurance of data quality.

Requirement #6 - Develop a Quality Assurance Project Plan

A Quality Assurance Project Plan (QAPP) that follows EPA guidelines must be developed that outlines the QA/QC parameters.

Requirement #7 – Schedule to Implement 12 months after plan Approval.

MRC's intent is to meet the installation milestones associated with Rule 12-15.

MRC's policy is to comply with all local and federal environmental regulations including the fence -line monitoring provisions of BAAQMD Rule 12-15. This includes meeting all downwind fence-line siting requirements, uptime requirements, and reportable quantifiable detection levels. Siting included the evaluation of five years of meteorological data as well as seasonal and recurring short-term meteorological events (such as quarterly wind roses) in assessing siting positions per the BAAQMD guidance document. Site locations for the fence-line equipment were selected to strategically position the fence-line monitors using the predominant and variable meteorological conditions and topographical terrain features within the refinery. Finally, the specific chemicals that require monitoring were determined for each source area based on process knowledge.

The following sections provide a summary of MRC's methodology for meeting the fence-line monitoring requirements of Rule 12-15.

Section 2 - Evaluation of Fence-line Requirements

Requirement #1 – Gases Requiring Open-path Measurements

As required by Rule 12-15, MRC will install open-path air monitoring systems for the detection and quantification of BTEX and H_2S. The addition of open-path H_2S systems will be completed and operational prior to January 1, 2023. MRC will notify the Air District within seven days after the system is operational and data in compliance with the QAPP is available on the website.

Requirement #2 - Other Gases to be Considered for Open-path Measurements

As required by Rule 12-15, MRC considered the measurement of sulfur dioxide (SO_2), alkanes or other organic compound indicators, 1,3-butadiene, and ammonia for inclusion in the Air Monitoring Plan. Alkanes and SO_2 will be included in the monitoring plan as they have the potential to be present in measurable quantities at MRC. 1,3-butadiene will not be included in the fence-line monitoring program because it is not produced as an intermediate or end-product at MRC and is only present in trace quantities at the refinery. Ammonia, where it is present in the form of anhydrous ammonia, is only in one location at the refinery and will already have local detection of release near the source prior to the fence-line plan implementation, therefore no fence-line monitoring for ammonia is included in the plan.

Figure 2.1 Demonstration of Open-Path Average Concentration vs Point Sampler Detection

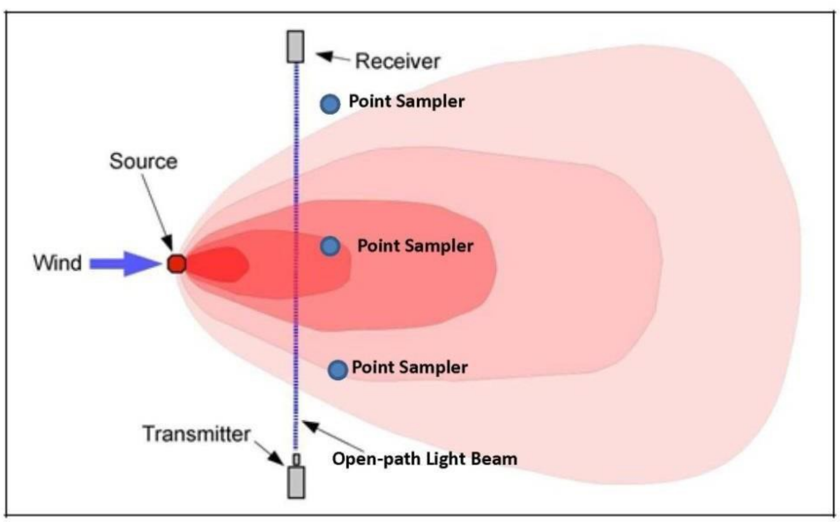


Table 2.1 presents the monitoring technologies proposed to comply with the Rule 12-15 monitoring requirements, along with the technology capabilities, common potential interferences for each instrument type and restrictions. Additional information for the Ultraviolet Differential Optical Absorption Spectroscopy (UV-DOAS), Tunable Diode Laser (TDL), Fourier Transform Infrared (FTIR), and Organic Gas Detectors (OGDs) air monitoring systems are included in the QAPP.

Technology Descriptions

The MRC fence-line monitoring program uses two different types of technologies to measure gases in the air. The first type, open-path air monitoring systems, uses beams of light to detect and quantify gases. The systems work by sending a beam of light into the open air and receiving it at a detector. When specific gases are present in the beam, some of the light is absorbed, and the detector can distinguish between a beam received in clean air, versus a beam when those specific gases are present. Often gases have their own distinct way of absorbing light and may absorb light at several different wavelengths. This acts almost like a fingerprint for the gas, and by comparing known reference standards to the results from field measurements, the system can identify the gas based on which wavelength absorption patterns are present. Likewise, the quantity of light that was absorbed is a direct function of the concentration of the gas in the air. By analyzing the size of the absorption that took place, the system can estimate the average concentration of the gas along the beam path. A single open-path analyzer can send a beam of light out over half a mile. This makes these systems ideal for use as a fence-line monitoring system where a significant amount of linear distance needs to be covered. MRC is proposing BTEX and SO_2 will be detected and quantified using Open-path UV Differential Optical Absorption Spectroscopy (UV-DOAS) air monitoring systems. Total alkanes will be detected and quantified by open-path FTIR. H_2S will be detected and quantified using open-path Tunable Diode Laser (TDL) air monitoring systems.

The second type of air monitoring system used in the monitoring program are point sampling devices. The point sample monitoring systems are suited for use in areas of the fence line that may not be suitable for open-path devices. These include areas with terrain limitations, or where sources release gases that do not absorb light well enough to be efficiently detected with an open-path system.

At MRC, point monitoring systems will be deployed to supplement the open-path air monitoring systems to detect the total amount of organic gases present. Although this technology is a point sensor method rather than an open path, it has the capability to detect gases on a real-time basis while meeting the operational efficiency requirements presented in the rule. In addition, the point monitoring systems have an operational advantage compared to open-path systems as they will continue to operate during conditions when the open-path technologies will be inoperable due to weather events (e.g., heavy fog or rain). This additional coverage will enhance the community benefit of the fence-line system. The point monitoring systems will be deployed at strategic points along the fence-line to capture emissions from the refinery. MRC is proposing to use Organic Gas Detectors (OGD) where open path is not suitable.

In either open path or point detection, using the data in combination with the metrological station data from the MET station located on site is helpful in determining where sources originate from and where the gases are moving towards. The basic difference is demonstrated in Figure 2.1. In this figure, a gas plume is generated from a source and released into the air. As the gases are released, they are carried by the wind and begin to disperse and move away from the source. As seen in the figure, the concentration of gases in the plume will be highest in the center of the plume (shown as the darker red) and closest to the source, while gas concentrations will be less at the edge of the plume (shown as the lighter color red) as the distance from the source increases. The shape of the plume can be affected by changing terrain and meteorological conditions, but in general, this dispersion pattern is an accurate depiction of what happens after a gas release.

Table 2.1 –Monitoring Equipment Overview

Equipment	Capabilities	Interferences	Measurement Errors	Restrictions
Extractive FTIR	Detects alkanes.	Water and CO_2 which can be compensated for with analytical Software	Monitoring uses multiple regression to analyze data	None
Open-path UV	Detects Benzene, Toluene, Xylene, Ethylbenzene, and Sulfur Dioxide at path lengths up to 1,000 Meters	Ozone and Oxygen which can be compensated for with analytical software	Monitor uses partial least squares regression to analyze data	Heavy Fog and Rain
Open-path TDL	Detects Hydrogen Sulfide Gas	Water and CO_2	Monitor uses multiple regression to analyze data	Heavy Fog and Rain
Organic Gas Detectors	Detects Total Hydrocarbons. No Loss of data quality due to rain or fog	None	None	None
Meteorological Station (MET)	Wind direction and speed, temperature, dew point, rain gauge	None	None	None

Sample Analysis Method

Each analyzer has a vendor-specific method for collecting and quantifying data. Each specific analytic method is described below:

Open-path UV DOAS

The UV DOAS air monitoring system detects benzene, toluene, ethylbenzene, xylene, and sulfur dioxide on a real-time basis using beams of ultraviolet light. A beam of light is sent out in the open air to a light detector at the other end of the beam path. The system identifies gases by examining the wavelengths of UV light that have been absorbed by the gases present in the light beam. The amount of gas in the air is proportional to the amount of light absorbed at specific wavelengths. The system uses a multivariate method to quantify data. This analytic approach is critical to ensure false detections of gas do not occur. Each target gas has a spectral library of gases covering the concentration range of the analyzer. It also includes libraries of potential interfering gases such as oxygen and ozone. In addition, the system has the ability to undergo data and quality assurance checks in the field by using either sealed or flow through gas cell.

Open-path Tunable Diode Laser

The TDLs detect Hydrogen Sulfide (H_2S) gas on a real-time basis using beams of infrared light. A beam of light is sent out in the open air to a reflector that sends the beam back along the same path. If H_2S gas is present in the air, it will absorb at certain known wavelengths of the light. The tunable diode laser analyzes the light beam for H_2S gas as well as water and methane which also absorb light in the same region as the H_2S gas. The system uses a multivariate approach to analyze the data to separate the total amount of light absorbance by each of the three gases and outputs a result for each gas. The system has the ability to undergo data and quality assurance checks using either sealed or flow through gas cells in the field.

Extractive FTIR

The FTIR has the capability to detect total non-methane hydrocarbons on a real-time basis while minimizing the impact of gases that interfere with alkane measurement such as water vapor and methane gas. The analytical method employed by the FTIR is a multiple regression technique that separates the total amount of light absorbance by the various gases and outputs a result for each gas. In the case of alkanes, this includes the contribution of interfering gases such as water vapor and methane. The system also can distinguish between various sources of alkanes by using wind speed and direction as well as compound component ratios associated with various production units. The system has the ability to undergo data and quality assurance checks in the field by monitoring known ambient gases or by using gas standards. Total alkanes, regardless of source, will be displayed on the website. However, during the monthly QA process, the data may be identified as not from the refinery depending on wind speed and direction and its spectral component signature. This information will be provided to MRC for their internal use.

Organic Gas Detectors

The Organic Gas Detectors based on the principle of photoionization are referred to as Photoionization Detectors (PIDs). The systems work by inserting a sample of ambient air into a sample chamber where it is exposed to a small lamp that produces ultraviolet light. If an organic gas is present in the sample, it will interact with the UV light and become ionized. Once the gas is ionized it can be measured with a gas detector. The major advantage of the PID air monitoring system is its sensitivity and ability to measure organic gases at very low concentrations in the air. The limitation of the system is it cannot discriminate between the different types of organic gases that are in the air. In addition, the system cannot measure C2-C3 hydrocarbons but is capable of measuring the majority of gases associated with refining.

Quantification Limits

Tables 2.2 and 2.3 provide an overview of the gases covered in the fence-line program, the detection technologies employed, and the lower and upper quantification limits (LoQ and UQL) attainable under optimal conditions.

Table 2.2 – Quantification Limits for Gases Monitored by Open-Path Systems

	Path 1		Path 2		Path 3		Path 4	
Distance (m)	445		810		825		435	
Gas	**LoQ** (ppb)	**UDL** (ppb)	**LoQ** (ppb)	**UDL** (ppb)	**LoQ** (ppb)	**UDL** (ppb)	**LoQ** (ppb)	**UDL** (ppb)
Benzene	0.9	5,483	0.9	3,012	0.8	2,958	0.9	5,609
Ethyl Benzene	15	5,483	12	3,012	12	2,958	15	5,609
Hydrogen Sulfide*	3.0	5,000	3.0	5,000	3.0	5,000	3.0	5,000
Sulfur Dioxide	4.0	2,202	2.2	1,210	2.2	1,188	4.1	2,253
Toluene	1.8	2,742	1.7	1,506	1.7	1,479	1.8	2,805
Xylene	1.0	2,742	0.8	1,506	0.8	1,479	1.0	2,805

* The BAAQMD requirement for the LoQ of the H_2S includes the requirement that the systems report a value between 3 and 25 ppb under optimal environmental conditions. For the TDL air monitoring system, ideal conditions include clear air, non-condensing atmosphere, relative humidity less than 95%, and stable optical alignment.

Table 2.3 – Detection Limits for Gases Monitored by Point Source Samplers

Point Source Monitor	Detection Limits	
	MDL (ppb)	**UDL** (ppb)
Total Alkanes	75	4,200
Total Organics	10	100,000

Table 2.2 – Detection Limits for Gasses Monitored by Open-Path Systems

	Path 1		Path 2		Path 3		Path 4	
Distance (m)	**445**		**810**		**825**		**435**	
Gas	**LDL** (ppb)	**UDL** (ppb)	**LDL** (ppb)	**UDL** (ppb)	**LDL** (ppb)	**UDL** (ppb)	**LDL** (ppb)	**UDL** (ppb)
H_2S	3	5,000	3	5,000	3	5,000	3	5,000
Benzene	0.8	5,483	0.5	3,012	0.4	2,958	0.9	5,609
Ethyl Benzene	4.5	5,483	2.5	3,012	2.4	2,958	4.6	5,609
Sulfur Dioxide	4.0	2,202	2.2	1,210	2.2	1,188	4.1	2,253
Toluene	1.8	2,742	1.0	1,506	1.0	1,479	1.8	2,805
Xylene	1.0	2,742	0.5	1,506	0.5	1,479	1.0	2,805

Table 2.3 – Detection Limits for Gases Monitored by Point Source Samplers

Point Source Monitor	Detection Limits	
	LDL (ppb)	**UDL** (ppb)
Total Alkanes	75	4200
Total Organics	10	100,000

Requirement #3 – Fence-line Coverage

This section describes the process used to determine where along the MRC fence-line the air monitoring equipment will be installed. Emission sources within the physical bounds of the refinery were identified and marked based on physical location and type of emissions. These sources are shown on a map of the refinery in Figure 3.1. Each emission source location was evaluated for the types of potential emissions and summarized in Table 3.1. Note that 96+% of all equipment covered by the refinery's fugitive emissions inspection program are included in these 10 areas.

Table 3.1 – Potential Emission Types from Source Areas

Area on Site Map	Source Type	Source Name	Emission Types
Area #1	Wastewater	Effluent Treatment Plant	BTEX[1], H_2S, SO_2, Alkanes
Area #1	Loading	Wharf	BTEX, H_2S, SO_2, Alkanes
Area #2	Storage	Distribution Tanks	BTEX, Alkanes
Area #3	Storage	Distillates Tanks	H_2S, Alkanes
Area #4	Process	Operations Central	BTEX, H_2S, SO_2, Alkanes
Area #5	Storage	Recovered Oil/Rerun Tanks	BTEX, H_2S, SO_2, Alkanes
Area #6	Process	COGEN, Gasoline Blending	BTEX, SO_2, Alkanes
Area #7	Process	Light Oil Processing	BTEX, H_2S, SO_2, Alkanes
Area #8	Process	Delayed Coking	BTEX, H_2S, SO_2, Alkanes
Area #9	Storage	Crude Tanks	BTEX, H_2S, Alkanes
Area #10	Storage	Vine Hill Storage Tanks	BTEX, H_2S, Alkanes

[1] BTEX includes benzene, toluene, ethylbenzene, and xylene

The fence-line monitors being installed as described in this Plan will complement and enhance air emission monitoring currently being done on the fence-line and on emission sources throughout the refinery for compliance with BAAQMD and EPA rules.

- Ground Level Monitors (GLMs) continuously sample the ambient air at four locations on the refinery fence-line and analyze for H_2S and SO_2 as required by BAAQMD regulations.
- Passive diffusion tubes are located around the refinery fence-line to be analyzed for benzene that began in 2018 as required by EPA's Refinery Sector Rule.

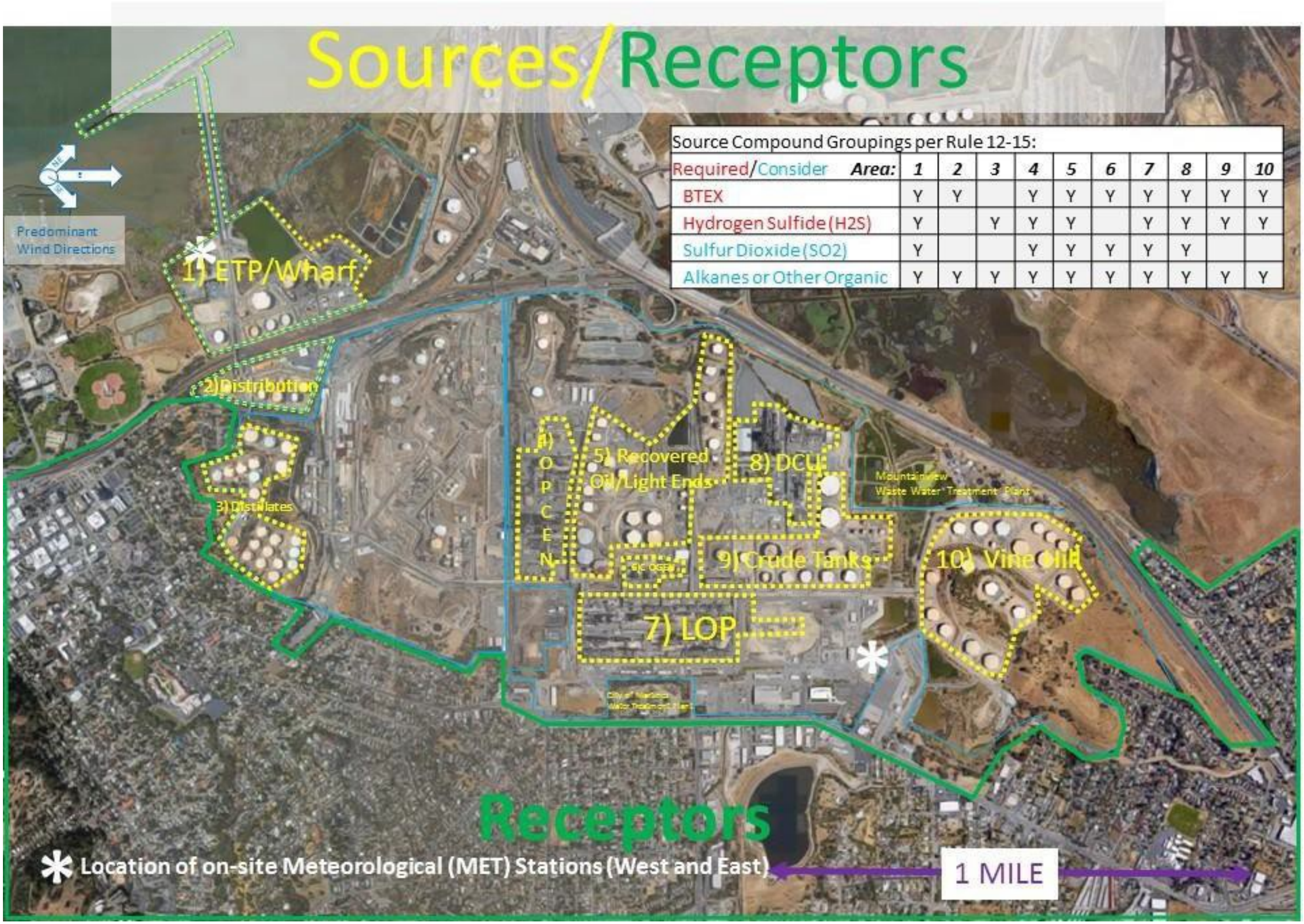
- Continuous emission monitors measure NOx emissions from heater and boiler stacks, SO_2 emissions from sulfur plants, CO emissions from CO Boilers, and sulfur in fuel gas as required by both BAAQMD and EPA rules.
- Hydrocarbon detection systems surround the propane and butane storage areas to provide an early indication of any leak from these tanks.
- Several hundred thousand valves, pumps, and connections are monitored throughout the refinery to detect any low-level hydrocarbon leaks by a team of trained inspectors as required by BAAQMD and EPA rules.

.Figure 3.1 Potential Emission Sources presented on the next page is an illustration of potential emissions sources at MRC.

Sources/Receptors

Source Compound Groupings per Rule 12-15:

Required/Consider Area:	1	2	3	4	5	6	7	8	9	10
BTEX	Y	Y		Y	Y	Y	Y	Y	Y	Y
Hydrogen Sulfide (H2S)	Y		Y	Y	Y		Y	Y	Y	Y
Sulfur Dioxide (SO2)	Y			Y	Y	Y	Y	Y		
Alkanes or Other Organic	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y



Wind Data

Meteorological data from two MRC on-site Meteorological (MET) stations operated by Western Weather were used to generate wind roses based on 2015 annual averages showing which sectors had winds blowing in each quadrant of the wind rose at least 10% of the time. The location of these MET stations can be seen in Figure 3.1. The wind roses showing these sectors are found in Figure 3.2.

The West MET station wind rose shows that the wind blows from the Southwest, West and Northwest more than 10% of the time and the East MET Station wind rose shows the wind blows from those same directions as well as from the South and Southeast. Although not shown, the 2011-2014 data were also evaluated and for all years the West MET station had the same 3 directions >10% and no other directions in any of the years. The East MET station had the same 5 directions >10% in all years except 2011 only had 4 of the directions >10% (not West) and no other directions were >10% in any of the years.

Seasonal weather patterns in the five years of wind data were also considered. February through October wind directions are like the annual wind roses. Calendar months November through January (labeled as Winter Conditions in Figure 3.3), show a wind direction from the East 16% and Northeast 13% of the time which accounts for most of the ~5% annual wind from either of these directions shown in Figure 3.2. Since the annual wind from these directions is much less than the 10% requirement for fence -line coverage and even during the winter period the frequency is only in the ~15% of the time range, additional fence-line coverage is not strictly required. However partial coverage for wind from these directions is included in the fence-line design as discussed below.

Figure 3.2 - Predominant Wind Direction

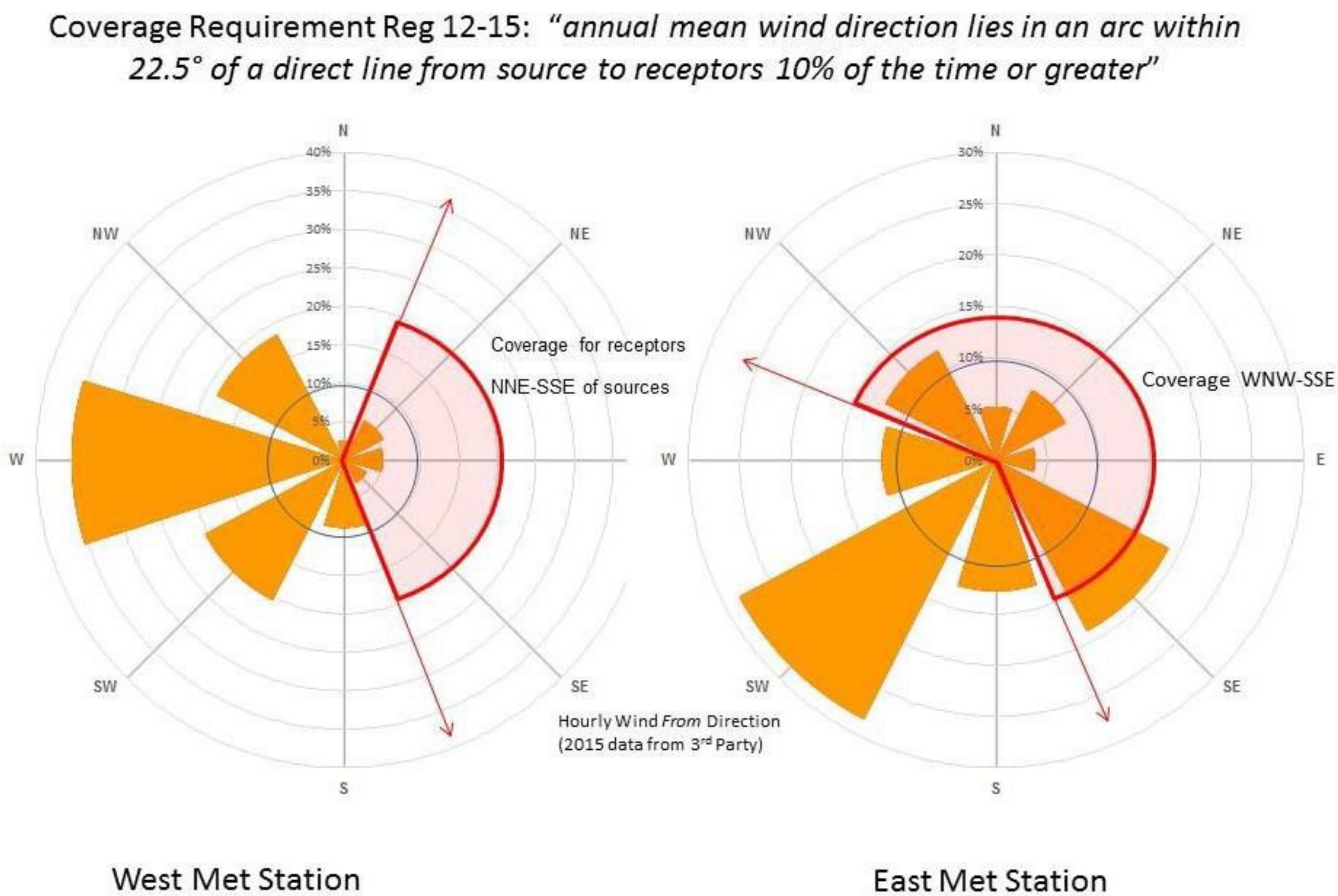
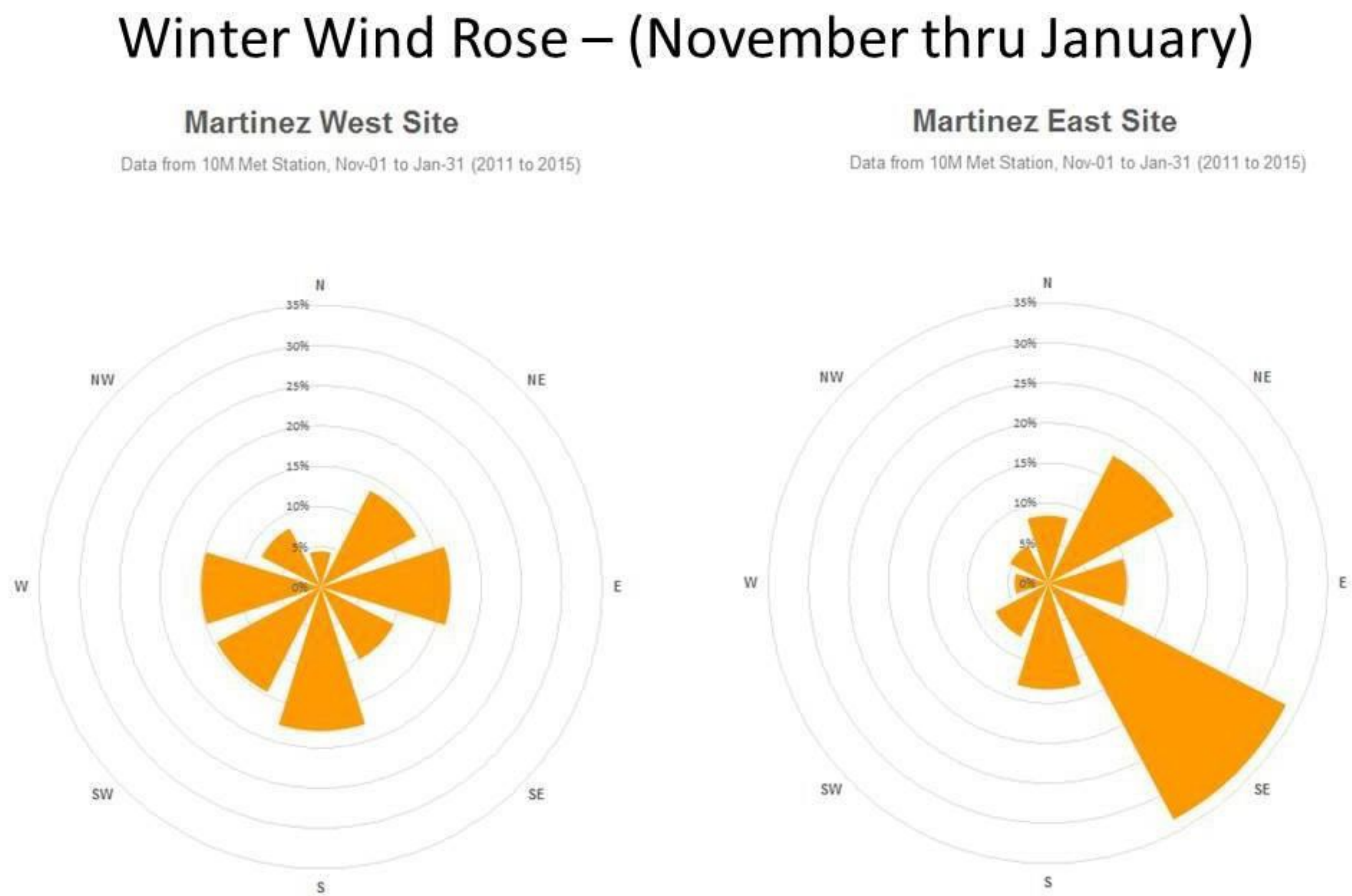


Figure 3.3 – Wind Rose During Winter Conditions



Location of Fence-line Systems

The following narrative presents the specific site location plan for the fence-line monitoring systems as shown in Figure 3.4. It is based on the source type, source location, predominant wind direction, and location of receptors. The West side includes the Wharf and Effluent Treatment Plant and stored products, and the East Side includes land east of MRC Avenue and most of the process units.

West Side of Refinery – Most of the time, emissions from the west side of the refinery will move in a direction without receptors or toward the east side of the refinery (for winds from the West or Southwest). For a wind from the Northwest, emissions from the storage tanks located at Area 3 (Distillates Storage Tanks) would go to receptors to the Southeast. These tanks include heavier refined products (jet fuel, diesel, MFO) and will be monitored for alkanes and H_2S along Path 1. The endpoints C and D were selected to maximize the line of site distance for maximum fence-line coverage.

For the winter weather winds represented in Figure 3.3 when wind comes from the East or Northeast a higher percentage of the time, Path 1 will also monitor for BTEX and SO_2 that could come from the process units east of Shell Avenue.

- Path #1 (see Figure 3.5 for the elevation profile) – From Site "C" at 164' elevation, the farthest southerly location of Area #3 (Distillates Storage Tanks) to Site "D" at 210' the farthest line of site location east of the source along the fence-line. Although the path is over 100' off the ground at the lowest point the path elevation is well aligned with the potential emission sources as the typical upwind sources range from 120-215' elevation.
- Path #1 will include UV DOAS to measure BTEX and SO_2, and a TDL to measure H_2S.
- Additionally, two extractive FTIR point monitoring systems will be installed at Sites "C" and "D" to detect alkanes.

Sites "A" and "B" will have point detection for detecting any hydrocarbons from Areas 1, 2, 3, or from East of Shell Avenue for wind directions from the East or Northeast. Site "A" was chosen to detect potential emissions from Area 1 (Effluent Treatment Plant and Wharf) or Area 2 (Distribution Tanks) that may go Southwest towards downtown Martinez and Site "B" was chosen as the farthest western location in the plant approximately halfway between Sites "A" and "C". As shown in Figure 3.8, the terrain is not suitable for an open path solution, however, the organic gas detectors used at Sites "A" and "B" are a good fit for detecting emissions from the potential sources in these adjacent areas.

East Side of Refinery - For the primary emission sources east of Shell Avenue, three open-path monitoring systems will be installed along the fence-line. See Figure 3.6 for the elevation profile. The specific location of the systems will be:

- Path #2 – Site "E", the Southwest corner of Area 7, Light Oil Processing facility at an elevation of 81' to Site "F", the top of the two-story Martinez Business Center (MBC) at an elevation of 55'. The lowest point between the sites is 22' with upwind sources ranging from 50-100'.
- Path #3 – Site "F", the top of the MBC at an elevation of 55' to Site "G" the top of a hill Southeast of Vine Hill (Area #10) at an elevation of 207'. The lowest point between the sites is 22' with upwind sources ranging from 20-160'.

- Path #4 – Site “G”, the top of the hill Southeast of Vine hill at an elevation of 207’ to Site “H” on the ridgeline between Vine Hill and I-680 at an elevation of 102’. The lowest point between the sites is 52’ with upwind sources ranging from 20-160’.

Each of the three paths will have UV DOAS to measure BTEX and SO_2, and a TDL to measure H_2S. Additionally, two extractive FTIR monitoring systems will be installed at Sites “F” and “G” (on the MBC and the top of the hill Southeast of Vine Hill) to detect alkanes.

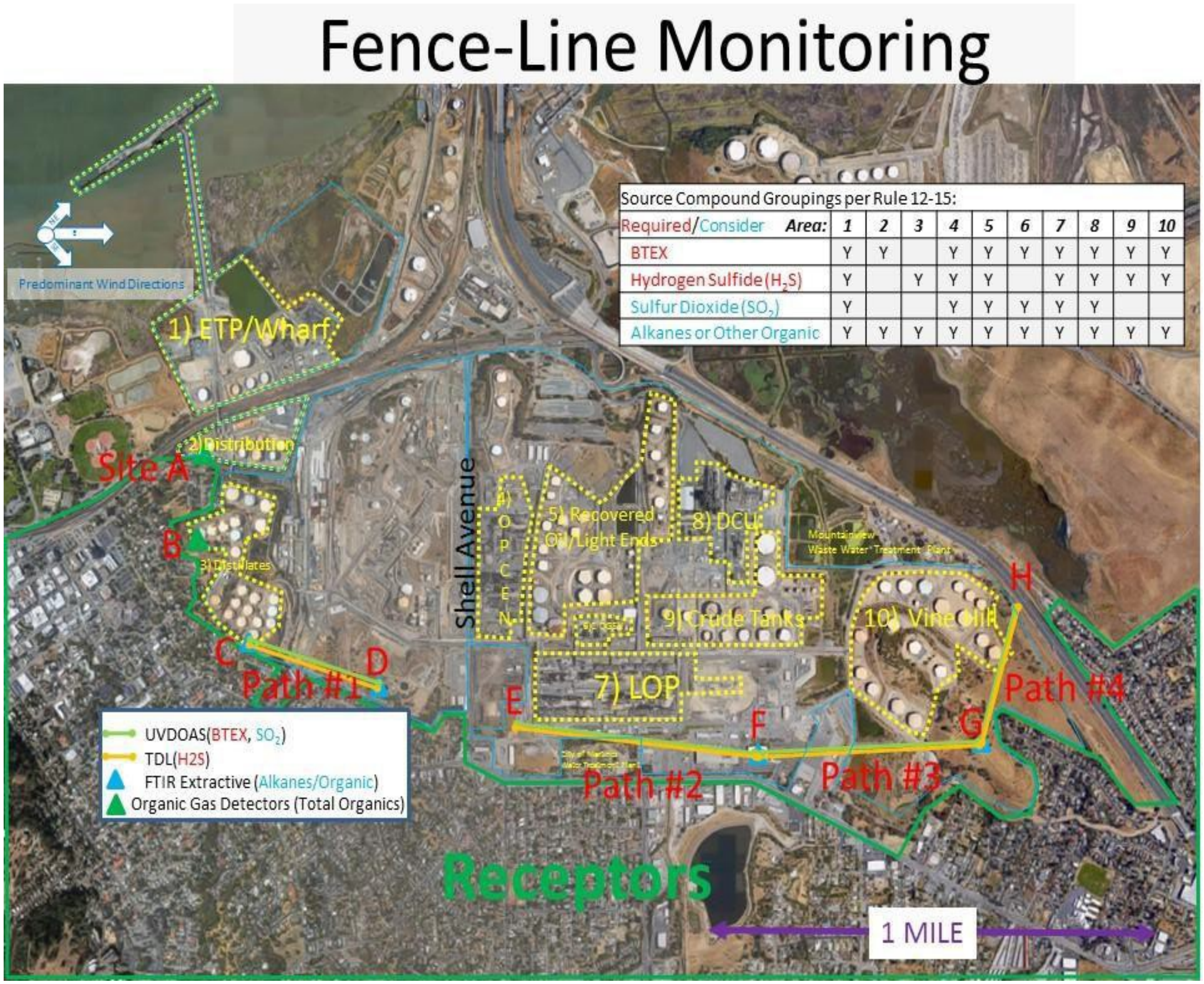
No open path is possible along the ~500m between Sites “D” and “E” due to the lack of line of site from the terrain as well as half the segment is not on refinery property as shown in Figure 3.7. A point sensor to the East of Site D was considered but can only be placed about one-third of the way between sites “D” and “E” to stay within the refinery security perimeter providing little difference in detection vs. the detection at site “D” only 100-150m away.

No Alkane Monitor is added at Site “E” as the emissions from predominate wind directions would be from Area 3 which is already covered for Alkanes at Site D or from Area 2 where BTEX coverage in Path #2 provides a surrogate for emissions that could come from these tanks if they could travel that far (nearly a mile) and be detectable. Area 1 would be greater than a mile from receptors near Site “E”.

No Alkane Monitor is added at site “H” due to the likelihood of false readings from the freeway and from the Mountainview Wastewater Treatment Plant. Also, BTEX provides a surrogate for alkanes for most emission sources.

There are no receptors within one mile north of Site “H” and across the North side of the refinery fence-line to the West of Area 2 Distribution, so no fence-line coverage is in the plan for this portion of the fence-line.

Figure 3.4 - Map of Fence-Line monitoring



Required/Consider Area:	1	2	3	4	5	6	7	8	9	10
BTEX	Y	Y		Y	Y	Y	Y	Y	Y	Y
Hydrogen Sulfide (H_2S)	Y		Y	Y	Y		Y	Y	Y	Y
Sulfur Dioxide (SO_2)	Y			Y	Y	Y	Y	Y		
Alkanes or Other Organic	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Figure 3.5 – Elevation Profile

Path #1

Figure 3.6 – Elevation Profile

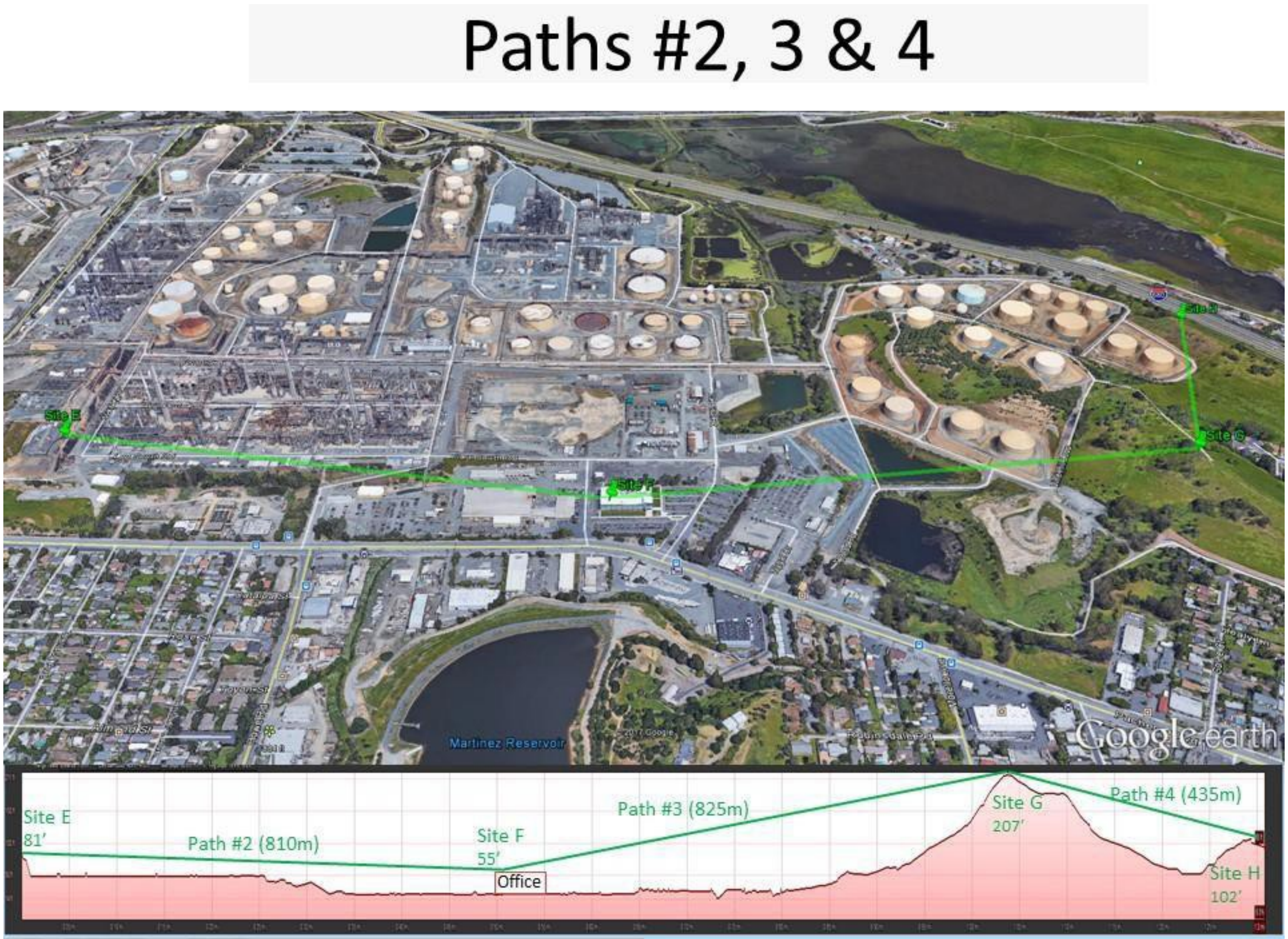


Figure 3.7 – Elevation Profile between Site D and E

Terrain from Sites D to E

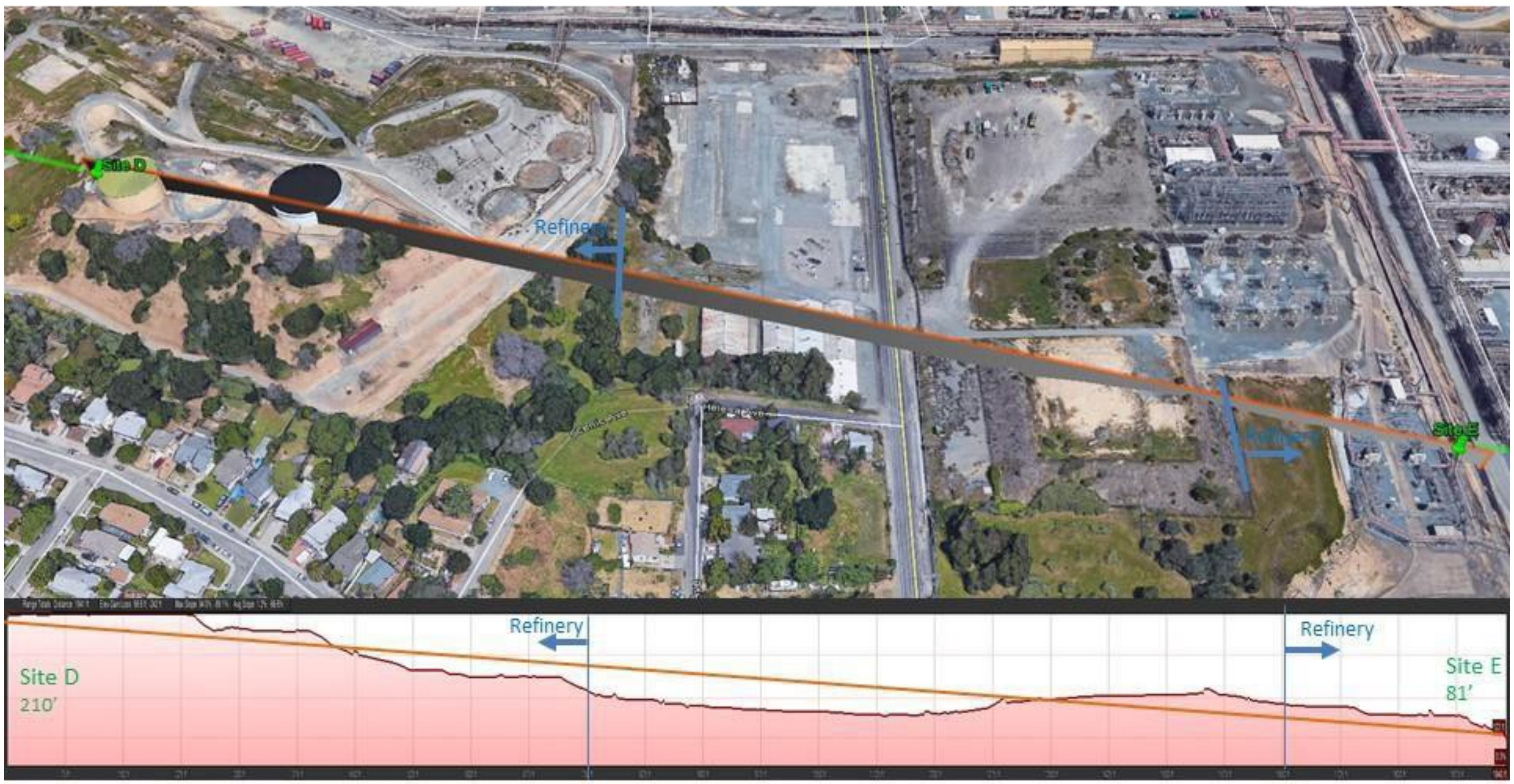
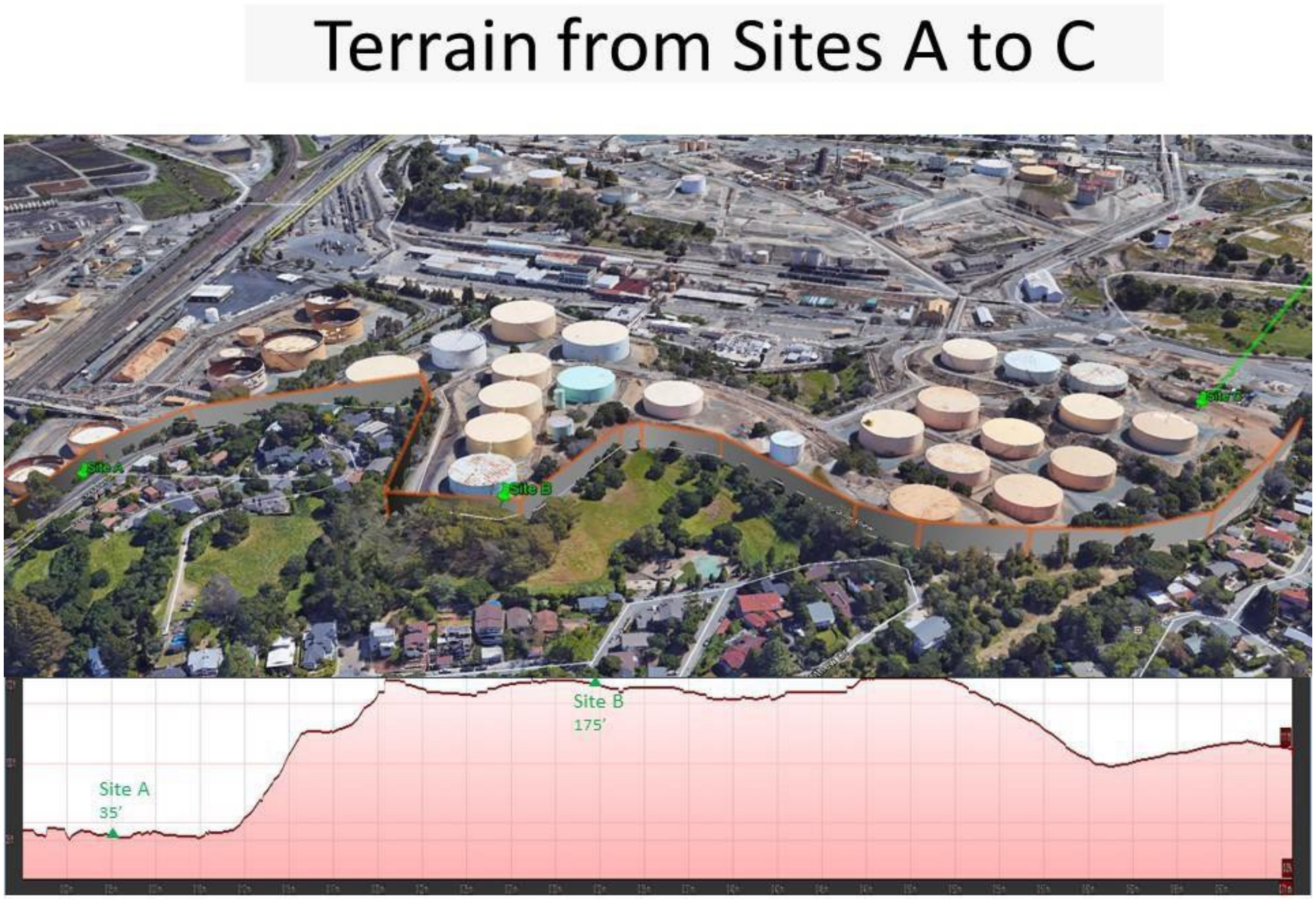


Figure 3.8 – Elevation Profile between Site A and C



Requirement #4 – Sample Time Resolution and Data Completeness

All air monitoring equipment specified for the MRC fence-line system will collect data on five-minute averages or as otherwise specified by the BAAQMD. All air monitoring equipment will meet a minimum of 75% completeness on an hourly basis 90% of the time based on annual quarters as defined earlier in this document or as otherwise specified by the BAAQMD. Atmospheric conditions beyond the control of the refinery that affect accurate measurements, such as dense fog, shall not be counted against data completeness requirements if appropriate meteorological measurements document time periods when these conditions exist.

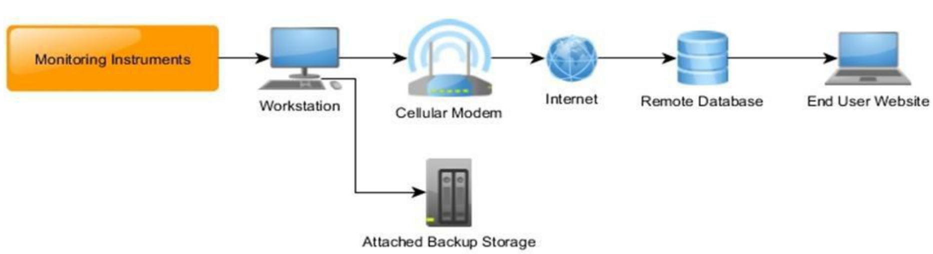
If an instrument's light signal drops below a predetermined signal strength the contractor will assess coincident signal drops on other instruments as well as the local meteorological conditions to determine the presence of rain or fog by examining current temperature, relative humidity, wind speed, dew point, and local rain gauge readings. If the local meteorological conditions are indicative of heavy rain or fog, the data will be identified and flagged as a weather-related event.

In addition to rain and fog, other types of environmental conditions beyond the control of the refinery can occur. These environmental factors include but are not limited to; strong winds, dust, and earthquakes all of which can impact the ability of open-path instruments to provide accurate measurements. In the event an instrument indicates a low signal; the data may be flagged as being caused by other environmental factors and will not be counted as instrument downtime, if appropriate.

Requirement #5– Data Presentation to the Public

Data from the monitoring stations will be transmitted to an Internet website where the real-time results can be viewed by the public. Figure 5.1 provides an example of how the monitoring data will be communicated to the public.

Figure 5.1 - Data Communication System



The website will be developed with input from the various stakeholders within the community and may evolve in the future as stakeholders identify appropriate changes. The community website will include a message board to inform the public of relevant information as needed. For example, the message board may be updated when an analyzer is undergoing maintenance or QA/QC checks, or other conditions where an analyzer is not in an operational state for an extended period. In addition, the public will be able to send emails suggesting enhancements to the public access website or any other issue of interest to the community.

Data from the fence line monitors will be transmitted to an internet website where the near-real-time results can be viewed by the public.

Data generated by the fence line monitoring equipment undergoes review throughout the measurement and reporting process. Included in this process are automated QA/QC checks that occur before data is reported on the real-time website. Under normal circumstances, a 5- minute average measurement will appear on the website within 10 minutes of the end of the measurement period. However, the data uploaded may be impacted by internet traffic. An automated system conducts the Quality Assurance checks before the data is reported to the website. The website will also make available a rolling 24-hour trend of the five-minute data for each gas reported.

Quarterly reports of QA'd data will be provided to the BAAQMD within 60 days after the end of each calendar quarter. The quarterly report format will be consistent with guidance issued as part of Attachments 2 and 3 of the BAAQMD Letter "Refinery Fenceline H_2S TDL Monitoring System Specifications" dated 12/22/22. The specific format is ~~found in NEWSOP3A and~~ provided in Appendix A and B of the MRC Quality Assurance Project Plan. The refinery will make data available to BAAQMD upon request prior to the report submittal. Both real-time and QA/QC'd data will be retained for five years.

As mentioned, the data collected and reported on the public website are based on five-minute averages. This allows the system to generate data at very low detection levels (which takes more to time average) while presenting updates to the community as quickly as possible. It is important to understand that health limits for gases are based on people being exposed to average concentrations that are much longer than the five-minute averages produced by the fence-line monitoring program. In fact, most health limits are based on exposures of 1-hour, 8-hour, or 24-hour averages, so it is important to keep the measurements from the fence-line systems in perspective. The State of California has generated guidance for acceptable exposure levels for many compounds. This guidance is published by California's Office of Environmental Health Hazard Assessment (OEHHA). For further information regarding the potential health impacts of gases that will be monitored at the Refinery fence line, please refer to the OEHHA guidelines on the topic: (https://oehha.ca.gov/chemicals).

The real-time website page will be incorporated into a larger website that will present additional resources to assist in the interpretation of the data. Information will be provided on the website to help the public understand the monitoring being done and the data being presented. Links to various public websites including the BAAQMD and OEHHA along with information about detection levels and typical background concentrations will help provide context for the data.

MRC's overall public communication process for refinery information includes the use of social media (e.g., Facebook and Twitter), media statements, and the Contra Costa County Community Warning System as appropriate. The fence-line monitoring website will be incorporated into these existing community relations programs. At the end of one year, MRC will evaluate the fence-line monitoring program by evaluating the data collected by the fence-line equipment using the

Measurement Quality Objectives (MQOs) specified by the QAPP as well as the on-stream efficiency (OSE) for each analyzer. If a deficiency is found at the time of the evaluation, or at any other time, corrective actions will be initiated to address the issue and improve the system performance. MRC will engage the community through its public communication process to ensure stakeholders are informed of any changes. MRC will perform an evaluation of the fence-line systems whenever an analyzer fails to meet MQO or OSE thresholds.

Requirement #6 - Quality Assurance Project Plan

A QAPP is included as a separate attachment to be updated with the approved Air Monitoring Plan, finalization of equipment, and contractor support for operating the monitoring equipment and website.

Quality Assurance Project Plan for the Martinez Refining Company Fence-Line Monitoring Program

Revision 5.9
FLM-QLT-QAPP-001

Martinez Refining Company

	Document Control			
Revision #	Revision Date	Description	Name	Signature
1	4/20/2017	Original Draft	Don Gamiles	
2	7/24/2017	Updated Draft	Don Gamiles	
3	12/7/2018	Updated Draft	Don Gamiles	
4	08/16/2019	Updated Draft	Don Gamiles	
5	08/22/2019	Updated Draft	Don Gamiles	
5.1	03/06/2020	Updated Requirements	Don Gamiles	
5.2	03/11/2020	Change in Ownership	Don Gamiles	
5.3	05/09/2022	Incorporated TDL	Don Gamiles	
5.4	05/27/2022	Addressed Comments	Don Gamiles	
5.5	08/27/2022	Addressed BAAQMD Comments	Don Gamiles	
5.6	01/31/2023	Addressed BAAQMD change in TDL requirements	Don Gamiles	
5.7	08/23/2023	Addressed BAAQMD comments	Don Gamiles	
5.8	11/17/2023	Addressed BAAQMD comments in NOD Letter	Don Gamiles	
5.9	6/20/24	Addressed BAAQMD comments in NOD Letter	Don Gamiles	
5.9.1	10/18/24	Addressed BAAQMD comments in NOD Letter	Don Gamiles	

Table of Contents

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List of Acronyms

APCO – Air Pollution Control Officer for the BAAQMD

BAAQMD – Bay Area Air Quality Management District

BTEX – Benzene, Toluene, Ethylbenzene, Xylenes

DQO – Data Quality Objectives

EPA – Environmental Protection Agency

FTIR – Fourier Transform Infrared Spectrometer

H2S – Hydrogen Sulfide

LDL – Lower Detection Limit

MBC – Martinez Business Center

MET – Meteorological Station

MRC – Martinez Refining Company

MQO – Measurement Quality Objectives

OEHHA – Office of Environmental Health Hazard Assessment

PPB – Parts Per Billion

QA/QC – Quality Assurance / Quality Control

QAPP – Quality Assurance Project Plan

SO2 – Sulfur Dioxide

TDL – Tunable Diode Laser

TRI – Toxic Release Inventory

UV-DOAS – Ultraviolet Differential Optical Absorption Spectroscopy

Section 1 – Fence-Line Monitoring Overview

On April 20, 2016, the Bay Area Air Quality Management District (BAAQMD) passed Regulation 12, Rule 15 (Rule 12-15), which mandates that Bay Area refineries formulate and submit an Air Monitoring Plan to the Air Pollution Control Officer (APCO) for approval in establishing and operating a fence-line monitoring system. The BAAQMD has also published guidelines to assist refineries in fulfilling the fence-line monitoring standards. The Martinez Refining Company (MRC) has developed its Air Monitoring Plan (AMP), and Quality Assurance Project Plan (QAPP) based on these guidelines from the BAAQMD. Whenever amendments are made to the AMP or QAPP, they will be forwarded to the Air District for approval.

MRC's policy is to comply with all local and national environmental regulations, including the fence-line monitoring stipulations of BAAQMD Rule 12-15. This includes meeting all requirements related to downwind fence-line siting, operational up-time requirements, quantifiable detection levels and any other regulatory operational parameters required by the BAAQMD. The evaluation of fence-line monitoring equipment locations included five years of meteorological data and periodic seasonal and recurring weather events such as quarterly wind roses. This ensured optimal equipment placement as per BAAQMD's guidance. The selected locations for the fence-line instruments strategically considered the predominant and variable meteorologic conditions and the topographical terrain features within the refinery.

Description of the Fence-Line Monitoring Program

A comprehensive overview of the fence-line monitoring program is included in the MRC Air Monitoring Plan (AMP). This program uses open-path air monitoring systems to detect and quantify various compounds using various technologies that include: benzene, ethylbenzene, sulfur dioxide, toluene, and xylene through Ultraviolet Differential Optical Absorption Spectroscopy (UV-DOAS); Total Alkanes measured using extractive Fourier Transform Infrared (FTIR) air monitoring; Organic Gas Detectors (OGD) measuring Total Organics; Hydrogen Sulfide (H_2S) concentrations determined by Tunable Diode Laser (TDL); and meteorological conditions recorded using EPA-approved meteorological devices. Figure 1.1 offers a map detailing the refinery's air monitoring equipment placements, and Table 1.1 lists the locations of each piece of equipment.

Figure 1.1 - Map of Fence-line Monitoring Program

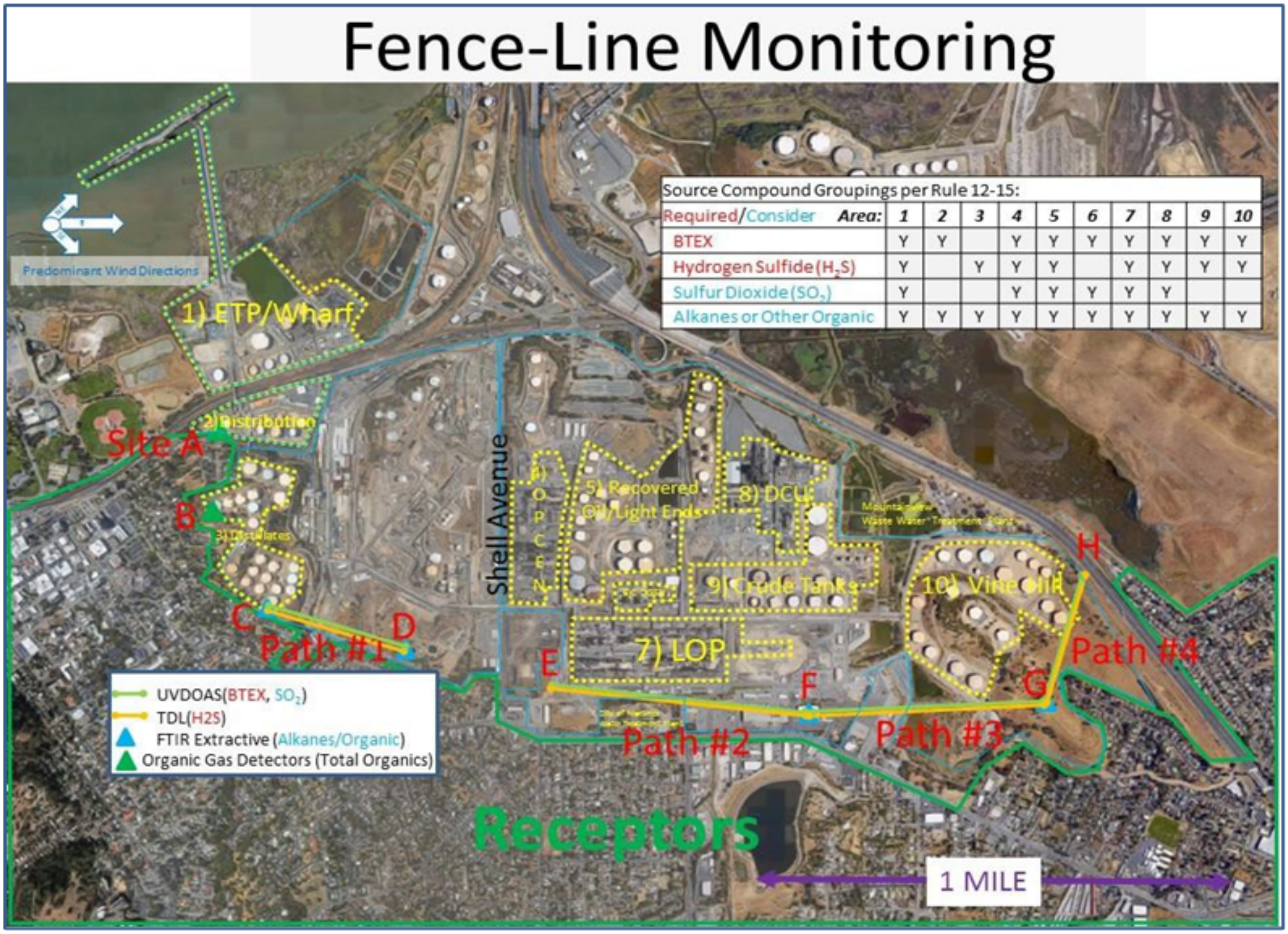


Table 1.1 - Monitoring Site Locations

Site # Name	GPS (North)	GPS (West)	Elevation (Feet)	Instrument
Site A	38°01’19.21” N	122°07’41.98” W	35	Organic Gas Detector
Site B	8°01’11.17” N	122°07’46.16” W	169	Organic Gas Detector
Site C S Distillates	38°00’59.26” N	122°07’35.22” W	164	TDL Source and UV-DOAS Source FTIR Extractive
Site D Firewater Tanks	38°00’54.02” N	122°07’17.13” W	207	UV-DOAS Receiver and TDL Reflector FTIR Extractive
Site E SW LOP	38°00’51.08” N	122°06’56.10” W	91	TDL and UV-DOAS Source

Site F MBC	38°00'47.40" N	122°06'23.04" W	55	TDL and UV-DOAS Source UV-DOAS Receiver and TDL Reflector FTIR Extractive
Site G Vine Hill	38°00'48.69" N	122°05'49.60" W	211	2 UV-DOAS Receiver and 2 TDL Reflector FTIR Extractive
Site H I-680	38°01'01.66" N	122°05'44.38" W	102	TDL and UV-DOAS Source

For the MRC refinery fence-line system, all designated air monitoring equipment collects data on five-minute averages. These devices will meet the minimum data completeness criteria, as defined in BAAQMD's correspondence to MRC dated December 22, 2022, further explained as:

Quarterly % Completeness = ([Hours in the calendar quarter with hour complete % ≥ 75%] / [Total hours in the calendar quarter]) × 100.

Here, an "hour" represents a distinct clock hour (0 - 23) on any given day, as opposed to a rolling 60-minute period. This method of data completeness assessment aligns with the guidelines of BAAQMD's letter, titled "Refinery Fenceline H_2S TDL Monitoring System Specifications" from 12/22/22. A complete description of the BAAQMD data reporting and completeness requirements are included as appendices to this document. After undergoing automated data Quality Assurance/Quality Control (QA/QC), the monitoring stations' data will be accessible to the public in real-time via a designated website as described in Section 8. This live page will be a part of a comprehensive site that offers supplementary resources for data interpretation. The integration of open-path H_2S systems was completed and put into operation on January 1, 2023.

Tables 1.2 and 1.3 provide an overview of the gases covered in the fence-line program, the detection technologies employed, and the lower and upper quantification limits (LoQ and UQL) attainable under optimal conditions.

Table 1.2 – Quantification Limits for Gases Monitored by Open-Path Systems

	Path 1		Path 2		Path 3		Path 4	
Distance (m)	445		810		825		435	
Gas	**LoQ** (ppb)	**UDL** (ppb)	**LoQ** (ppb)	**UDL** (ppb)	**LoQ** (ppb)	**UDL** (ppb)	**LoQ** (ppb)	**UDL** (ppb)
Benzene	0.9	5,483	0.9	3,012	0.8	2,958	0.9	5,609
Ethyl Benzene	15	5,483	12	3,012	12	2,958	15	5,609
Hydrogen Sulfide*	3.0	5,000	3.0	5,000	3.0	5,000	3.0	5,000
Sulfur Dioxide	4.0	2,202	2.2	1,210	2.2	1,188	4.1	2,253
Toluene	1.8	2,742	1.7	1,506	1.7	1,479	1.8	2,805
Xylene	1.0	2,742	0.8	1,506	0.8	1,479	1.0	2,805

* The BAAQMD requirement for the LoQ of the H_2S includes the requirement that the systems report a value between 3 and 25 ppb under optimal environmental conditions. For the TDL air monitoring system, ideal conditions include clear air, non-condensing atmosphere, relative humidity less than 90%, and stable optical alignment.

Table 1.3 – Detection Limits for Gases Monitored by Point Source Samplers

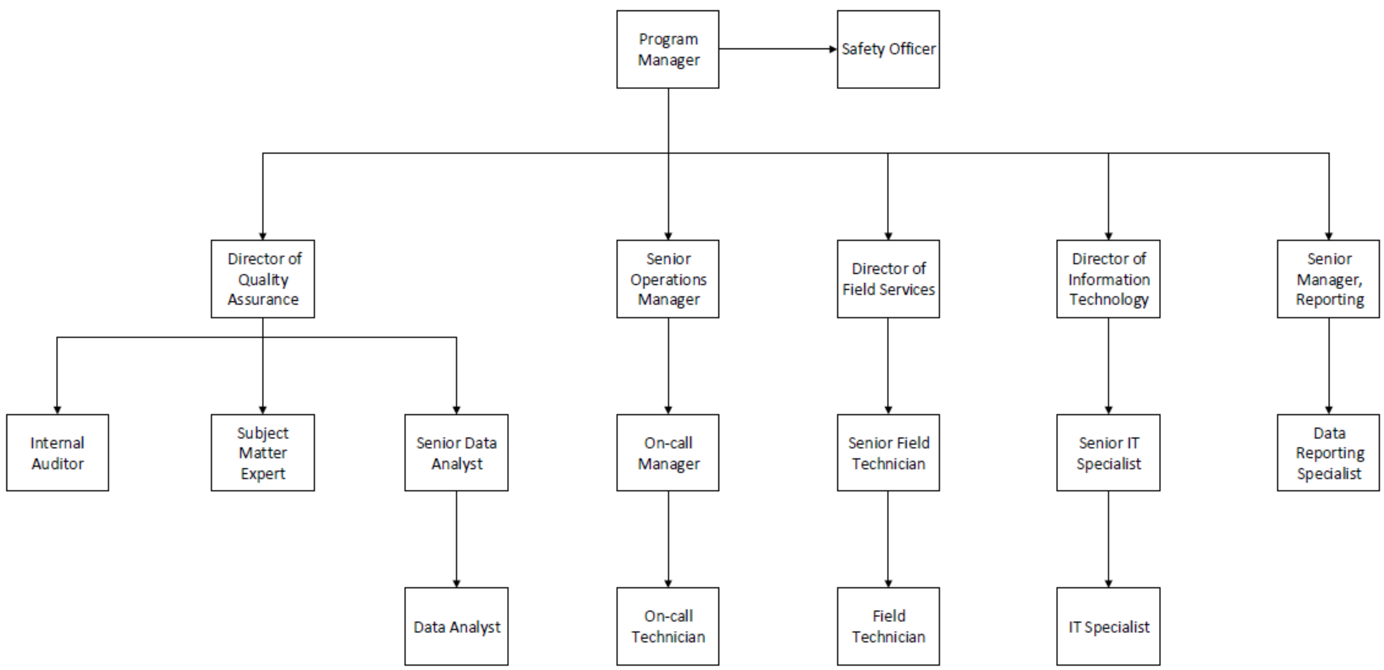
Point Source Monitor	Detection Limits	
	MDL (ppb)	**UDL** (ppb)
Total Alkanes	75	4,200
Total Organics	10	100,000

Section 2 – Project Management

Fence-Line Monitoring Task Organization

The operational framework of the program is established between MRC and the contractor, Argos Scientific Inc. (Argos), which holds the responsibility for the systems' operation and maintenance. The organizational structure for the MRC Monitoring Program is shown in Figure 2.1. below which lists key personnel from Argos detailing their roles, and responsibilities within the MRC fence-line program.

Figure 2.1 – MRC Fence-line Air Monitoring Program Organization Chart



Contractor Personnel Job Tasks, Qualification, and Training

Management, data analysts and the operators of the monitoring equipment shall be trained in their area of focus, including but not limited to data management, QA/QC, the operation, maintenance, and operational verification of the equipment, and will also be provided the necessary resources to troubleshoot any technical issues. As necessary, all personnel will undergo specific annual refresher training in their areas of focus. Training for equipment operators will be provided by the technical experts who have undergone vendor-specific training for each analyzer or are recognized experts in the operation and maintenance of that equipment. The Training Coordinator will document and verify staff have successfully completed the training. The following are the basic responsibilities of each of the personnel:

~~Contractor~~ Program Manager - Primary interface between MRC and Argos / Overall Program Management.

Responsibilities

- Ensures compliance with contract and QAPP.
- Contract review with client.
- Ensures continuous improvement within quality system.
- Manages overall program.

Safety Officer – Safety Officers are responsible for planning, implementing, and overseeing company employees' safety at work. Their main duty is to ensure that the company complies and adheres to the client's Health and Safety guidelines.

Responsibilities

- Plan and implement health and safety policies and programs.
- Advise and lead employees on various safety-related topics.
- Review existing policies and procedures and make changes as necessary.
- Conduct risk assessment.
- Enforce preventative measures.
- Check if all the employees are acting in adherence with rules and regulations.
- Prepare reports on accidents and violations and determine causes and institute corrective actions.

Senior Operations Manager - Ensure system operations meet the requirements of the QAPP.

Responsibilities

- Work with system manager and field services to maintain a schedule of site work for the technical teams.
- Maintain a workflow system to manage the progress and completion of projects in a systematic and transparent manner.
- Keep management team updated with any changes in schedules.
- Ensure that sufficient stock of the consumables and necessary resources required for the work is available.
- Ensure the quality of all reports.
- Function as a Technical Signatory and sign reports.

Director Quality Assurance - Ensures QA/QC meets requirements of the QAPP.

Responsibilities

- Oversee the quality process.
- Update quality system documentation.
- Manage the corrective action process.
- Analyse data to facilitate continuous improvement.
- Oversee data management and review processes.
- Final review and approval of data validation / invalidation actions.
- Coordinate management response for data issues that cannot be rectified according to established procedures.

Senior Data Analyst -

Responsibilities

- Perform complex and/or nonroutine data analysis functions
- Oversee daily data review
- Review data Validation/Invalidation according to Table 4.1 and associated SOPs
- Review documentation and rationale for invalidated data
- Inform Quality Assurance Director if data cannot be rectified according to established procedures

Data Analyst -

Responsibilities

- Ensure all data are reviewed daily.
- Identify and report any data anomalies to the Sr Data Analyst and Director, Quality Assurance.
- Validate/Invalidate data according to Table 4.1 and associated SOPs.
- Document rationale for invalidated data.
- Inform superiors if data cannot be rectified according to established procedures.
- Collaborate with Technical Experts to enhance the data review process.

Subject Matter Expert – Evaluates methods, QA/QC, preventative maintenance, and calibration of instruments and equipment at regular intervals and makes changes to the QAPP as necessary; coordinates proper installation and qualification of new instruments; engages in troubleshooting and repair of equipment including requalification.

Responsibilities

- Troubleshoots and repairs instruments, including coordination of vendor calls, with proper documentation and follow-through to return instruments to active service with proper re-qualification.
- Assists in writing and developing standard operating procedures (SOPs) associated with instrumentation and equipment. Revise SOPs as necessary and directed.
- Assist in training technical staff in instrument operations, SOPs, and proper documentation associated with instruments and equipment.
- Coordinates qualification of instrument operator personnel and supports individual training needs.
- Evaluate any instrument-specific method changes.

Internal Auditor – Independently ensures monitoring program complies with the QAPP.

Responsibilities

- Coordinates and executes internal audits.
- Ensures continuous improvement of the quality system.
- If needed, arranges and coordinates for 3rd party audits.
- Coordinates annual management review of QAPP.

Senior Manager - Reporting- Ensure data and notifications meet the requirements of the QAPP.

Responsibilities

- Final review of quarterly data summary reports.
- Data processing and daily validation and compilation of resultant reports.
- Approval of Daily, monthly, and calibration data compilations, including final reports and website content.
- Ensure reports are completed promptly and within quality guidelines.

- Verify reported gas detections for approval by the Program Manager.
- Manages notification system for equipment operation.

Data Reporting Specialist

Responsibilities

- Daily, monthly, and calibration data compilation, including data preparation for reports and website data validation.
- Follow guidelines from the program manager to ensure reports are completed promptly and within quality guidelines.
- Identify reported gas detections for approval by the Senior Manager, Reporting.

On-call Manager – Responsible for Managing the System On-call Program

Responsibilities

- Oversee on-call program.
- Oversee remote operation, calibration of analysers/samplers.
- Track unscheduled remote maintenance.
- Oversee training of on-call operators.
- Final signatory on closed out work orders.

On-call Technician - Execute routine and non-routine remote work according to the QAPP.

Responsibilities

- Perform routine maintenance and quality checks as required, and record data and events in accordance with these tasks.
- Monitor alarms and resolve them in a timely manner.
- Align open path systems.

Director of Field Services

Responsibilities

- Develop routine maintenance and quality checks as required, and record data and events in accordance with these tasks.
- Review routine site visit reports associated with QA/QC or maintenance.
- Submit consumable purchases and instrument maintenance as required.
- Perform instrument commissioning and any other duties that are required.
- Review safety briefing and logs.
- Sign off on work orders.

Senior Field Technician

Responsibilities

- Oversee routine maintenance and quality checks as required, and record data and events in accordance with these tasks.
- Develop site visit reports associated with QA/QC or maintenance.
- Sign off on consumable purchases and instrument maintenance are required.
- Lead on instrument commissioning and any other duties that are required.
- Perform daily safety briefing meetings.
- Technical lead on field related work orders.
- Refinery training coordination with Safety Officer.
- Adhere to all ~~the~~ rules and regulations.

Field Technician

Responsibilities

- Perform routine maintenance and quality checks as required, and record data and events in accordance with these tasks.
- Perform field QA/QC or maintenance.
- Record consumable purchases and instrument maintenance are required.
- Perform instrument commissioning and any other duties that are required.
- Participate in daily safety briefing ~~log~~ meetings.
- Support field related work orders.

Director of Information Technology

Responsibilities

- Oversee the integration and management of data collection from various sampling equipment, ensuring accurate and timely data acquisition.
- Ensure the database infrastructure is robust, scalable, and secure to store the collected data efficiently.
- Implement stringent data security measures and ensure compliance with relevant data protection regulations to safeguard sensitive information.
- Lead the development and maintenance of interactive and user-friendly data visualizations on the company website to present data in an accessible and informative manner.
- Oversee the seamless integration of data collection systems with the database and web presentation layers, ensuring smooth data flow across all platforms.

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Senior Information Technology Specialist

Responsibilities

- Oversee the configuration, optimization, and maintenance of network infrastructures, including hardware and software components, to ensure optimal performance and reliability.
- Manage and support the database systems, ensuring data integrity, security, and availability. This includes performing regular backups and recovery operations.
- Monitor network performance, identify problem areas, and implement solutions to enhance system

efficiency and prevent downtime.
- Assist in planning and executing IT projects, including system upgrades, new technology implementations, and infrastructure enhancements, ensuring alignment with business objectives.
- Create and maintain detailed documentation, including system configurations, standard operating procedures (SOPs), and troubleshooting guides, to support IT operations and training.
- Provide training and support to end-users on various IT systems and applications, enhancing their ability to utilize technology effectively and efficiently.
- Implement and maintain security protocols to protect data and IT infrastructure, ensuring compliance with relevant regulations and standards.

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Information Technology Specialist

Responsibilities
- Install, configure, and maintain network systems, including local area networks (LAN), wide area networks (WAN), and cloud networks, ensuring stable and secure connectivity.
- Set up and upgrade hardware and software components, ensuring compatibility and optimal performance for data collection and presentation systems.
- Provide direct technical support to users, helping them resolve issues with hardware, software, and network connectivity. This includes setting up workstations and troubleshooting problems.
- Assist in managing and maintaining the database infrastructure, ensuring data integrity, security, and availability.
- Implement and maintain data security measures, including firewalls, antivirus programs, and access control policies, to protect sensitive information from unauthorized access and cyber threats.
- Monitor the performance of IT systems, identifying and resolving issues to minimize downtime and ensure continuous operation of data collection systems.
- Create and maintain detailed documentation of IT systems, including network configurations, hardware setups, and troubleshooting procedures, to support IT operations and training.

Section 3 – Description of Hardware and Technology

Sample Analysis

Samples will be collected using UV-DOAS air monitors for the measurement of benzene, ethylbenzene, sulfur dioxide, toluene, and xylene. Extractive FTIRs will be used for the measurement of total alkanes. TDLs will be used for the measurement of H_2S. Organic Gas Detectors will be used for total organics. Each analyzer has a vendor-specific method for collecting and quantifying data. A description of each specific analytical method as well as equipment necessary to move and store data are listed below:

Open-path UV-DOAS

The UV-DOAS air monitoring system utilizes ultraviolet light beams for real-time detection of gases including benzene, toluene, ethylbenzene, xylene, and sulfur dioxide. This system projects an ultraviolet light beam in open air toward a detector situated at the opposite end of the beam's path. The system identifies gases by examining the wavelengths of UV light that have been absorbed by the gases present in the light beam. The amount of gas in the air is proportional to the amount of light absorbed at specific wavelengths.

To quantify data, the system employs a multivariate analytical method, which is critical in avoiding false gas detections. Every target gas is associated with a spectral library spanning its concentration range. Each target gas has a spectral library of gases covering the concentration range of the analyzer. It also includes libraries of potential interfering gases such as oxygen and ozone.

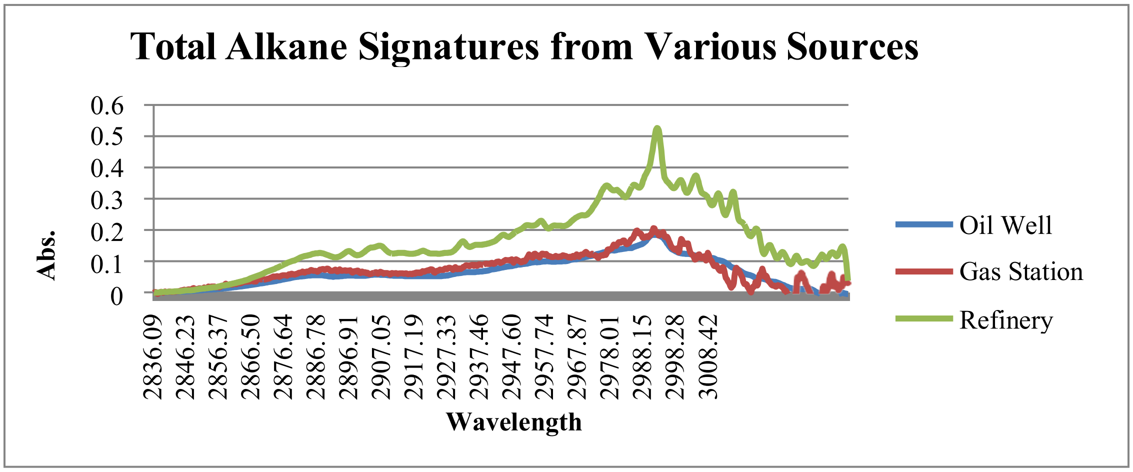
The data output includes the quantified results of all gases in the light spectra, which can be used as real-time performance checks. For example, quantified results for ozone should track ozone concentrations collected by BAAQMD at various stations located throughout the Bay Area. Since the system quantifies ozone in real-time, ozone concentrations are compared to BAAQMD reference method ozone concentrations to judge data validity. Should the measured ozone concentrations fall outside the range for ozone concentrations contained in Table 4.1 at the designated BAAQMD air monitoring station, the data will be flagged for further review.

The system uses a sealed cell with a known concentration of BTEX and SO_2 that can be remotely controlled to be inserted into the same optical path used for atmospheric quantification of target gasses to perform “bump” and calibration checks. The cell provides a safe, effective way to determine measurement quality parameters including relative standard deviation and percent error. “Bump” tests will be performed at least monthly: meeting the relative standard deviation and percent error requirements described in Table 4.1, with at least a three-point calibration check performed at least quarterly with different concentrations to the “bump” test concentrations. All tests will utilize gas concentrations that meet BAAQMD requirements or standard industry practices. The three-point calibration test will also meet the relative standard deviation and percent error requirements described in Table 4.1.

Extractive FTIR

The FTIR has the capability to detect total non-methane hydrocarbons on a real-time basis while minimizing the impact of gases that interfere with alkane measurements such as water vapor and methane gas. The analytical method employed by the FTIR is a multiple regression technique that separates the total amount of light absorbance by the various gases and outputs a result for each gas. In the case of alkanes, this includes the contribution of interfering gases such as water vapor and methane. The system also has the ability to distinguish between various sources of alkanes by using wind speed and direction as well as compound component ratios associated with various production units. Figure 3.1 shows the different types of spectral signatures for various sources of alkanes. The system has the ability to undergo data and quality assurance checks in the field by monitoring known ambient gases or by using gas standards. Total alkanes (regardless of source) will be displayed on the website, however, during the monthly QA/QC process, the data may be identified as potentially not originating from the refinery depending on its spectral signature (though this QA process will not be displayed on the public website and is solely for the internal informational purposes for the refinery). The methodology to identify sources involves collecting the spectral features for alkanes when the wind direction is from different sources i.e., various refinery process areas, local highways, and other industrial facilities. Once the data is collected, the resulting absorbance spectra can be converted into a qualitative library spectrum that can be inserted in the analytic software which then analyses the data. The results of the analysis will include residuals that can be used to identify specific sources.

Figure 3.1 - Spectral Signature of Alkanes from Various Sources



The system uses permeation tubes filled with hexane to perform "bump" and calibration checks that use the same optical path used for atmospheric quantification of alkanes. The cells provide a safe, effective way to determine measurement quality parameters including relative standard deviation and percent error. "Bump" tests will be performed at least monthly: meeting the relative standard deviation and percent error requirements in Table 4.1, with at least a three-point calibration check performed at least quarterly with different concentrations to the "bump" test concentrations. All tests will utilize gas concentrations that meet BAAQMD requirements or standard industry practices. The three-point calibration test will also meet the relative standard deviation and percent error requirements in Table 4.1.

Open-path TDL

The AirOptic open-path H_2S tunable diode laser (TDL) monitoring system is a monostatic system that uses mid-infrared laser light to scan across a narrow band of the infrared spectrum where gases such as H_2S, water, and methane absorb light. The system utilizes wavelength modulation to enhance signal-to-noise characteristics to reach path-average limits of quantification (LoQs) in a range of 3 to 25 ppb with an upper detection limit of 5,000 ppb. Real-time LoQs are calculated using methods described in MSOP-001 SOC. The system continuously tracks and logs the measurement and spectral signature of H_2S, water, and methane in the gas sample. It then employs a classical least squares analysis routine to model their infrared light absorption. To determine the concentration of H_2S in the gas sample, the software actively subtracts the interfering gases from the sample spectra and then performs an analysis of the H_2S absorbance spectra. The system uses a single corner cube retro reflector that allows the system to remain in optical alignment with no major adjustments over time.

The data output includes the quantified results of all gases in the light spectra, which can be used as real-time performance checks. For example, quantified results for methane should be above the natural ambient atmospheric background level of 1.72 ppm. Since the system quantifies methane in real-time, along with moisture and other interferent gases, the verification of methane above natural ambient levels will be used as a real-time data quality check. Should methane concentrations drop below traditional ambient levels (currently 1.72 ppm), the data will be flagged for review. In addition to the measurement of ambient gases such as methane and water, other data quality checks are employed to evaluate each data point on a real-time basis.

The system uses an H_2S calibration gas cell to perform "bump" and calibration checks that use the same optical path used for atmospheric quantification of H_2S. The cells provide a safe, effective way to determine measurement quality parameters including relative standard deviation and percent error. "Bump" tests will be performed at least monthly: meeting the relative standard deviation and percent error requirements in Table 4.1, with at least a three-point calibration check performed at least quarterly with different concentrations to the "bump" test concentrations. All tests will utilize gas concentrations that meet BAAQMD requirements or standard industry practices. The three-point calibration test will also meet the relative standard deviation and percent error requirements in Table 4.1.

Organic Gas Detector

- Organic Gas Detectors are based on the principle of photoionization and are referred to as Photoionization Detectors (PIDs). The system functions by introducing an ambient air sample into a chamber where it is subjected to ultraviolet light from a specialized lamp. Should the sample contain an organic gas, it will ionize upon interacting with the UV light. The ionized gas is then quantifiable using a detector. A primary strength of the PID air monitoring system is its remarkable sensitivity, allowing for the detection of organic gases at low concentrations. However, the system's limitation lies in its inability to distinguish between different organic gas types present in the air. Furthermore, while it cannot detect C2-C3 hydrocarbons, it remains effective in identifying the majority of gases related to refining.

Meteorological Station

- The East Side Meteorological Station will provide real-time wind speed and direction to the website. Meteorological instruments will be operated according to the EPA Quality Assurance Handbook for Air Pollution Measurement Systems Volume IV PSD Measurement Quality Objectives. In addition, the website also receives data from the meteorological station located at the East Site of the refinery. It should be noted that the operation of meteorological systems and the data produced by the system is supplied via a separate contractor through an API.

Workstations

Workstations include the following equipment and are considered data communications systems that transfer data from the instruments to data storage.

- The analyzers use Microsoft Windows based computer workstations to collect, analyze, and transmit data. The workstations will be industrial-grade computer workstations.
- Loggers
- The outputs of the analyzers are collected by dataloggers that buffer and transmit the data to Cloud-Based Data Storage.
- Routers
- Computer routers will be used to network the analyzers together so the information from each system can be transmitted to the Internet.
- Remote Restart Equipment
- Equipment with internet-based remote restart capabilities will be integrated into vital components of the monitoring system. This enables the equipment, in the event of an error status, to be remotely shut down and reactivated to potentially resolve the issue.

- Cloud-based Data Storage

Data from the monitoring network will be stored on a cloud-based storage system with data backup capability. The data set will encompass raw data, inclusive of raw spectral details, relevant flagging, and documented actions aligned with the pertinent SOPs. The finalized data will be provided to BAAQMD upon their request.

Section 4 – Quality Management System

The overall goals of the fence-line monitoring program are to:

- Provide continuous air quality concentration information on a short enough time scale to address changes in fence-line concentrations of compounds associated with refinery operations;
- Provide data of sufficient accuracy to identify when concentrations of compounds associated with refinery operations are elevated as compared to other monitoring locations throughout the Bay Area;
- Provide context to the data so that the community can determine differences in air quality between their location and other locations in the Bay Area; and
- Potentially aid in identifying corrective actions that will lower emissions.

"Data Quality Objectives" or "DQOs" are established to ensure collected data are of sufficient quality and quantity to support these program goals. The specific DQOs for the monitoring program at MRC are designed to ensure all the data, both real-time and QA/QC parameters, meets the quality standards for presentation to the public and the BAAQMD. Data checks are formulated around EPA Quality Assurance/Quality Control protocols published in documents such as:

Environmental Technology Verification (ETV) Protocol for Optical Remote Sensors
https://archive.epa.gov/nrmrl/archive-etv/web/pdf/01_vp_openpath.pdf

EPA – Compendium Method TO-16
https://www3.epa.gov/ttn/amtic/files/ambient/airtox/to-16r.pdf

EPA – FTIR Guidance Document
https://www3.epa.gov/ttn/amtic/files/ambient/longpath/r-96-040.pdf

Throughout the measurement process, focus is placed on specific elements of the monitoring program. These are the critical elements:

- System operation
- Data validation
- Monthly and quarterly system challenges
- Instrument operation and maintenance

To ensure collected data are of sufficient quality and quantity to support the goals of the fence-line monitoring program, a variety of routine checks are performed on the monitoring systems and data according to standard operating procedures. For each check, specific "Measurement Quality Objectives" or "MQOs" have been developed to define the acceptable levels of precision, accuracy, completeness, representativeness, and comparability, and other system and data characteristics. Specific MQOs are provided in Table 4.1. Should any of these MQOs not be satisfied, a root cause analysis will be conducted, followed by the initiation and documentation of a corrective action plan to address the problem. Each MQO will undergo assessment and, when required, revisions during the Internal System Audit Plan and the Annual Management Review. These audits are intended to ensure continuous improvement of the fence-line systems.

Standard Operational Procedures

Four SOPs have been developed for the MRC systems and specific parameters are outlined in Table 4.1. System Operation Checks are designed to monitor equipment and transfer data from the equipment to various databases. Data Validation Checks are designed to ensure data meets the Data Quality Indicators. System Challenge Checks are designed to ensure proper calibration of equipment. Operation and Maintenance Checks are designed to ensure appropriate maintenance meets manufacturer and data quality requirements.

System Operation Check (MSOP-001 SOC)

The objective of the System Operation Checks (SOCs) is to continuously monitor the system in real-time to confirm the analyzer's functionality and data transfer ensuring the timely generation of valid data. If any check indicates a possible performance discrepancy, a notification is sent to the designated support team for evaluation and necessary corrective measures. SOC flags can be generated by the instrument itself, by monitoring site parameters such as Internet connectivity, as well as evaluating external events such as weather-related issues. Specific SOCs are listed in Table 4.1 and are detailed in the instrument-specific System Operations Checks procedures.

Data Validation Checks (MSOP-002-DVC)

The purpose of the Data Validation Check (DVC) is to ensure that any data meets appropriate data quality standards. DVCs are performed in real-time, daily, anytime a data point is outside of normal parameters, at least monthly and at least quarterly. Specific DVCs are listed in Table 4.1 and are detailed in the Data Validation Checks procedures.

System Challenge Checks (MSOP-003 SCC)

The purpose of the System Challenge Checks (SCCs) is to verify the air monitoring systems are meeting their operational performance requirements. The tests are performed by inserting a known concentration of gas into the beam path or sample port and measuring the system's response. Specific SCCs are listed in Table 4.1 and are detailed in the instrument-specific System Challenge Check procedures.

Operation and Maintenance Checks (MSOP-004 OAM)

The purpose of the Operation and Maintenance Checks (OMCs) is to ensure the systems are being operated and maintained per the manufacturer's recommended standards. Specific OMCs are listed in Table 4.1 and are detailed in the instrument-specific Operation Maintenance Check procedures.

Internal System Audit and Management Review

The Internal System Audit Plan will utilize a qualified Argos staff member not associated with the MRC systems to develop an audit plan to review documentation and evaluate whether the AMP, QAPP, SOPs are being followed and identify any deficiencies. Identified deficiencies will follow the Root Cause Analysis and Corrective Action Procedure provided in Appendix C. All data and documentation will be reviewed to determine what weaknesses exist in the Data Quality System and whether data and documentation adhered to the QAPP and SOPs

.The Annual Management Review will utilize results from the Internal Audit as well as data trends and issues, QA/QC outcomes, maintenance schedules and how well MQOs are being met and whether any additional action beyond findings from Internal Audit are warranted to maintain and improve data quality . The Internal Audit will be documented, reviewed by MRC and will be provided to the Air District upon request. This plan is the first step of the audit process further described in Section 9. The plan will be developed to determine parameters to be examined in both the system audit and performance evaluation audit based on review of maintenance and performance of the quality system throughout the prior year.

The Internal Auditor will be responsible for reviewing the previous year's records to determine which parameters will be the focus of the audit plan and will include, at a minimum, a review of data completeness, adherence to measurement quality objectives and their appropriateness, equipment performance during quality assurance testing and whether SOPs were followed in regard to data evaluation and invalidation. The plan, along with audit results discussed in Section 9 will be incorporated in a report to management with findings and corrective actions that follow the outlined process contained in Appendix C. Many of these processes are outlined in the applicable and appropriate SOPs.

A synopsis of the MQOs for every instrument, data quality metrics, and program management procedures can be found in the subsequent tables. These tables are specific to instrumentation and broken into subsections. However, when referred to in this QAPP and SOPs the general term, Table 4.1 will be used. If a parameter is not met, a flag is inserted with the data and that data is reviewed, at a minimum, as stated in the "Type of Flag and Action" column.

In general, data is defined as falling into four main categories:

- Valid data based on meeting all parameters for valid data and presented to the public on the website
- Invalid data based on not meeting at least one parameter for valid data which will not be presented on the public website
- Qualitative or preliminary data, which will be further reviewed to determine validity which will be differentiated on the public website and changed based on further data review and notation changed to either valid/invalid
- QA/QC data which will be stored in a separate database and used to determine whether instrumentation is meeting data quality goals and will not be presented on the website. If a QA Failure occurs, causal analysis and corrective action will be performed until a passing test occurs

Table 4.1 – Summary of Measurement Quality Objectives for Air Monitoring System

Table 4.1.A – Data Communication System

Potential Issue	Check	Frequency	If Parameter is Met Flag is Inserted	Type of Flag and Action
General Instrument Flags – MSOP-001-SOC				
Logger Not Storing Data to Cloud Database Flag 1	Cloud-based database server pings connection with the logger and fails after 2 second time out	Every 10 Seconds	Cloud-based server does not continually maintain contact with logging system	Data Communication Any gaps investigated, corrected and explained (power outage, instrument failure, etc.) and data backfilled
Logger Failure Flag 2	Cloud-based database server verifies connection status with the logger (running, stopped, failed, etc.,)	Every 10 Seconds	All data generated is not stored in the database	Data Communication Any gaps investigated, corrected and explained (power outage, instrument failure, etc.) and data backfilled
Instrument Computer Communication Failure Flag 3	Logger verifies connection with Instrument computer (retry attempts fail to retrieve data)	Every 1 (TDL)/10 (OGD)/60 (UV/FTIR) seconds	Logger does not continually maintain contact with instrument computer	Data Communication Any gaps investigated, corrected and explained (power outage, instrument failure, etc.) and data backfilled
Instrument Hardware Failure Flag 4	Data is being supplied to the Instrument Computer from the instrument (Code that retrieves data indicates no new data retrieved)	Every 1 (TDL)/10 (OGD)/60 (UV/FTIR) seconds	Instrument does not continually maintain contact the Instrument Computer	Instrument Failure Any gaps investigated, corrected and explained (power outage, instrument failure, etc.) and data recovered, if possible
Instrument Software Failure Flag 5	Data is being supplied to the Instrument Computer from the instrument (Number of data points that were inserted into or updated in database – upserted count)	Every 1 (TDL)/10 (OGD)/60 (UV/FTIR) seconds	Instrument does not send updated data to the Instrument Computer	Instrument Software Failure Any gaps investigated, corrected and explained (power outage, instrument failure, etc.) and data recovered, if possible

Instrument or Instrument Software failure may result in data loss. Other flags are informational and data likely to be recovered and backfilled.

Table 4.1.B – UV DOAS System

Potential Issue Or Information	Check	Frequency	If Parameter Met Flag is Inserted	Type of Flag and Action
UV DOAS Flags – MSOP-002-DVC and MSOP-003-SCC				
Light Signal Low Flag 10	UV light signal	Every 5 minutes	UV light signal < 9% full scale	Data invalidated and reviewed quarterly
Light Signal High Flag 11	UV light signal	Every 5 minutes	UV light signal > 90% full scale	Data invalidated and reviewed quarterly
Data Below Detection Limit Validation Flag 20	Instrument specific quantification limit (ISQL) – compound specific	Every 5 minutes	Classic Least Squares curve fit $R^2 < 0.70$ and Concentration between +/-ISQL	Data considered valid, below LoQ and reviewed quarterly
Data Detect Quantifiable Flag 21	Instrument specific quantification limit (ISQL) – compound specific	Every 5 minutes	Classic Least Squares curve fit $R^2 \geq 0.70$ and concentration $\geq$ ISQL	Data considered valid and reviewed daily (invalidated/validated)
Data Detect Qualitative Flag 22	Instrument specific quantification limit (ISQL) – compound specific	Every 5 minutes	Classic Least Squares curve fit $R^2 < 0.70$ and concentration $\geq$ ISQL or $\leq$ - ISQL	Data considered preliminary and reviewed daily (invalidated/validated and/or quantified)
Background Validity* Flag 23	Measured concentration < 0 ppb – compound specific	Every 5 minutes	Classic Least Squares curve fit $R^2 > 0.70$ and concentration ≤ 0	Data considered preliminary and reviewed daily (invalidated/validated and background adjusted, if necessary)*
ISQL Set High Flag 24	Instrument specific quantification limit (ISQL) – compound specific	Every 5 minutes	Classic Least Squares curve fit $R^2 \geq 0.70$ and concentration between $\pm$ ISQL	Data considered valid, below LoQ and reviewed quarterly

Ozone Comparison Failure Flag 40	Measured ozone compared to reference (BAAQMD Concord Station)	Hourly	Measured ozone concentration outside 25% of reference measurement	Data considered valid and reviewed daily (BAAQMD notified of reference failure)
Reference Ozone Site Retrieval Failure Flag 50	Retrieve measured ozone at reference site	Hourly	Data from Reference Site not available (Outside Argos control)	Data considered valid and reviewed daily (BAAQMD notified of reference failure)
QA Mode Flag 60	Data Information	Dependent	Identify data associated with QA Checks	Informational Flag - data stored as QA data
Precision Pass Flag 70	Relative Standard Deviation (RSD) Measurement	At least monthly	RSD ≤ 15%	Informational Flag – QA Pass - stored as QA data
Precision Fail Flag 71	Relative Standard Deviation (RSD) Measurement	At least monthly	RSD > 15%	Informational Flag – QA Failure - stored as QA data and Casual Analysis and Corrective Actions performed
Quarterly Precision Pass Flag 74	Relative Standard Deviation (RSD) Measurement	At least quarterly	RSD ≤ 15%	Informational Flag – QA Pass - stored as QA data
Quarterly Precision Fail Flag 75	Relative Standard Deviation (RSD) Measurement	Quarterly	RSD > 15%	Informational Flag – QA Failure - stored as QA data and Casual Analysis and Corrective Actions performed
Accuracy Pass Flag 80	Percent Error Measurement	At least monthly	Percent Error ≤ 15%	Informational Flag – QA Pass - stored as QA data
Accuracy Fail Flag 81	Percent Error Measurement	At least monthly	Percent Error > 15%	Informational Flag – QA Failure - stored as QA data and Casual Analysis and Corrective Actions performed
Quarterly Accuracy Pass Flag 84	Percent Error Measurement	Quarterly	Percent Error ≤ 15%	Informational Flag – QA Pass - stored as QA data
Quarterly Accuracy Fail Flag 85	Percent Error Measurement	Quarterly	Percent Error > 15%	Informational Flag – QA Failure - stored as QA data and Casual Analysis and Corrective Actions performed

* The UV instrument periodically collects a sample of air that contains no benzene. Instances of this are identified when R2 ≥ 0.70 and the resultant concentration being negative (usually associated with compounds other than benzene). It can be corrected by identifying a true zero background for the target gas and reprocessing the data with the corrected background.

Table 4.1.C –UV_DOAS ISQL Values

	Path 1	Path 2	Path 3	Path 4
Gas	**ISQL (ppb)**	**ISQL (ppb)**	**ISQL (ppb)**	**ISQL (ppb)**
Benzene	0.9	0.9	0.8	0.9
Ethylbenzene	15	12	12	15
Sulfur Dioxide	4	2.2	2.2	4.1
Toluene	1.8	1.7	1.7	1.8
Xylene	1	0.8	0.8	1

Table 4.1.D – TDL System

Potential Issue Or Information	Check	Frequency	If Parameter is Met Flag is Inserted	Type of Flag and Action
TDL Flags - MSOP-002-DVC and MSOP-003-SCC				
Light Signal Low Flag 10	Light Signal	Every 5 minutes	Light signal < 1%	Data invalidated and reviewed weekly
Data Below LoQ and Quantifiable Flag 20	Light Signal Limit of Quantification (LoQ) ISQL	Every 5 minutes	Light Singal ≥ 1% and LoQ < 25.0 ppb	Data is considered valid and reviewed weekly
Data Detect Quantifiable Flag 21	Validation of H_2S detect	Every 5 minutes	Reported value is greater than detection limits and all internal quantification checks have been met.*	Data is considered valid and reviewed daily
Data Detect Qualitative Flag 22	Validation/invalidation of H_2S detect	Every 5 minutes	Reported value is greater than detection limits and one or more internal quantification checks are not met.*	Data considered preliminary and reviewed daily (invalidated/validated and/or quantified)
Real-Time LoQ Valid Flag 23	LoQ	Hourly	LoQ ≤ 25.0 ppb and last hour average LoQ < 15.0 ppb	Hourly data meets BAAQMD requirements, is considered valid and reviewed weekly
Real-Time LoQ Invalid Flag 24	LoQ	Hourly	LoQ > 25.0 ppb or last hour average LoQ > 15.0 ppb	Hourly data does not meet BAAQMD requirement, is removed from data set for completeness and is reviewed weekly
Methane Real-Time Data Invalid Flag 42	Measured methane to reference (Local FTIR)	Hourly	Measured methane concentration outside 25.0% of reference measurement	Hourly data is considered invalid and is reviewed weekly
QA Mode Flag 60	Data Information	Dependent	Identify data associated with QA Checks	Informational Flag - data stored as QA data

Precision Pass Flag 72	Relative Standard Deviation (RSD) Measurement	At least monthly	RSD ≤ 15.0%	Informational Flag – QA Pass - stored as QA data
Precision Fail Flag 73	Relative Standard Deviation (RSD) Measurement	At least monthly	RSD > 15.0%	Informational Flag – QA Failure - stored as QA data and Casual Analysis and Corrective Actions performed
Quarterly Precision Pass Flag 74	Relative Standard Deviation (RSD) Measurement	Quarterly	RSD ≤ 15.0%	Informational Flag – QA Pass - stored as QA data
Quarterly Precision Fail Flag 75	Relative Standard Deviation (RSD) Measurement	Quarterly	RSD > 15.0%	Informational Flag – QA Failure - stored as QA data and Casual Analysis and Corrective Actions performed
Accuracy Pass Flag 82	Percent Error Measurement	At least monthly	Percent Error ≤ 15.0%	Informational Flag – QA Pass - stored as QA data
Accuracy Fail Flag 83	Percent Error Measurement	At least monthly	Percent Error > 15.0%	Informational Flag – QA Failure - stored as QA data and Casual Analysis and Corrective Actions performed
Quarterly Accuracy Pass Flag 84	Percent Error Measurement	Quarterly	Percent Error ≤ 15.0%	Informational Flag – QA Pass - stored as QA data
Quarterly Accuracy Fail Flag 85	Percent Error Measurement	Quarterly	Percent Error > 15.0%	Informational Flag – QA Failure - stored as QA data and Casual Analysis and Corrective Actions performed

* A valid detection of H_2S includes the following conditions have met:

The maximum methane peak curve of the Absorbance Spectrum is between pixels 32 and 34 to ensure that a pixel shift has not occurred in the spectrometer and the pattern curve match for the target compound is accurate.
The calculated spectral fit statistic - Chi Squared < 0.15
The quantified value of ambient Methane concentration > 1.72 ppm, and
RH Reference < 90.0%

These are defined as internal Quality Assurance checks.

Table 4.1.E – FTIR System

Potential Issue Or Information	Check	Frequency	If Parameter is Met Flag is Inserted	Type of Flag and Action
FTIR Flags - MSOP-002-DVC and MSOP-003-SCC				
Light Signal Low Flag 10	FTIR light signal	Every 5 minutes	FTIR light signal < 12.5% full scale	Data invalidated and reviewed weekly
Light Signal High Flag 11	FTIR light signal	Every 5 minutes	FTIR light signal > 87.5%	Data invalidated and reviewed quarterly
Data Below LoQ and Quantifiable Flag 20	Instrument specific quantification limit (ISQL) – compound specific	Every 5 minutes	Concentration < ISQL and ISQL concentration to sigma ratio < 3	Data considered valid, below LoQ and reviewed weekly
Data Detect Quantifiable Flag 21	Instrument specific quantification limit (ISQL) – compound specific	Every 5 minutes	Concentration ≥ ISQL and concentration to sigma ratio ≥ 9	Data considered valid and reviewed daily (invalidated/validated)
Data Detect Qualitative Flag 22	Instrument specific quantification limit (ISQL) – compound specific	Every 5 minutes	Concentration ≥ ISQL and concentration to sigma ratio < 9	Data considered preliminary and reviewed daily (invalidated/validated and/or quantified)
Data Excessive Omissions Flag 30	Data quality check – Missed Scans	Every 5 minutes	Omitted Scans > 20	Data considered preliminary and reviewed daily (invalidated/validated and/or quantified)
Methane Real-Time Data Valid Flag 42	Measured methane to reference (Local FTIR)	Hourly	Measured methane concentration outside 25% of reference measurement	Data considered valid and reviewed daily (BAAQMD notified of reference failure)
Reference RH Failure Flag 51	Measured RH at reference site	Hourly	Data from Reference Site available (Outside Argos control)	Data considered valid and reviewed daily (BAAQMD notified of reference failure)
QA Mode Flag 60	Data Information	Dependent	Identify data associated with QA Checks	Informational Flag - data stored as QA data

Precision Pass Flag 72	Relative Standard Deviation (RSD) Measurement	At least monthly	RSD ≤ 15.0%	Informational Flag – QA Pass - stored as QA data
Precision Fail Flag 73	Relative Standard Deviation (RSD) Measurement	At least monthly	RSD > 15.0%	Informational Flag – QA Failure - stored as QA data and Casual Analysis and Corrective Actions performed
Quarterly Precision Pass Flag 74	Relative Standard Deviation (RSD) Measurement	Quarterly	RSD ≤ 15.0%	Informational Flag – QA Pass - stored as QA data
Quarterly Precision Fail Flag 75	Relative Standard Deviation (RSD) Measurement	Quarterly	RSD > 15%	Informational Flag – QA Failure - stored as QA data and Casual Analysis and Corrective Actions performed
Accuracy Pass Flag 82	Percent Error Measurement	At least monthly	Percent Error ≤ 15.0%	Informational Flag – QA Pass - stored as QA data
Accuracy Fail Flag 83	Percent Error Measurement	At least monthly	Percent Error > 15.0%	Informational Flag – QA Failure - stored as QA data and Casual Analysis and Corrective Actions performed
Quarterly Accuracy Pass Flag 84	Percent Error Measurement	Quarterly	Percent Error ≤ 15.0%	Informational Flag – QA Pass - stored as QA data
Quarterly Accuracy Fail Flag 85	Percent Error Measurement	Quarterly	Percent Error > 15.0%	Informational Flag – QA Failure - stored as QA data and Casual Analysis and Corrective Actions performed

Table 4.1.F – FTIR ISQL Values

	Site D	Site E	Site F	Site G
Gas	**ISQL (ppb)**	**ISQL (ppb)**	**ISQL (ppb)**	**ISQL (ppb)**
Total Alkanes	75	75	75	75

Table 4.1.G – OGD System

Potential Issue Or Information	Check	Frequency	If Parameter is Met Flag is Inserted	Type of Flag and Action
OGD Flags - MSOP-002-DVC and MSOP-003-SCC				
Data Below LoQ Quantifiable Flag 20	Instrument specific quantification limit (ISQL) – compound specific	Every 5 minutes	Measured concentration < 10.0 ppb	Data considered valid, below LoQ and reviewed weekly
Data Detect Quantifiable Flag 21	Instrument specific quantification limit (ISQL) – compound specific	Every 5 minutes	Measured concentration ≥ 10.0 ppb	Data considered valid and reviewed daily (invalidated/validated)
Data Detect Qualitative Flag 22	Instrument specific error code	Every 5 minutes	Error code received from instrument	Preliminary data considered invalid and reviewed daily (invalidated/validated and/or quantified)
Data Excessive High Concentration Flag 26	Data quality check – Missed Scans	Every 5 minutes	Measured concentration ≥ 1,000.0 ppb	Data considered preliminary and reviewed daily (invalidated/validated and/or quantified)
QA Mode Flag 60	Data Information	Dependent	Identify data associated with QA Checks	Informational Flag - data stored as QA data
Precision Pass Flag 72	Relative Standard Deviation (RSD) Measurement	At least monthly	RSD ≤ 15.0%	Informational Flag – QA Pass - stored as QA data
Precision Fail Flag 73	Relative Standard Deviation (RSD) Measurement	At least monthly	RSD > 15.0%	Informational Flag – QA Failure - stored as QA data and Casual Analysis and Corrective Actions performed
Quarterly Precision Pass Flag 74	Relative Standard Deviation (RSD) Measurement	Quarterly	RSD ≤ 15.0%	Informational Flag – QA Pass - stored as QA data

Quarterly Precision Fail Flag 75	Relative Standard Deviation (RSD) Measurement	Quarterly	RSD > 15.0%	Informational Flag – QA Failure - stored as QA data and Casual Analysis and Corrective Actions performed
Monthly Accuracy Pass Flag 82	Percent Error Measurement	At least monthly	Percent Error ≤ 15.0%	Informational Flag – QA Pass - stored as QA data
Monthly Accuracy Fail Flag 83	Percent Error Measurement	At least monthly	Percent Error > 15.0%	Informational Flag – QA Failure - stored as QA data and Casual Analysis and Corrective Actions performed
Quarterly Accuracy Pass Flag 84	Percent Error Measurement	Quarterly	Percent Error ≤ 15.0%	Informational Flag – QA Pass - stored as QA data
Quarterly Accuracy Fail Flag 85	Percent Error Measurement	Quarterly	Percent Error > 15.0%	Informational Flag – QA Failure - stored as QA data and Casual Analysis and Corrective Actions performed

Table 4.1.H – Maintenance for All Systems

Potential Issue Or Information	Check	Frequency	MQO
Maintenance Flags – MSOP-0040-OAM			
Routine Operation Flag 90	Follow the manufacturer-recommended operational procedures.	Continuous	Documentation demonstrating operational procedures are being followed.
Routine Maintenance Flag 91	Follow the manufacturer-recommendation for maintenance procedures.	Continuous	Documentation demonstrating routine procedures are being followed.

These flags are all informational in nature and will result in data being invalidated only if SOP is not followed as determined by an independent audit and agreed upon by Argos management.

Section 5 – Data Management

Data Validation Protocol

The data generated by the air monitoring system undergoes numerous checks to ensure that validated data is presented to the public in real-time, and to the BAAQMD as part of the quarterly reporting process. The specific timetable for the data quality checks is presented in Table 5.1 below.

Table 5.1 – Data Quality Checks Timetable

Data Check Description	Frequency	Job Responsibility	Output
Real-time check of data quantification	Continuous through software	Automated system	Notification flag if data is not valid as outlined in Table 4.1
Real-time check of Hardware and Software	Continuous through software	Automated system	Notification flag if hardware and/or software malfunction occurs as outlined in Table 4.1
Daily Data Reconciliation	Daily	Data Analyst	Reconciles all flagged data to determine if data is valid. If data is not valid, then root cause analysis is initiated
Weekly Data Review	Weekly	Senior Data Analyst	Reviews all data and determines if data quality procedures are followed
Quarterly Data Review	Quarterly	Project Manager	Reviews all data to ensure the information meets BAAQMD data reporting requirements

Data Validation Process

The general flow of data for all instruments is shown in Figure 5.1 below. A more detailed figure of how data is processed is provided in Figure 5.2 below. Checks to ensure proper communication from the instrument, through the instrument computer and data logger and to the cloud-based databases are similar and provided in MSOP-001-SOC. Data validation checks are performed to ensure data quality indicators and, in some cases, instrument metadata and are met and are provided in MSOP-002-DVC. The data for each system is unique because each instrument has its own way of processing data, but the general flow is similar for all instrumentation.

Figure 5.1: General process flow for Data Collection and Validation

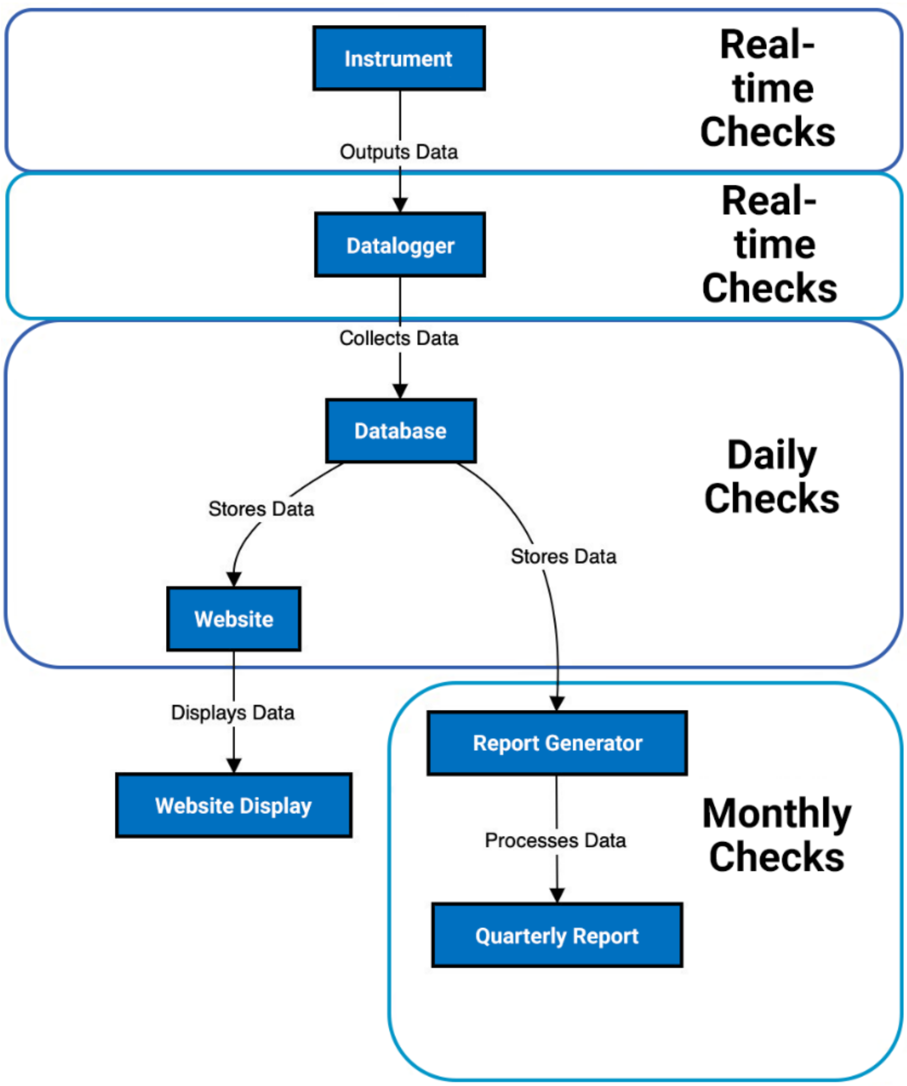
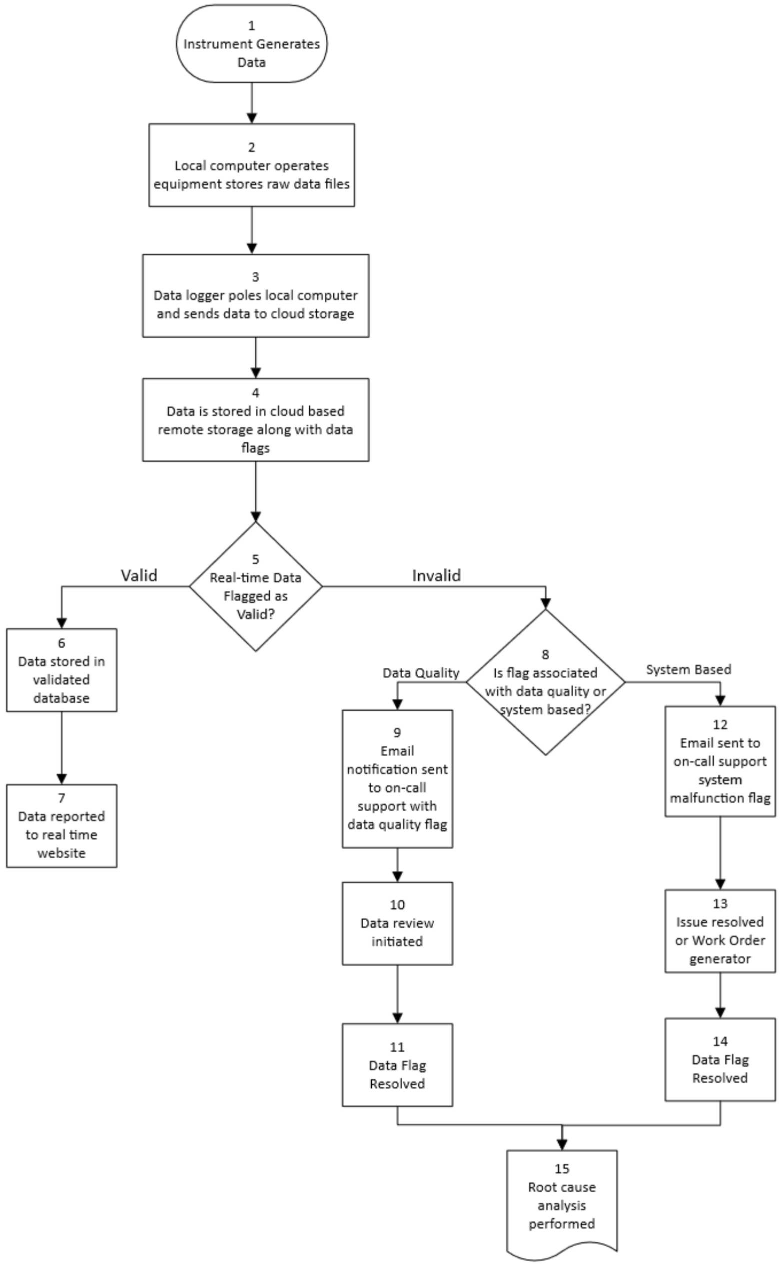


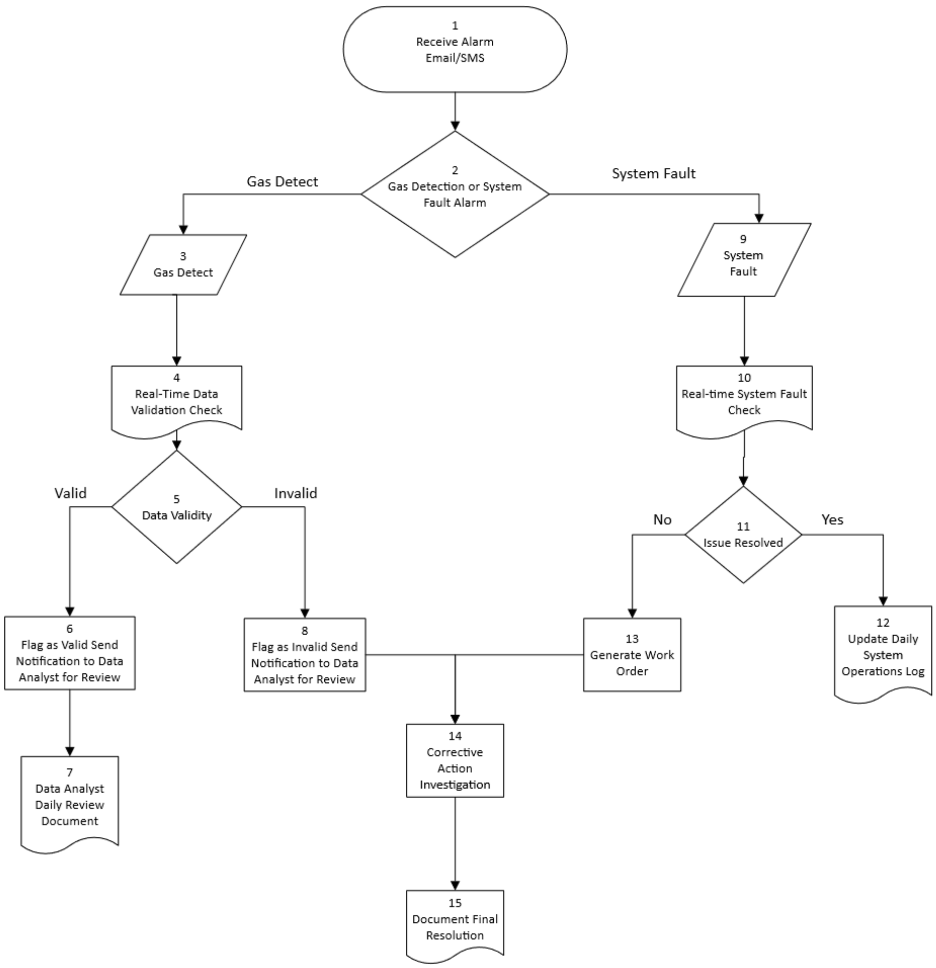
Figure 5.2 – Detailed Data Flow



Data Flagging

Data that is generated by the instruments undergo real-time checks to determine the validity of the data being recorded, as well as the operational status of each element of the monitoring system. Data that is determined to be valid via real-time data quality checks as described in Table 4.1 are considered to be quantitative in nature and are recorded in the cloud-based database system as valid data. . Table 4.1 provides additional information on flags that provide instrument information, contain QA/QC information, or other operational parameters that do not affect data quality, and are not used to determine real-time data validity. Data that does not meet data quality parameter criteria are considered flagged for review based on the specific issue real-time checks listed in Table 4.1. Any data that is flagged for review will be performed by trained staff with results, and lessons learned recorded. In addition, data is further reviewed after generation as outlined below and the process for the generation of data flags is addressed in the Standard Operating Procedures. Figure 5.2 below presents the process flow for addressing data quality during the data collection process.

Figure 5.2: Data Validation Decision Tree



Daily Validation Checks of Recorded Data

Further checks are made on the data by an Argos data analyst on a daily basis. The aim of the analysis is to:

- Assess if possible weather-related effects occurred.
- Validate any possible detections that are qualitative in nature.
- Invalidate data detections that do not meet Table 4.1 requirements.
- Evaluate invalid data that has failed the real-time check above and is marked for further review and validation as described in the Sections below.

The raw data is not adjusted. Data flags are reviewed by a trained Data Analyst and clearing of those flags as well as any other adjustments necessitated by the data review are documented in a separated database that includes all validated data. Raw, instrument generated data along with all flagging as outlined in Table 4.1 are not adjusted. All changes made between the raw and validated datasets are logged in a daily/weekly validation report and the process review documented. The date of changes made is noted along with the staff who authorized the changes as well as the rationale for the changes. At the end of the daily validation process, all information is uploaded to the cloud-based document storage system so it can be reviewed by a senior data analyst.

Weekly Review by Senior Data Analyst

At this level of data validation, data is reviewed by a project management level staff member to ensure all the above processes have been followed and is finalized for inclusion into the quarterly reporting format that is required by the BAAQMD. To achieve this, a validated report generation application is run on the validated data set to provide the data in the BAAQMD format. This is then validated by a senior data analyst who performs the following checks. For each instrument the five-minute (or other defined time) average data is then checked by a senior data analyst against the following:

- Compare the data to the data trends for the week.
- Validate any adjustments made as outlined in applicable SOPs.
- Log any further changes made to the validated data set.
- Review the log of data adjustments and send the report to Project Management staff for final review.

When the weekly review is completed, the data will be in a format and quality level for insertion into the quarterly report to be submitted to the BAAQMD.

Quarterly Data Review

Before the quarterly report support is submitted to the BAAQMD, the data is checked by a senior data analyst who looks at data to ensure they meet SOPs checks and BAAQMD requirements. Specific elements associated with the review include:

- Validate weather-related flags and calculations.
- Validate any data that has an hourly completeness between 65 and 80%.
- Verify downtime where QA and Maintenance took place.
- Calculate the completeness.
- Send a report to Project Management staff for final review.

In addition to reviewing the final report, the senior data analyst will also make recommendations regarding the operation and maintenance of the monitoring equipment as needed.

Section 6 – Instrument Maintenance

Instrument maintenance and repair interventions are conducted as required, guided by ongoing assessment of instrument error signals and data trends identified in the above data review steps. In addition to service and repair calls conducted on an as-needed basis, as identified in the above data review steps, preventive maintenance is conducted based on the schedules provided by the instrument manufacturer or further outlined in the MSOP-004-OAM.

Section 7 – Document Control

Document Control will include the following elements to update and control documents to ensure the latest versions of documents are available. A new document number will be generated, and project management staff will review and approve all changes and sign the new document as approved and notify all users that a new version is available and archive previous versions.

Records of data flagging, reviews, and other related actions will be stored as additional databases, with rationale for data changes/actions documented with associated data including which staff member made those changes and on what date. Overall document control (outside of the data review outlined above) will include:

- Electronic copies of controlled documents including
  - Manuals, policies, procedures, and work instructions as locked PDF documents.
  - Forms, templates, and checklists as locked PDFs or saved as Word or Excel templates (depending on application and use).
  - Registers, plans, and databases that are password protected.
  - Reports provided to MRC and BAAQMD

Section 8 – Website and Dashboard Management

The real-time Website is operated and maintained by Argos who will be solely responsible for its content. This section addresses the methods used to provide information to the public, including message board updates, notification of significant events, data reporting, learning center section, and a contact page. The website is found at https://www.fenceline.org/martinez. The website defaults to the Real-Time Data Tab. The website has the following tabs:

- Program History
- Learning Center
- Real-time-Data
- Documents Archive

The Program history tab has the following text: "*On April 20, 2016, the Bay Area Air Quality Management District (BAAQMD) adopted Regulation 12 Rule 15 which requires Bay Area refineries to develop and submit an Air Monitoring Plan for APCO approval to establish and operate a fence-line monitoring system. The plan can be found in the Documents Archive of this website. Additional information can also be found in the Learning Center.*"

How the rest of the sections of the website are managed is described below.

Real-Time Data

As can be seen in Figure 8.1 below, the website displays the raw data received from the on-site loggers that are stored in the database. In addition, the website also receives data from the meteorological station located at the East Site of the refinery. It should be noted that the operation of meteorological systems and the data produced by the system is supplied via a separate contractor through an API.

Figure 8.1: Realtime-Data Tab (Landing Page)

This part of the website is managed through display rules based on the underlying data in the database. Data is displayed on the public website based on the requirements of Table 4.1. This means that any valid data, not associated with QA activities (calibrations) is displayed on the public website, quantitative data is displayed and noted as such and may be changed depending on review, and invalidated data is not displayed on the website. After QA processes are completed and the data reviewed as described above, the data will be notated as being valid and fully reviewed. This information will be included in the Quarterly Report submitted to the BAAQMD.

There is also a message board used to inform the public of any maintenance, QA, or other issues occurring at the site. There is a notification system that sends out notifications to two different mailing groups:

- Maintenance notifications regarding instrument QA and downtime
- Gas Exceedance Notifications that show any values above the BAAQMD guideline values

Gas values shown on the website are managed programmatically using a set of rules that are based on the status flag values assigned to the real-time data during the Data Management process described in Section 5 with flag identification numbers provided in Table 4.1.

If the data on the website indicates offline, low signal status or other defined parameter for longer than 30 minutes, an email is sent to the on-call group so that the issue can be remotely diagnosed. If necessary, a technician is sent to the site to resolve the issue. If the value for a particular parameter is above the BAAQMD threshold values, the gas exceedance notification group is notified, and a data analyst is assigned to investigate the exceedance. These mailing lists are managed according to the requirements of the site.

If there is any maintenance or quality assurance being performed on-site, or if there are any significant events or equipment downtime that need to be communicated to the public, these are displayed on a message board on this website page. The messages on the message board are controlled by accessing a password-protected portal that allows for the composition of the message and the appropriate message is uploaded by appropriate Argos staff.

Learning Center

The Learning Center section of the website contains definitions of acronyms used on the website, chemical definitions, a description of the instruments used on site, the minimum detection limits, or other defined parameters of each of the instruments. The content of this page is managed by Argos and can be updated through a password-protected secure portal.

Documents Archive

As mentioned above, the Documents Archive section of the website contains the current Fence Line Air Monitoring Plan, QAPP and other documents. All documents can be uploaded as required through a secure, password-protected portal by Argos.

Contacts

The Contacts section of the webpage allows the public to contact appropriate Argos staff with any message. This message is then reviewed and acted upon by appropriate Argos staff, who can then take action as agreed upon by MRC.

Section 9 – Audit and Response Actions

The Argos team includes an Internal Auditor whose duties are solely around independent assessment of the measurement effort. The goal of performing an audit is to ensure the Quality System is continuously improved. The audit will include a review of all data and documentation, whether guidelines contained in this QAPP, and associated SOPs are being followed and whether instrumentation is performing to manufacturer specifications. An audit plan will be developed to identify any additional areas that may be impacting data quality including, but not limited to routine maintenance schedules, data management, data communication, instrument performance in varying environmental conditions, performance of Causal Analysis and Corrective Actions, staff training and qualifications and management and supervisorial oversite.

All performance and technical systems audits are conducted following the guidance documents in the “EPA Quality Assurance Handbook” series, Volumes I, II, and IV. Additional method specific quality guidance is provided by the applicable sections of the manufacturer operating manuals, in the absence of an EPA guidance document specific to the application of an equipment-specific measurement. The audit team will allow BAAQMD staff to observe audits performed on the equipment if they desire.

This first step of these audits is the development of an audit plan, discussed in Section 4.

Technical Systems Audits

Technical systems audits for field operations have several areas of focus and will be performed at least annually. The primary goal of technical system audits is to determine if operation and maintenance of the fence-line air monitoring system conforms with the procedures and criteria specified in this QAPP and associated SOPs and is intended to ensure continued improvement in system operation. The audit is conducted employing a checklist as a guide to the major topics to be assessed as defined by the audit plan, and the auditor is free to allow greater amounts of time to any area as needed. The checklist is prepared in advance of the audit and is based on information presented in the QAPP and associated SOPs and in general, the guidance of the EPA QA Handbook series.

The field technical system audit includes a review of overall equipment siting and exposure, site visit logs, continuous analyzer and meteorological operating procedures and documentation and any site maintenance activities. From this assessment, the auditor can determine the quality requirements for the monitoring effort from the QAPP and associated SOPs, and then report on the level of adherence to the specifications. This review includes traceability documentation for gas standards and test equipment to conduct quality control checks on pollutant and meteorological monitors. Where the specification appears incomplete or inadequate, the auditor should be able to apply EPA guidance document information and personal experience and utilize Appendix C to ensure corrective actions are applied.

Technical systems audits may cover the following instrumentation aspects:

- Compare actual O&M practices with SOPs.
- Inspect preventative and unscheduled maintenance logs.
- Inspect spare parts inventories.
- Inspect exterior and interior structures (clean, serviceable, etc.).
- A review of logs and determinations is done to determine if past problems were addressed/resolved.
- Examine all open path, point source and meteorological system functions and components using the maintenance checklist to confirm that the equipment is operating with manufacturer specifications.

Performance Evaluation Audits

Performance evaluation audits are quantitative audits and will be conducted at least annually as described earlier coincident with one of the programmed quarterly assurance checks as outlined in Table 4.1 (percent error, relative standard deviation and linearity) along with a review of daily and weekly checks and then perform additional quarterly checks that are described in Section 5. Performance evaluation audits will consist of third-party reviews of open-path analyzer spectral analysis and blind challenges of the monitors with reference gases with concentrations known only to the assessor. As discussed earlier, the audit plan may include a specific focus on areas identified by the Independent Auditor that affect overall data quality based on a review of overall performance of the MRC fence-line system.

Reports to Management

Reports for field performance and technical systems audits conducted include a statement of the scope of the audit, summary presentation of results, and a listing of specific observations or findings related to the specifications under review. Also, the field data and traceability documents for each audit standard employed are included. Any findings will use the process outlined in Appendix C to determine and enact corrective actions.

Section 10 – Reporting

Data from the fence-line monitors will be transmitted to an internet website where the near-real- time results can be viewed by the public as described in Section 8. Data generated by the fence-line monitoring equipment undergoes review throughout the measurement and reporting process as described above. This process incorporates automated QA/QC evaluations prior to the data being displayed on the real-time website. Under normal circumstances, a five-minute average measurement will appear on the website within 10 minutes of the end of the measurement period. However, the data uploaded may be impacted by internet traffic and additional review. An automated system conducts the Quality Assurance checks before the data is reported to the website as described above. Data analysts and Project Management staff conduct additional data review to validate/invalidate data as described in Section 5 above. The website will also make available a rolling 24-hour trend of the five-minute data for each compound reported.

The website will report required LoQs in real-time for the TDL and the instrument manufacturer's LoQ for the other instrumentation. When data falls below the LoQ, the website will display the LoQ and indicate "<MDL of [calculated LoQ]

or [instrument manufacturer LoQ}" In instances where the light signal is below set parameters provided in Table 4.1, the website will report the LoQ and state that light level is too low to accurately measure compound concentrations.

Quarterly reports will be provided to the BAAQMD within 60 days after the end of each calendar quarter. The quarterly report format is consistent with guidance issued as part of the BAAQMD Letter "Refinery Fenceline H_2S TDL Monitoring System Specifications" dated 12/22/22. The specific format is found in Appendix A and B and provided below. MRC will provide the BAAQMD with five-minute average concentration data in a tabular format, using a comma-separated value (CSV) file. This file will adhere to the format specified by the BAAQMD, encompassing signal intensity, LoQ calculations, and all pertinent data and documentation for any invalidated, flagged, or otherwise qualified data entries. BAAQMD retains the discretion to share the five-minute average data with the public, either via the BAAQMD website or through public records inquiries. Prior to official report submission, MRC will promptly furnish any requested data to BAAQMD. Should any data be invalidated or excluded, MRC will provide the data and appropriate documentation in the Quarterly Report to BAAQMD. The validity of such actions will be in compliance with the appropriate SOPs and all other relevant documents and can be independently verified by BAAQMD based on the available data described above.

Appendix A - Required Procedures for Quarterly Reporting

All quarterly reports submitted following the date of this letter must meet the following specifications:

1. Quarterly reports must be submitted to the Air District within 60 days following the end of each calendar quarter.
2. Assign a unique identification number to each instrument or system that generates fence-line air monitoring data; add the unique IDs to the tables in the AMP and QAPP that identify the corresponding fence-line monitoring equipment.
3. Report all fence-line monitoring concentration data as five-minute averages.
4. Submit the following data for all instrument/parameter combinations to the Air District in a single comma-separated value (CSV) data file using the template provided by the Air District with the following fields:

    a. facility_name – the name of the facility where the equipment is located
    b. instrument_id – the unique identification number assigned to the instrument described above
    c. instrument – a short descriptive name for the instrument associated with the reported unique ID (e.g., "H2S TDL", "OGD1", "OGD2", etc.)
    d. parameter – the name of the pollutant being measured and reported
    e. date – the date of measurement, reported in Pacific Standard Time and formatted as "yyyy-mm- dd"
    f. time – the hour of the day and the beginning of the five-minute period over which measurements were collected and averaged, reported in Pacific Standard Time (without any adjustments for daylight saving time) and formatted as "hh:mm" using 24-hour notation, where hh is the number of full hours (00 – 23) that have passed since midnight; for example, a five-minute average concentration based on measurements collected between 1:10 pm and 1:15 pm should have a time stamp of "13:10"
    g. mean_concentration – the arithmetic mean pollutant concentration measured over the corresponding averaging period; for measurements below the LOQ, the mean concentration must be reported as a numeric value based on the actual values returned by the instrument during the corresponding averaging period
    h. units_of_measure – the units of measure corresponding to the reported mean pollutant concentration
    i. averaging_period – the averaging period (in minutes) for the reported mean pollutant concentration; this should be "5" unless otherwise approved by the Air District and specified in the QAPP
    j. observation_count – the number of values that comprise the reported mean concentration
    k. validity_indicator – an indicator ("Y" or "N") representing whether the reported mean concentration represents a valid air measurement; types of invalid data include but are not limited to data affected by instrument malfunction, environmental conditions, or data collected during a QC verification procedure
    l. error_codes – one or more error codes (as specified in the QAPP) explaining the reason for invalid or missing data; multiple codes should be separated by a semicolon without spaces, and the field should be left blank for valid data
    m. max_value – the maximum concentration measured during the corresponding averaging period, reported in the same units of measure as the mean concentration
    n. required_loq – the required LOQ for the corresponding instrument, reported in the same units of measure as the mean concentration
    o. real time_loq – the real-time average LOQ for the corresponding averaging period, reported in the same units of measure as the mean concentration
    p. signal – the average measured light signal for the corresponding averaging period
    q. signal units – the units of measure for the corresponding light signal

5. For every instrument/parameter combination, the data file outlined above must contain a record for every five-minute period in every hour for the entire quarter. Where pollutant measurements are missing:

   a. ***The following fields should be populated with their respective values:***

      i. facility name
      ii. instrument id
      iii. instrument
      iv. parameter
      v. date
      vi. time
      vii. error codes

   b. ***All other fields should be populated with a value of "NA"***
6. Provide the information related to data completeness as further outlined in attachment 3.
7. Identify all monthly bump tests and quarterly calibration checks performed in the quarter, including failed bump tests and calibration checks; for each bump test and calibration check, specify: the system or equipment in question, the type of test or check performed, the beginning date and time, the ending date and time, and the date and time the equipment resumed normal operation. A failure to meet the specifications during two or more bump tests in any quarter, or four bump tests in any 12-month period, will result in a violation of the relative standard deviation and percent error specifications (as applicable) and QAPP requirements. Any such occurrence will invalidate all data prior to the failed bump test going back to the last passing bump test, and invalidated data will count against data completeness requirements.
8. Report the results of all bump tests and calibration checks, including relative standard deviation and percent error measurements; for any bump test or calibration check that yields relative standard deviation measurements outside of the stated specifications, including a root cause analysis and a narrative description of the maintenance or repairs performed to return the system to proper operation.
9. Describe any corrections made to any data to account for the effects of gas cells or other equipment on light transmission; such corrections must be consistent with the procedures explained in QAPP.

Appendix B - Required Procedures for Assessing and Reporting Quarterly Data Completeness

1. For all instrument/parameter combinations, calculate the data completeness statistics below for each hour of the calendar quarter and include the results in the respective quarterly report to the Air District; provide the information in a single CSV data file for all instruments/parameters using the template provided by the Air District.
2. In the cover letter that accompanies the quarterly report, include the results of the following calculation based on data for the respective quarter along with a statement as to whether MRC met the required 90% completeness threshold:
   a. Quarterly % Completeness = [count of hours in the calendar quarter where hr_complete_pct ≥ 75%] [count of all hours in the calendar quarter] × 100
3. For every hour of the calendar quarter where data has been excluded due to adverse atmospheric or environmental conditions, MRC's quarterly report must include meteorological data and a narrative explanation sufficient to justify invalidation of the data. If MRC fails to adequately substantiate the exclusion of any data due to adverse atmospheric or environmental conditions, the Air District will consider the respective hour of data to be missing and will recalculate the Quarterly % Completeness statistic for purposes of determining compliance with the data completeness requirement.
4. Data completeness statistics:

   b. possible -The maximum number of five-minute average concentrations that can be measured in a given hour and logged in the DMS; because data are reported in Pacific Standard Time, this should always be equal to 12
   c. captured -The actual number of five-minute average concentrations that were measured in a given hour and logged in the DMS; for each hour, this value should equal the count of reported five-minute average concentrations where the validity indicator field is equal to "Y" or "N"
   d. missing -The number of possible five-minute average concentrations not measured or logged in the DMS in a given hour; for each hour, this value should equal the count of reported five-minute periods where the mean concentration field is reported as "NA"
      i. missing = possible – captured
   e. missing_pct -The percentage of missing five-minute average concentrations in a given hour relative to the possible number of average concentrations missing_pct = (missing / possible) x 100
   f. In all cases, an "hour" refers to an individual clock hour (0 - 23) of a particular day rather than a rolling 60-minute period.
   g. Field definitions and formatting for the facility_name, instrument_id, instrument, parameter, date, and hour columns in the provided template should be consistent with specifications.
   h. invalid_total -The number of invalid (for any reason) five-minute average concentrations measured and logged in the DMS in a given hour; for each hour, this value should equal the count of reported five-minute average concentrations where the validity indicator field is equal to "N"
   i. invalid_total_pct -The percentage of invalid (for any reason) five-minute average concentrations measured and logged in the DMS in a given hour
      i. invalid_total_pct = (invalid_total / possible) x 100
   j. invalid_environmental - The number of invalid five-minute average concentrations in a given hour due to adverse atmospheric or environmental conditions; for each hour, this value should equal the count of reported five-minute average concentrations where the validity indicator field is equal to "N" and where the error_codes field contains one or more error codes documented in the QAPP and associated with adverse

atmospheric or environmental conditions

k. invalid_other -The number of invalid five-minute average concentrations in a given hour due to anything other than adverse atmospheric or environmental conditions; this may include, but is not limited to, planned or unplanned maintenance; for each hour, this value should equal the count of reported five-minute average concentrations where the validity indicator field is equal to "N" and where the error_codes field contains one or more error codes documented in the QAPP and not associated with adverse atmospheric or environmental conditions
l. invalid_other_pct -The percentage of invalid five-minute average concentrations in a given hour due to anything other than adverse atmospheric or environmental conditions
   i. invalid_other_pct = (invalid_other / possible) x 100
m. expected -The number of possible five-minute average concentrations in a given hour, adjusted for periods of low visibility during adverse atmospheric or environmental conditions
   i. expected = possible – invalid_environmental
n. valid -The number of valid five-minute average concentrations measured and logged in the DMS in a given hour; for each hour, this value should equal the count of reported five-minute average concentrations where the validity_indicator field is equal to "Y"
o. valid_pct -The percentage of valid five-minute average concentrations in a given hour relative to the possible number of five-minute concentrations
   i. valid_pct = (valid / possible) x 100
p. hr_complete_pct -The percentage of valid five-minute average concentrations in a given hour relative to the expected number of data points
   i. hr_complete_pct = (valid / expected) x 100

Appendix C - Required Procedures for Determining Failure Cause and Associated Corrective Action Procedures

Purpose

The purpose of this Appendix is to outline a standardized process for conducting causal analysis and implementing corrective actions following incidents, deviations, or non-conformances. This ensures continuous improvement and prevention of recurrence.

Scope

This Appendix applies to all employees and departments within the organization involved in the identification, analysis, and resolution of non-conformance events, incidents, or quality issues.

Definitions

- Causal Analysis: A process used to identify the underlying cause(s) of a deviation, incident, or non-conformance.
- Corrective Action: Actions taken to eliminate the root cause(s) of a non-conformance, preventing recurrence.
- Root Cause: The primary reason for the occurrence of a problem, deviation, or non-conformance.
- Non-conformance: Any deviation from established standards, procedures, or quality requirements.

Responsibilities

- Team Leader/Manager: Ensure compliance with this procedure, assign personnel for analysis, and approve corrective actions.
- Causal Analysis Team: Conduct root cause analysis, suggest corrective actions, and track their implementation.
- Quality Assurance (QA): Verify and monitor the effectiveness of corrective actions and maintain documentation.

Procedure

Identify the Problem

Trigger Event: Non-conformance, incident, or deviation is detected (e.g., via quality audits, instrument malfunction, operational disruptions).
Initial Reporting: Document the event immediately in the appropriate reporting system (e.g., Non-Conformance Report (NCR), Incident Report).

Containment Actions

If necessary, implement immediate containment actions to prevent further occurrences while investigation is ongoing. These actions should be short-term and not viewed as the corrective action.
Document containment actions taken.

Assemble Causal Analysis Team

Assemble a team based on expertise relevant to the event.
Assign a team leader responsible for guiding the process and reporting progress.

Causal Analysis Process

Data Collection: Gather all relevant data such as incident reports, logs, and witness statements and then perform the following:

- Employee Root Cause Analysis Tools: Use one or more of the following methods for analysis:
  - 5 Whys: Keep asking "why" until the underlying root cause is identified.
  - Fishbone Diagram (Ishikawa): Map out possible causes in categories such as equipment, processes, people, and environment.
  - Fault Tree Analysis: Systematically break down the potential causes of the failure.
- Identify the Root Cause: Using the chosen method, identify the primary cause or causes of the event.

Develop Corrective Action Plan

Develop a plan with the information below:

- Objective: Eliminate the root cause(s) identified in the analysis.
- Action Plan: Include specific, measurable, attainable, relevant, and time-bound (SMART) actions.
- Approval: The corrective action plan should be approved by the Manager and QA before implementation.
- Resource Allocation: Ensure that adequate resources (personnel, materials, and time) are assigned to implement the corrective action.

Implement Corrective Actions

- Execute the action plan and:

- Assign responsible people to each corrective action and ensure that timelines are adhered to.
- Document the progress and completion of each corrective action in the Corrective Action Report (CAR).

Verification of Corrective Actions

Develop and document an Effectiveness Check: Monitor and verify the effectiveness of the corrective action to ensure that the issue does not recur.
Follow-up: QA or assigned personnel will conduct follow-up checks (e.g., audits, reviews) to ensure the corrective action has been effective over time.

Close-Out and Documentation

Once the corrective action has been verified as effective, close out the Corrective Action Report (CAR).
Ensure all documentation related to the incident, causal analysis, and corrective actions are filed appropriately.
Retain records in accordance with company document retention policy.

Review and Continuous Improvement

Periodically review incidents and corrective actions to identify trends and opportunities for process improvements.
Update processes and procedures to reflect lessons learned from the causal analysis and corrective actions.

Records and Forms

- Incident Report Form
- Non-Conformance Report (NCR)
- Corrective Action Report (CAR)
- Root Cause Analysis Tools
- Containment Action Documentation

Master Standard Operation Procedure (MSOP)-001-SOC

System Operations Checks of Air Monitoring System

Contents

1.0 - SOP Description

The purpose of the System Operation Checks (SOC) is to continuously check the system in real-time to ensure the analyzer is working as defined by the instrument manufacturer in a manner to produce valid data to the appropriate cloud-based database. This SOP applies to all instrumentation and networking hardware in operation at MRC. If a check occurs that indicates a potential performance issue, a message is sent to the on-call support team to evaluate the issue and perform corrective actions as needed. SOC flags can be generated by the instrument itself, by monitoring site network parameters such as Internet connectivity, as well as evaluating the data for external events such as weather-related issues. Data validation procedures are covered in MSOP-002-DVC, calibration procedures are covered in MSOP-003-SCC and operation and maintenance procedures are covered in MSOP-004-OAM. The specific standard operation checks (SOCs) for the air monitoring systems at MRC that deal with internet or equipment operational issues are listed in Table 4.1 as Data Communication Systems of the latest version of the Quality Assurance Project Plan for the Martinez Refining Company Fence-Line Monitoring Program.

2.0 - Summary of Method

The fence line network monitoring system has alarms set up to automatically monitor the operation of the system as described above.

Argos and, where appropriate, refinery staff, are notified via email if any equipment is operating outside the set operational parameters. They are set to notify Argos and refinery staff when the possibility of communication error may affect data or data collection. Argos staff review data generated associated with the identified issue and begin a troubleshooting process outlined in the Argos Alarm Response Procedures Guide. If the issue cannot be corrected through this troubleshooting process, a work order is produced to direct field staff to correct the issue. If data transmission to the MRC fence-line website is affected for more than 1 hour, refinery staff are notified.

3.0 - Definitions

Non-conformance - Non-fulfilment of a requirement.

Requirement - A need or expectation that is stated, generally implied, or obligatory.

Correction - Action taken to eliminate a detected non-conformity.

Corrective Action - Action taken to eliminate the cause of a detected non-conformance or other undesirable situation in the management system or process, so as to prevent recurrence.

Preventive Action - Action taken to determine and eliminate the causes of a potential non-conformance or other undesirable potential situation to prevent occurrence.

Improvement - Action taken to improve an otherwise satisfactory process or system.

Management Team - Includes the Managing Director, Manager and General Managers or authorized designees.

Root Cause analysis - A root cause analysis is conducted to determine the real cause (not symptoms or explanations) of non-conformities. The root cause is the reason a problem started in the first place.

4.0 - Health & Safety Warnings

When field technicians are dispatched to field locations to troubleshoot an issue, they should follow all required safety protocols required by the client. This includes all site-specific training as required by the Occupational Safety Council of America and general site-specific training requirements. In addition, before a field technician goes on-site, a job safety analysis will be performed. This will include a site-specific walk-through of the tasks to be performed so specific hazards can be identified and mitigated.

5.0 – Cautions

Site specific cautions will be included in the job safety analysis provided to all technicians who enter the refinery and are kept in the individuals training files.

6.0 – Interferences

Interferences are not included in this procedure.

7.0 - Personnel Qualifications/Responsibilities

Complete job descriptions are available from Argos Scientific. General items are provided below.

- Field Technicians / Contract Technicians
    - It is the responsibility of all Technicians/Contract Technicians to visit sites when needed to assist in troubleshooting issues and performing corrective actions. Appropriate refinery staff will be notified prior to entering the refinery.
    - Qualification of field technicians include refinery-specific training provided by accredited training agencies. Instrument specific training is provided by the technical experts who have undergone vendor-specific training for each analyser or are recognized experts in the operation and maintenance of that equipment. The Training Coordinator will document and verify staff have successfully completed the training.
- On-call Technician
    - It is the responsibility of these staff to respond to any notification provided by the real-time monitoring software regarding equipment malfunctions and begin the process of troubleshooting the issue.
    - Qualification of the On-call Technician include specific training on how to remotely connect to affected sites and the basics of computer and instrument operation necessary to troubleshoot and address issues that can be corrected remotely.
- Senior Operations Manager

- The Senior Operations Manager is responsible for allocating specific sites to personnel and following up that visits are undertaken as required. The Technical Manager is authorized to take corrective and preventative action on any deficiencies indicated during the troubleshooting and corrective action process.

8.0 - Equipment and Supplies

Equipment and supplies associated with the activity will be specified in the work order that will be issued for each specific activity.

9.0 - Procedure

The procedure is initiated by an email to the on-call support technician who will attempt to correct the specific issue. If the issue is resolved, the event is documented in the on-call log and the event is closed out. If the issue cannot be resolved by the on-call support technician, a work order is created and sent to the project manager who implements the troubleshooting and corrective action steps included in the work order. The process flow for each event condition is included in Appendix A. An example of a work order form is included in Appendix B.

9.1 Instrument Hardware Malfunction Error Flags Sent As Described in Table 4.1.A of the Latest Quality Assurance Project Plan for MRC

1. An email is sent out to on-call support technicians notifying them of the specific instrument malfunction code and refinery personnel will be notified via SMS or email of the event.
2. An on-call support technician checks to see if the instrument is operational. If it is determined that the instrument has failed, and it is not a software issue:
    - A work order is created and then the work order is passed on to the Technical Manager who initiates the corrective activities outlined in the work order, instructing a Field Technician to affect repairs or arrange for a backup instrument to be installed
3. If the instrument is operational then the on-call support technician:
    - Takes control of on-site computers using the Argos remote access system to observe probable causes through observation and depending on findings will either:
        - Re-initialize any data acquisition software: or
        - Perform a power cycling/ reboot of the affected network device or instrument, if the system is shut down due to a power outage or an update cycle.
        - If the fault persists, a work order is created to assess the fault. The work order is then passed on to the Technical Manager who initiates the corrective activities outlined in the work order.
    - Once the fault is found and corrected, the work order is closed out and the system is put back into working order. If determined necessary by the

Project Manager, verification of proper instrument operation as outlined in MSOP-003-SCC will be performed.

- Instrument software will be checked to ensure that the instrument parameter setup is correct, and the system is working properly, and data is being sent, received and stored correctly.

9.2 Flags Sent As Described in Table 4.1.A of the Latest Quality Assurance Project Plan for MRC for Instrument or Software Malfunction

These data flags are generated when an instrument or software package is determined to be malfunctioning. The key aspect of this corrective action process is that the on-call staff will initiate actions remotely. The steps for the corrective action process are as follows:

1. An email is sent out to the on-call support technicians notifying them of the specific instrument or network malfunction code.
2. An on-call support technician will attempt to remotely access the onsite computer using the Argos remote access system.
3. If remote access was successful, then;
   - Re-establish communications; then,
   - Restart all data collection programs.
4. If Argos cannot establish a remote connection, then the on-call support technician will initiate work order and refinery personnel will be notified via SMS or email of the event.
5. Argos Field Technician or a qualified subcontractor will be dispatched to restart the appropriate network device or onsite computer.
6. If the restart is successful, then all data collection programs will be restarted.
7. If restarting is not possible, then the Field Technician will install the backup field network component or computer.
8. The remote technician will start all data acquisition programs on the onsite computer.
9. The malfunctioning network component or onsite computer will be sent to Argos for repair.
10. The Technical Manager will close out the work order.

9.3 –Internet/Data Flags Sent As Described in Table 4.1.A of the Latest Quality Assurance Project Plan for MRC for Internet Malfunctions

In the event of an Internet malfunction, remote on-call staff will be unable to resolve the issue. Therefore, a field technician will be dispatched onsite to assess the problem and initiate the corrective action process. The steps for this process are as follows:

1. An email is sent out to the on-call support technician notifying them of the specific instrument or network malfunction code and refinery personnel will be notified via SMS or email of the event. Argos will post a note to the message board of the real-time website stating that the Internet connection has been lost and actions are in place to re-establish the connection

2. Argos will begin the process of troubleshooting by issuing a work order and an Argos Field Technician will attempt to reconnect to the Internet by resetting the modem located at the monitoring station.

3. The internet connection will be investigated to determine the failing network component and, if:
   a. The connection has been re-established, no further action is needed.
   b. The connection has not been re-established, then the following actions will be taken;
      i. The Argos Field Technician will check all network components, onsite computer and instrument to make sure they are still collecting data,
      ii. If the issue is determined to be instrument related, the technician will affect repairs.
   c. If the network components are in working order and the issue is the cloud-based server or other internet related failure, the issue will be reported to the provider to correct the issue
4. The real-time website will be updated as the corrective action(s) are taken.
5. The Senior Operations Manager will close out the work order.

9.4 Environmental Conditions

1. If the signal strength drops below a pre-set threshold as describedin Table 4.1 of the Latest Quality Assurance Project Plan for MRC , the on-call technician will be notified via email and refinery personnel will be notified via SMS or email of the event. Upon receiving this notification, Argos will access the instrument remotely via the Argos remote access system to determine if the loss of signal is due to weather (e.g., fog, rain etc.), obstruction by trees, light sources wearing out, or misalignment of optical components.
2. The real-time website message board will be updated to indicate which instrument has low signal. Data from that monitoring station will be flagged accordingly.
3. If the notification is weather related, then no additional action will be taken.
4. If the notification may be due to an instrument misalignment, then a work order will be initiated for an Argos Operational Technician to re-align the system.
5. If after the system has been re-aligned:
   - The signal strength is no longer low, so no further action is needed.
   - The signal strength is still consistently low, then further diagnostics are required, including replacement of light sources.

6. Once the signal has been optimized by alignment, an on-site technician contacts the on-call technician to conduct a verification of proper instrument operation (no flags are generated) and ensures that onsite computer setup was done correctly, and the system is working properly. If determined necessary by the Project Manager, verification of proper instrument operation as outlined in MSOP-003-SCC will be performed.
7. The remote technician checks the following before logging out of the remote computer:
    1. Signal strength.
    2. Open-path Systems - Light transmission is above levels defined in Table 4.1 of the latest version of the Quality Assurance Project Plan for the Martinez Refining Company Fence-Line Monitoring Program
    3. That a background has been collected before going live for TDL and UV-DOAS systems.
    4. Data is reported to the website.
8. The Senior Operations Manager will close out the work order.

10.0 - Instrument or Method Calibration and Standardization

There is no specific method of calibration and standardization for this procedure.

11.0 - Sample Collection

There are no specific sample collection activities for this procedure.

12.0 - Sample Handling and Preservation

There are no specific sampling and preservation requirements for this procedure.

13.0 - Sample Preparation and Analysis

There are no specific sample preparation and analysis requirements for this procedure.

14.0 – Troubleshooting

See Section 9.0 for specific troubleshooting requirements.

15.0 - Data Acquisition, Calculations, & Data Reduction Requirements

Specific data acquisition, calculations and data reduction protocols for the raw data are found in the operations guide for the specific system.

16.0 - Computer Hardware & Software

No specific hardware or software requirements are associated with this SOP.

17.0 Data and Records Management

A data summary report will be provided by the Senior Operations Manager. The report will document the specific event and follow-up actions associated with the activity. This includes, but is not limited to, the issuance of a Work Order and Corrective Actions reports. An electronic copy of the data will also be kept by the Technical Manager.

18.0 - Quality Control and Quality Assurance Section

After the field portion of the activity is completed, the Senior Operations Manager will generate a written report. The draft of the written report is first peer-reviewed for technical content by the Subject Matter Expert or by a member of the operations staff. The final report has been completed and transmitted to the Program Manager.

19.0 - Reference Section

Argos Work Order Procedure

Argos Statistical Analysis Document

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

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SECTION 4 – Follow Up Activities – Root Cause Analysis

Follow Appendix C - Required Procedures for Determining Failure Cause and Associated Corrective Action Procedures contained in the latest version of the Quality Assurance Project Plan for MRC

Master Standard Operation Procedure (MSOP)-002-DVC

Data Validation Checks of Air Monitoring System

Contents

1.0 - SOP Description:

The purpose of Data Validation Checks (DVC) is to ensure the data produced by the fence line air monitoring systems meets all Bay Area Air Quality Management District (BAAQMD) Regulation 12, Rule 15 (Rule 12-15) data quality parameters. This SOP applies to all instrumentation in operation at MRC. The SOP describes the methods used to check data in real-time, verify detections above threshold levels, verify monthly and quarterly calibration checks that meet BAAQMD threshold levels, and the data validation procedure for data included in the quarterly report submitted to the BAAQMD. If a data flag generated by Argos software occurs that indicates a potential performance issue, a message is sent to the on-call support team to evaluate the issue and perform corrective actions as needed. DVC flags can be generated by the instrument software itself, ensuring the instrument is operating according to manufacturer requirements, or by comparing data to reference equipment operated by the BAAQMD as well as evaluating the data for external events such as weather-related issues. Data transfer procedures are covered in MSOP-001-SOC, calibration procedures are covered in MSOP-003-SCC and operation and maintenance procedures are covered in MSOP-004-OAM.

2.0 - Summary of Method

Data produced by the fence line monitoring system is designed to meet all of the quality assurance requirements as presented in BAAQMD Rule 12-15. To achieve this goal, data undergoes validity checks. Data is checked as described in Table 4.1 of the latest version of the Quality Assurance Project Plan for the Martinez Refining Company Fence-Line Monitoring Program (QAPP for MRC) to ensure data reported to the real-time community website is as accurate as possible. Data produced during gas challenges as described in MSOP-003-SCC is analyzed and reviewed to ensure the results meet specific BAAQMD performance criteria for percent error and relative standard deviation. Data is reviewed monthly to ensure it is compliant with BAAQMD quarterly performance criteria. The specific DVCs for the air monitoring systems at MRC are provided in Section 9 for each specific instrument with MQOs provided in the latest version of the QAPP for MRC.

3.0 - Definitions

Open-path UV DOAS

Correlation Coefficient (R^2) – The statistical measure of the strength of a linear relationship between the absorbance spectra and the quantitative reference spectra for a specific gas.

[redacted]

Open-path TDL

Chi-Square Statistic - A test that measures how a model compares to actual observed data.

[redacted]

Extractive FTIR

[redacted]

4.0 - Health & Safety Warnings

If a field technician is dispatched to the field location, they should follow all the required safety protocols required by the client. This includes all site-specific training as required by the Occupational Safety Council of America and general site-specific training requirements. In addition, before a field technician goes on-site, a job safety analysis will be performed. This will include a site-specific walk-through of the tasks to be performed so specific hazards can be identified and mitigated.

5.0 – Cautions

Site specific cautions will be included in the job safety analysis.

6.0 – Interferences

There are no specific interferences associated with this SOP.

7.0 - Personnel Qualifications/Responsibilities

Complete job descriptions are available from Argos Scientific. General items are provided below and are also described in the latest version of the QAPP for MRC.

Field Technicians / Contract Technicians

It is the responsibility of all Field Technicians/Contract Technicians to visit sites when needed to assist in troubleshooting issues and performing corrective actions or quality control/quality assurance (QA/QC) checks. Appropriate refinery staff will be notified prior to entering the refinery.

- Qualification of field technicians include refinery-specific training provided by accredited training agencies. Instrument specific training is provided by the technical experts who have undergone vendor-specific training for each analyser or are recognized experts in the operation and maintenance of that equipment. The Training Coordinator will document and verify staff have successfully completed the training.

On-call Technician

It is the responsibility of these staff to respond to any notification provided by the real-time monitoring software regarding equipment malfunctions and begin the process of troubleshooting the issue.

- Qualification of the On-call Technician include specific training on how to remotely connect to affected sites and the basics of computer and instrument operation necessary to troubleshoot and address issues that can be corrected remotely.

Data Analyst – Analyzes data to ensure data quality objectives are met by reviewing data on a periodic basis to ensure all data related flags are addressed, validating detection of gases above predetermined action thresholds. remotely performing calibration checks of instruments described in MSOP-003-SCC and performing final validation of field data or getting guidance on issues from technical experts on specific instrumentation data validation.

- Qualification of the Data Analyst include graduation with a degree in data analysis or similar field and training in the specifics of data management and analysis of equipment in use at MRC.

Senior Data Analyst – Reviews program elements to ensure AMP, SOPs, and QAPPs are being followed by reviewing activities to ensure all elements of program are being followed and assisting in the annual audit of programs.

- Qualification of the Senior Data Analyst includes the same as the Data Analyst plus at least four years of experience working with data generated by air monitoring equipment and EPA data quality expectations and guidance.

Subject Matter Expert – Investigates instances where the data analysist, based on training and experience, is unable to determine data validity and provides input on issues that may be causing instrument issues.

- Qualifications of the Subject Matter Expert include at least 10 years of open path monitoring experience as well as specific training and education in the data generation and operation of all equipment employed at MRC. This may be accomplished either by going through extensive vendor specific training on all operational aspects of the specific equipment or extensive knowledge and experience.

Director of Quality Assurance – Ensures contractor reporting requirements of the QAPP are met and reviews all data on at least a quarterly basis. Ensures that documents associated with the QAPP are controlled by managing and reviewing routine reports and filings, reviewing storing, distributing, tracking and archiving company documents, distributing controlled files to MRC as required in the QAPP, managing paper files and ensuring adherence to deadlines.

- Qualifications of the Director of Quality Assurance includea combination of education with at least four years of direct experience with open-path technologies

8.0 - Equipment and Supplies

Equipment and supplies associated with the activity will be specified in the work order that will be issued for each specific activity.

9.0 - Procedure

The procedures for each of the data validation checks listed below for each instrument will be addressed. If at any time a data validation check fails to meet its threshold validation criteria in Table 4.1 of the latest version of the QAPP for MRC, a work order will be initiated and sent to the Director of Quality Assurance who implements the troubleshooting and corrective action steps included in the work order.

9.1 Real-Time Data Quality Checks

For all instruments at MRC, the Data Analyst will be notified by email if data related flags have been generated by Argos system software. If the measured value produced by the instrument is above the manufacturer's specified quantification capability for a gas but fails to meet the data quantification flags provided in Table 4.1 of the latest version of the QAPP for MRC, it is considered a qualitative detect and the data is flagged for further review by an Argos Data Analyst.

All data that is not flagged as described in the latest version of the QAPP for MRC is considered valid but will undergo a further review by the Data Analyst, Senior Data Analyst and Director of Quality Assurance to ensure validity. All action taken on data will be documented with the reason for the decision based on operational parameters of the instrument or input from a Subject Matter Expert for that specific instrumentation. The name of the decision maker will be recorded along with the date of the action.

Flags generated by Argos software are described in Table 4.1 of the latest version of the QAPP for MRC provide the data review staff (Data Analyst, Senior Data Analyst and Director of Quality Assurance) with defined parameters which must be met for the data to be considered valid, however, the data review staff will use additional information such as raw spectral data and instrument operational and environmental factors to aid in the determination of validity for the specific instrument. The data review staff will use professional judgment and experience based on the flags and additional information to make validity decisions. If the data review staff is unable to justify the invalidation of that data, he/she will consult with a Subject Matter Expert who will make that determination and document that decision as described above.

Data is first reviewed by a Data Analyst on a daily basis with specific attention to data flags generated by Argos software. Data is then reviewed by the Senior Data Analyst on a weekly basis to ensure all QAPP requirements are met, data invalidation is soundly based and properly documented. The Director of Quality Assurance will also review all data on a monthly basis to ensure all QAPP requirements are met, data invalidation is soundly based and properly documented.

This process is provided in the below flow diagram in Appendix A.

9.2 Daily Validation Checks of Recorded Data

Checks are made on the data by an Argos Data Analyst on a daily basis. The aim of the analysis is to:

- Assess if possible weather-related effects occurred.
- Review and validate any possible detections.
- Evaluate invalid data that has failed the real-time check above and is marked for further review and validation as described in the Sections below.

Once the dataset has been through this process it is uploaded to a validated data database that is used for reporting. It should be noted that raw data is not adjusted. All changes made between the raw and validated datasets are logged in a daily/weekly validation report and the process review documented.

[redacted]

The following elements are evaluated by the Data Analyst to determine validity of a data point for each open path system.

Open-path TDL Air Monitoring System

The daily data validity checks for the open-path TDL air monitoring system include the following:

[redacted]

Open-path UV Air Monitoring System

The daily data validity checks for the open-path UV DOAS air monitoring system include the following:

[redacted]

Extractive FTIR Air Monitoring System

The daily data validity checks for the extractive FTIR air monitoring system include the checks:

[redacted]

Organic Gas Detector

The real-time daily validity checks for the Organic Gas Detector include the following data checks:

[redacted]

9.3 – Weekly Data Checks

Data is reviewed by an Argos Senior Data Analyst staff member to ensure all the above processes have been followed. This check ensures all data validity checks have been followed and documented. All data invalidation is reviewed to determine if appropriate action has been taken. If it is determined that additional action is required, the Senior Data Analyst will consult with the Subject Matter Expert about the specific equipment, as needed, and report to management if any action needs to be taken to improve data quality.

The monthly checks for the air monitoring systems data checks include the following:

[redacted]

[redacted]

9.4 – Monthly Data Checks

Data is reviewed by the Director of Quality Assurance to ensure all work processes have been followed and is finalized for inclusion in the quarterly reporting format that is required by the BAAQMD. The data to be checked review includes the following:

- Performance of each instrument against the onstream efficiency requirement of 90% calculated according to the BAAQMD reporting procedure.
- Data on monthly bump tests.
- Data on quarterly calibrations (if applicable).
- Description of corrections made to data due to QA.
- Five-minute average data in the format prescribed by the BAAQMD.
- Hourly completeness data in the format prescribed by the BAAQMD.

The final quarterly report is generated and then sent to Project Management staff who then issue the report to the client.

[redacted]

10.0 - Instrument or Method Calibration and Standardization

There is no specific method of calibration and standardization for this procedure.

11.0 - Sample Collection

There are no specific sample collection activities for this procedure.

12.0 - Sample Handling and Preservation

There are no specific sampling and preservation requirements for this procedure.

13.0 - Sample Preparation and Analysis

There are no specific sample preparation and analysis requirements for this procedure.

14.0 – Troubleshooting

See Section 9.0 for specific troubleshooting requirements.

15.0 - Data Acquisition, Calculations, & Data Reduction Requirements

Specific data acquisition, calculations and data reduction protocols for the raw data are found in the operations guide for each of the specific analyzers.

16.0 - Computer Hardware & Software

No specific hardware or software requirements are associated with this SOP.

17.0 Data and Records Management

Records of data flagging, reviews, and other related actions will be consistently stored as additional databases, with rationale for data changes/actions documented with associated data including which staff member made those changes and on what date.

18.0 - Quality Control and Quality Assurance Section

After the field portion of the activity is completed, the Senior Operations Manager will generate a written report. The draft of the written report is first peer-reviewed for technical content by the Subject Matter Expert or by a member of the operations staff. The final report has been completed and transmitted to the Program Manager.

19.0 - Reference Section

Latest version of the QAPP for MRC
Latest version of SOPs for MRC

Appendix A Process Flow Diagrams for Data Validation

Open-path UV DOAS Data Validation Checks

Flag 10 - Light Signal Low

[redacted]

Flag 11 – Light Signal High

[redacted]

Code 22 - Data Detect Qualitative

[redacted]

Code 23 – Background Validity Flag

[redacted]

Code 40 – Ozone Comparison Flag

[redacted]

Open-path TDL Data Validation Checks

Flag 10 - Light Signal Low

[redacted]

Code 22 - Data Detect Qualitative

[redacted]

Code 24 - Real-Time LoQ Invalid

[redacted]

Code 41 – Relative Humidity Comparison Flag

[redacted]

Code 42 – Methane Concentration Check Flag

[redacted]

Extractive FTIR Data Validation Checks

Flag 10 - Light Signal Low

[redacted]

Flag 11 - Light Signal High

[redacted]

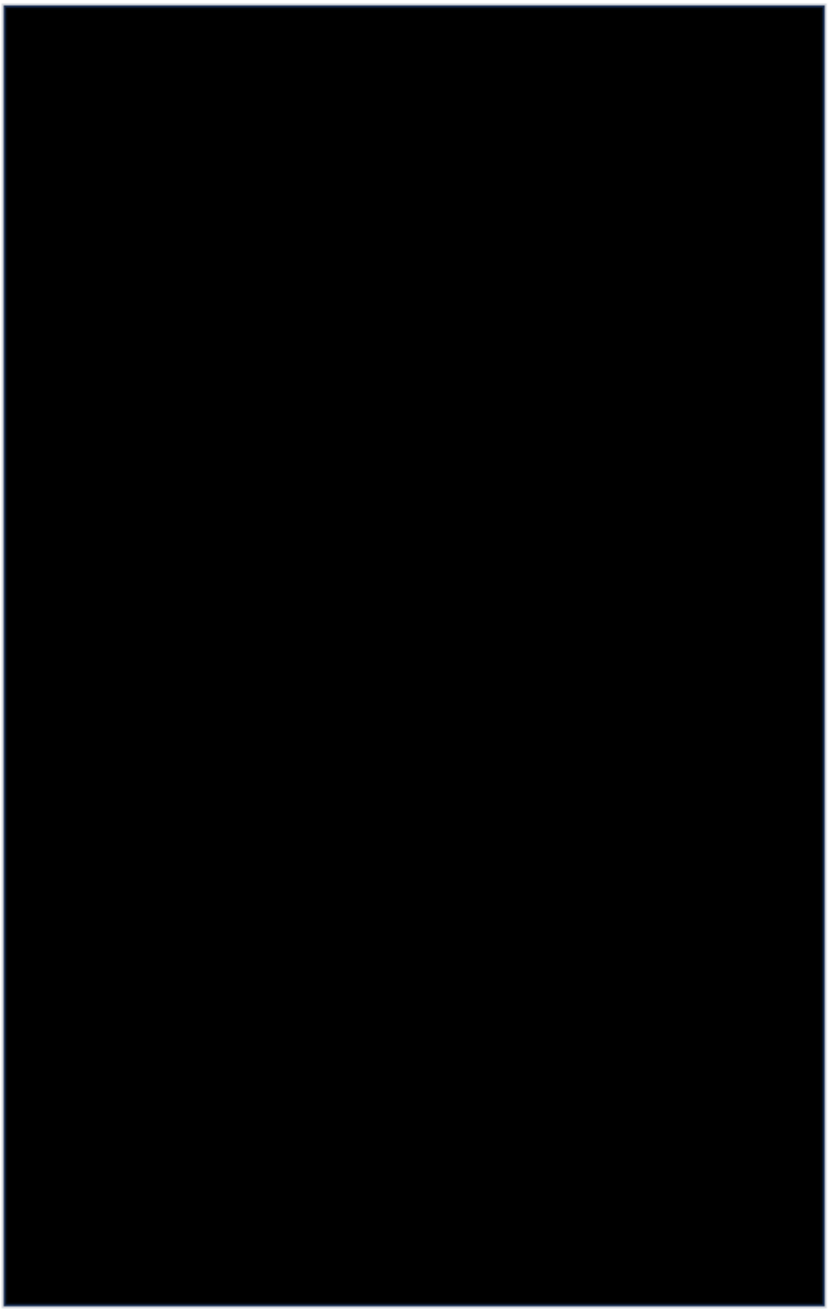
Code 22 - Data Detect Qualitative

[redacted]

Code 30 – FTIR Dropped Scans

[redacted]

Code 41 – Relative Humidity Comparison Flag



Code 42 – Methane Concentration Check Flag

[redacted]

Master Standard Operation Procedure (MSOP)-003-SCC

System Challenges of Air Monitoring Systems

Contents

1.0 - SOP Description:

The purpose of the system challenge is to verify the air monitor systems can meet the Bay Area Air Quality Management District (BAAQMD) Quality System Program calibration and "bump test" (system challenge checks) requirements including TDL requirements stated in the letter dated December 22, 2023. That letter states the following:

"For reference, the minimum detection limit (MDL) of a measurement process is defined as the lowest concentration of the analyte that can be reliably detected (i.e., distinguished from zero), and the LOQ is the lowest concentration at which the analyte can not only be reliably detected but at which predefined goals for accuracy and precision (relative standard deviation) are met. The accuracy and precision (relative standard deviation) specifications of 15% must be met at each calibration point. Failure to meet these specifications must trigger repair, maintenance, and root cause analysis, followed by repeat calibration checks until a passing calibration check is completed."

Based on this guidance, flags for data and Quality Assurance/Quality Control are presented in Table 4.1 of latest version of the Quality Assurance Project Plan for the Martinez Refining Company Fence-Line Monitoring Program (QAPP for MRC). In addition to the specific checks, the procedures for performing repair, maintenance, and root cause analysis are included in the Appendix of this document.

This SOP applies to all instrumentation in operation at MRC. Argos Data Analysts coordinate system challenge checks (SCCs) in coordination with Field Technicians at the refinery if the instrument does not have remote system challenge capabilities. The Data Analyst determines if the insertion of calibration gas(es) meets the requirements of percent error and relative standard deviation requirements contained in Table 4.1 of the latest version of the latest version of the QAPP for MRC. During calibration and bump testing data are flagged to identify those data points within the cloud-based database and exclude them from being displayed on the real-time website along with a note on the message board that calibration is being performed. Data collection and transfer procedures are covered in MSOP-001-SOC, data validation procedures are covered in MSOP-002-DVC and operation and maintenance procedures are covered in MSOP-004-OAM.

Appendix A presents the specific process flow associated with each data flag.

2.0 - Summary of Method

The fence line monitoring systems are designed to have known concentrations of gas inserted in the same path as ambient air sampled in real time. This method ensures that system challenges represent the same conditions as measurement of ambient air. The specific methods for inserting the target gases are included in the Operations Manuals for each specific analyzer. Once a gas is inserted into the analyzer, data is collected which is then analyzed using various statistical analysis techniques by an Argos Data Analyst. The results of the analysis are recorded in a data summary report. If all the checks meet the requirements specified in the latest version of QAPP for MRC, then the system will be put back into operation. If any of the data checks are not met, then repair, maintenance, and root cause analysis, followed by repeat calibration checks occur until a passing calibration check is completed. The Data Analyst then reviews all data generated since the last data challenge to determine the validity of that data, or if that data needs to be adjusted. The Data Analyst may engage the Subject Matter Expert of the specific instrument to assist in this assessment. Any changes to the data are noted in the appropriate database with the name, date and rationale for the changes. All original generated data remains in a separate database and is unchanged.

3.0 - Definition

Non-conformance - Non-fulfilment of a requirement.

Requirement - A need or expectation that is stated, generally implied, or obligatory.

Correction - Action taken to eliminate a detected non-conformity.

Corrective Action - Action taken to eliminate the cause of a detected non-conformance or other undesirable situation in the management system or process, to prevent recurrence.

Management Team - Includes the Managing Director, Manager and General Managers or authorized designates.

Root Cause analysis - A root cause analysis is conducted to determine the real cause (not symptoms or explanations) of non-conformities. The root cause is the reason why a problem started in the first place.

4.0 - Health & Safety Warnings

If a field technician is dispatched to field perform system calibration or bump checks, they should follow all required safety protocols specified by the client. This includes all site-specific training as required by the Occupational Safety Council of America and general site-specific training requirements. In addition, before a field technician goes on-site, a job safety analysis will be performed. This will include a site-specific walk-through of the tasks to be performed so specific hazards can be identified and mitigated.

5.0 – Cautions

Site specific cautions will be included in the job safety analysis provided to all technicians who enter the refinery and are kept in the individuals training files.

6.0 – Interferences

There are no specific interferences associated with this SOP.

7.0 - Personnel Qualifications/Responsibilities

Complete job descriptions are available from Argos Scientific. General items are provided below and are also described in the latest version of the QAPP for MRC.

Field Technicians / Contract Technicians

It is the responsibility of all Technicians/Contract Technicians to visit sites when needed to assist in system challenges, where necessary, troubleshooting issues and performing corrective actions. Appropriate refinery staff will be notified prior to entering the refinery.

- Qualification of field technicians include refinery-specific training provided by accredited training agencies. Instrument specific training is provided by the subject matter experts who have undergone vendor-specific training for each analyser or are recognized experts in the operation and maintenance of that equipment. The Training Coordinator will document and verify staff have successfully completed the training.

Data Analyst – Analyzes data to ensure data quality objectives are met by reviewing data on a periodic basis to ensure all data related flags are addressed, validating detection of gases above predetermined action thresholds. remotely performing calibration checks of instruments described in this MSOP and performing final validation of field data or getting guidance on issues from technical experts on specific instrumentation data validation.

- Qualification of the Data Analyst includes graduation with a degree in data analysis or similar field and training in the specifics of data management and analysis of equipment in use at MRC.

Senior Data Analyst – Reviews program elements to ensure AMP, SOPs, and QAPPs are being followed by reviewing activities to ensure all elements of program are being followed and assisting in the annual audit of programs.

- Qualification of the Senior Data Analyst includes the same as the Data Analyst plus at least four years of experience working with data generated by air monitoring equipment and EPA data quality expectations and guidance.

Subject Matter Expert – Investigates instances where the data analysist, based on training and experience, is unable to determine data validity and provides input on issues that may be causing instrument issues.

- Qualification of the Subject Matter Expert include at least 10 years of open path monitoring experience as well as specific training and education on the data generation and operation of all equipment employed at MRC. This may be accomplished either by going through extensive vendor specific training on all operational aspects of the specific equipment or extensive knowledge and experience.

Senior Manager Reporting– Ensures contractor reporting requirements of the QAPP are met and reviews all data on at least a quarterly basis. Ensures that documents associated with the QAPP are controlled by managing and reviewing routine reports and filings, reviewing storing, distributing, tracking and archiving company documents, distributing controlled files to MRC as required in the QAPP, managing paper files and ensuring adherence to deadlines.

- Qualification of the Senior Manager Reporting include a combination of education with at least four years of direct experience with open-path technologies

8.0 - Equipment and Supplies

Equipment and supplies associated with the activity are addressed in the instrument specific operations manuals.

9.0 - Procedure

9.1 Description of Procedure

This procedure outlines the processes used to determine the Limits of Quantification for the TDL, the calculation of relative standard deviation, the calculation of percent error, and the measurement linearity for the analyzers associated with the fence line air monitoring network. The specific steps associated with inserting the gas into the analyzer are included in the operational manuals associated with each instrument. Once the data is collected, it is then analyzed using the procedures listed in this section. If at any time a system challenge check fails to meet its threshold validation criteria in Table 4.1 of the latest version of the QAPP, a work order will be initiated and sent to the data manager who implements the troubleshooting and corrective action steps included in the work order. In addition, all data generated since the last data challenged will be reviewed as described above and adjusted, if possible, or invalidated, if warranted.

9.2 Data Analysis of Air Monitoring Systems

Table 9.2 presents the specific gas concentration ranges for monthly bump checks and quarterly calibrations checks as all systems at MRC for the specific instruments being challenged.

Check Type	Frequency	Concentration Low (ppb)	Concentration High (ppb)
Open Path UV-DOAS			
Bump Check	Monthly	10	30
Calibration Low	Quarterly	10	30
Calibration Mid	Quarterly	100	150
Calibration High	Quarterly	300	400
Open Path FTIR			
Bump Check	Monthly	400	600
Calibration Low	Quarterly	400	600
Calibration Mid	Quarterly	1900	2200
Calibration High	Quarterly	4800	5200
Open Path TDL			
Bump Check	Monthly	60	100
Calibration Low	Quarterly	40	60
Calibration Mid	Quarterly	250	360
Calibration High	Quarterly	725	900

Organic Gas Detector Point Source Monitor			
Bump Check	Monthly	900	1100
Calibration Low	Quarterly	900	1100
Calibration Mid	Quarterly	4500	5500
Calibration High	Quarterly	9000	11000

9.2.1 Collection of Data

The specific steps associated with the system challenges for all air monitoring systems.

9.2.1.1 Open-path TDL

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

9.2.1.2 Open-path UV DOAS

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

- If the system is undergoing a bump check, and the Data Analyst confirms that the system challenge has passed, the instrument is put back in data mode, the system is put back on-line and the message board on the real-time website is updated to reflect that no calibration activities are taking place.

- If the Data Analyst determines that the system challenges or bump test did not pass, a work order is generated, causal analysis is performed, the instrument is repaired or replaced, and a passing system test is completed.

9.2.1.3 Extractive FTIR

- The field technician puts the instrument in calibration mode which then stops the data being collected from being reported to the website. A notation will be placed on the message board of the real-time website that system challenges are being performed. Data will also be flagged and sent to the remote database as being calibration data.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

- [redacted] undergoing a bump check, and the Data Analyst confirms that the system challenge has passed, the instrument is put back in data mode, the system is put back on-line and the message board on the real-time website is updated to reflect that no calibration activities are taking place.

- If the Data Analyst determines that the system challenges or bump test did not pass, a work order is generated, causal analysis is performed, the instrument is repaired or replaced, and a passing system test is completed.

9.2.1.4 Organic Gas Detector

- The field technician puts the instrument in calibration mode which then stops the data being collected from being reported to the website. A notation will be placed on the message board of the real-time website that system challenges are being performed. Data will also be flagged and sent to the remote database as being calibration data.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

- If the system is undergoing a bump check, and the Data Analyst confirms that the system challenge has passed, the instrument is put back in data mode, the system is put back on-line and the message board on the real-time website is updated to reflect that no calibration activities are taking place.

- If the Data Analyst determines that the system challenges or bump test did not pass, a work order is generated, causal analysis is performed, the instrument is repaired or replaced, and a passing system test is completed.

9.2.2 Generation of Statistical Analysis of Data

The specific steps for analyzing the data collected during the gas challenges are as follows:

[redacted]

[redacted]

[redacted]

- For the TDL, the Limits of Quantification are determined by taking the lowest standard deviation of 26 consecutive one-second measurements generated by the instrument during the background collection period and multiply the result by a factor of 10. For all other instruments, the LoQ is determined by the manufacturer, but this method can be used to ensure that the LoQ meets the manufacturer's requirements.
- The relative standard deviation and percent error are determined by taking the lowest combined percentage of error and relative standard deviation for 26 consecutive raw measurements of gas collected during the gas insertion.
- System linearity is calculated by inputting the average concentrations included in the relative standard deviation and accuracy calculations and inputting this information into the data worksheet.

9.2.3 Review and Analysis of Data

Upon completion of Data Analysis of the data, the data analyst will perform the following tasks:

- If all the data quality parameters are met, the data analysts will consolidate the data into a report that will be compliant with BAAQMD Regulation 12, Rule 15 (Rule 12-15) reporting requirements for bump and calibration checks.

- If any of the data quality parameters are not met, the data analyst will begin the corrective action process to determine the root cause of the issue and the implementation of corrective actions. The corrective action procedure is included as an appendix to this MSOP.

The report will be reviewed by the Senior Data Analyst to ensure all procedures, calculations and documentation were performed in accordance with this MSOP and BAAQMD requirements.

10.0 - Instrument or Method Calibration and Standardization

All gases used to challenge the system will include calibration certificates from the gas supplier that state the gases are NIST Traceable, the measured concentration of the gas and the measurement error associated with the analysis.

11.0 - Sample Collection

Sample collection follows the specific data collection procedures listed in the instrument specific user manuals for each technology.

12.0 - Sample Handling and Preservation

There are no specific sampling and preservation requirements for this procedure.

13.0 - Sample Preparation and Analysis

There are no specific sample preparation and analysis requirements for this procedure.

14.0 – Troubleshooting

See Section 9.0 for specific troubleshooting requirements.

15.0 - Data Acquisition, Calculations, & Data Reduction Requirements

The following equations are used to define the specific formulas used to calculate the relative standard deviation (precision), percent error (accuracy), and linearity of data sets. Specific examples of deriving these equations using Microsoft Excel are included in the appendix of this document.

15.1 Measurement Standard Deviation:

The standard deviation (σ) of a measurement set is defined by the following equation:

$$\sigma = \sqrt{\frac{\sum (x - \overline{x})^2}{n - 1}}$$

where:

x = average reported concentration from the measurement set

x = concentration reported in individual absorbance spectrum

n = number of data points

15.2 Measurement Relative Standard Deviation

Relative Standard Deviation (RSD), also known as the coefficient of variation, is a statistical measure that is used to quantify the relative standard deviation and repeatability of a set of measurements or values. It is expressed as a percentage and is calculated by dividing the standard deviation by the mean (average) of the data set, and then multiplying by 100. The relative standard deviation is given by the following formula:

$$RSD = \left|\frac{\sigma}{\overline{T}}\right| \cdot 100$$

Where RSD is the Relative Standard Deviation

σ is the measurement standard deviation

$\overline{T}$ = the average value of the measurements

15.3 Measurement Accuracy

Measurement accuracy of the data set will be evaluated for target gases by inserting a calibration gas into the beam path with a known concentration of a target gas and comparing the calibration gas concentration to the concentration measured by the monitor. The relative accuracy (A) of the monitor with respect to the reference gas is assessed using the following formula:

$$A = \frac{|\overline{R} - \overline{T}|}{\overline{R}} \cdot 100$$

Where:

A = accuracy of each measurement

$\overline{R}$ = the average value of the reference gas

$\overline{T}$ = the average value of the measurements

15.4 Measurement Linearity

The linearity of a set of measurements refers to how well they can be fitted to a straight line. In other words, it's a measure of how linear the relationship is between two variables. The most common method to quantify linearity is through linear regression analysis, particularly using the Pearson Correlation Coefficient for linear relationships.

The response of an instrument may not be linear over its entire measurement range, where if not corrected, could result in data bias. Changes to the linearity of an instrument over time may be indicative of deteriorating performance and will be reviewed on at least a quarterly basis, and if changes to the Pearson Correlation

Coefficient by more than 20% will result in a Causal Analysis and Corrective Action to be performed (Appendix C of the QAPP for MRC)

The Pearson Correlation Coefficient (often denoted as r) is a measure of the linear correlation between two variables X and Y. Its value ranges from -1 to 1, where:

- 1 indicates a perfect positive linear relationship,
- -1 indicates a perfect negative linear relationship,
- 0 indicates no linear relationship.

The formula to calculate the Pearson Correlation Coefficient is:

$$r = \frac{\sum(X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum(X_i - \bar{X})^2 \sum(Y_i - \bar{Y})^2}}$$

Where:

- X_i and Y_i are individual sample points,
- $\bar{X}$ is the mean of the X values,
- $\bar{Y}$ is the mean of the Y values.

This formula essentially measures the degree of linear relationship between the two variables. A high absolute value of r indicates a strong linear relationship, while a value close to zero suggests a weak linear relationship. R is then squared to provide a positive number to determine compliance with the QAPP.

Another way to assess linearity is to use a linearity plot. This involves plotting the measured variable against the known values (standards), and then calculating the best fit line, typically using least squares regression. The degree of deviation from this line is used to assess the linearity of the measurements.

This will also be performed at least annually and used to correct data based on the linearity curve.

16.0 - Computer Hardware & Software

Hardware or software requirements associated with this MSOP are contained in the instrument specific operations manuals.

17.0 Data and Records Management

A data summary report will be provided by the data analyst. The report will document the specific results of the calibration and system challenge activities.

.

18.0 - Quality Control and Quality Assurance Section

After the field portion of the activity is completed, the Technical Manager will generate a written report. The draft of the written report is first peer-reviewed for technical content by the Team Leader or by a member of the operations staff. The final report is completed and transmitted to the Document Control Officer.

19.0 - Reference Section

- Argos Scientific Operations Manual for Open-path Air Monitoring System
- Environmental Technology Verification Program (Advanced Monitoring Systems Pilot) – Test/QA Plan for Verification of Optical Open Path Monitors

[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]		

Appendix A – Process Flow Diagrams for Data Flags

Figures A1 through A8 present the process flow diagrams for each of the status flags associated with the system challenges using known concentrations of gas.

Figure A-1 - Flags 70 or 74 – Relative standard deviation Passed for Monthly or Quarterly Calibration Check

[redacted]

Figure A-2 - Flags 71 or 75 – Relative standard deviation Passed for Monthly or Quarterly Calibration Check

[redacted]

Figure A-3 - Flags 80 or 84 – Accuracy Passed for Monthly or Quarterly Calibration Check

[redacted]

Figure A-4 - Flags 81 or 85 – Accuracy Failed for Monthly or Quarterly Calibration Check

[redacted]

Appendix B – Measurement Statistics Using Microsoft Excel

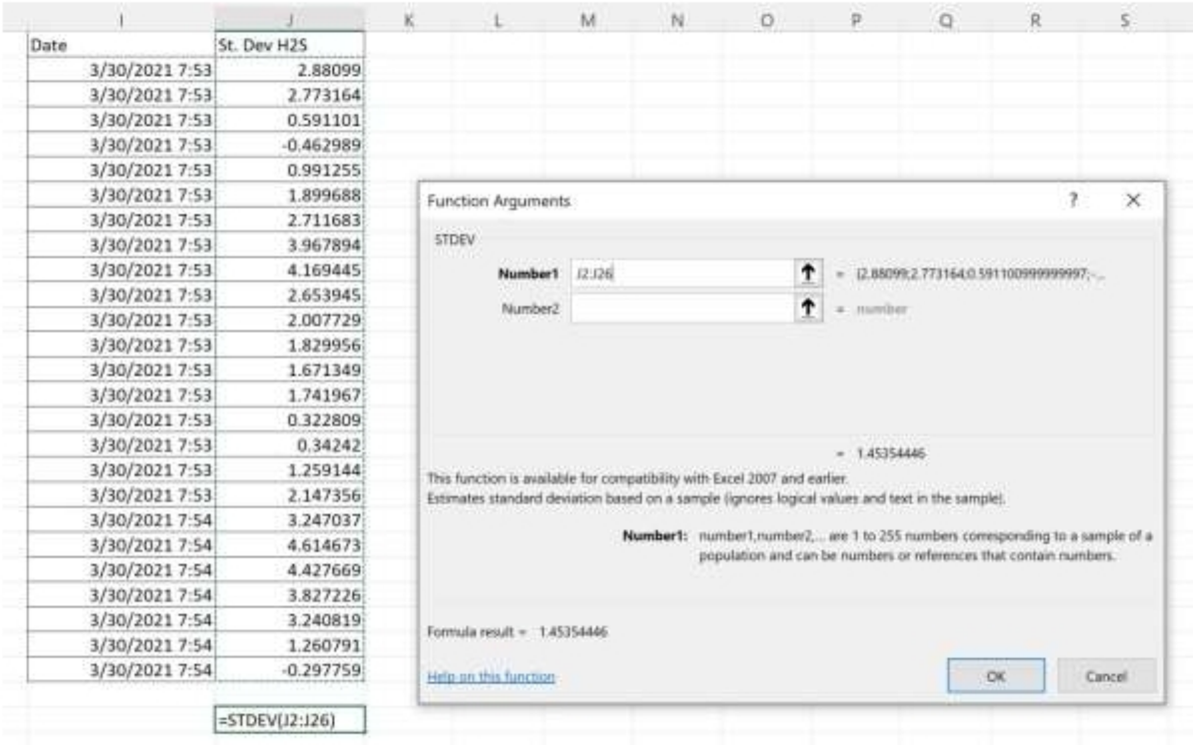
Calculating the Standard Deviation of a Measurement Set in Excel

In Excel insert the data into a column

Choose 26 consecutive data points from the desired time period.

Date	H2S
3/30/2021 7:53	2.88099
3/30/2021 7:53	2.773164
3/30/2021 7:53	0.591101
3/30/2021 7:53	-0.46299
3/30/2021 7:53	0.991255
3/30/2021 7:53	1.899688
3/30/2021 7:53	2.711683
3/30/2021 7:53	3.967894
3/30/2021 7:53	4.169445
3/30/2021 7:53	2.653945
3/30/2021 7:53	2.007729
3/30/2021 7:53	1.829956
3/30/2021 7:53	1.671349
3/30/2021 7:53	1.741967
3/30/2021 7:53	0.322809
3/30/2021 7:53	0.34242
3/30/2021 7:53	1.259144
3/30/2021 7:53	2.147356
3/30/2021 7:54	3.247037
3/30/2021 7:54	4.614673
3/30/2021 7:54	4.427669
3/30/2021 7:54	3.827226
3/30/2021 7:54	3.240819
3/30/2021 7:54	1.260791
3/30/2021 7:54	-0.29776
3/30/2021 7:54	-0.06576

Highlight the specific measurement set to be analyzed and using the Standard Deviation (STDEV) function in EXCEL, calculate the standard deviation of the measurement set.

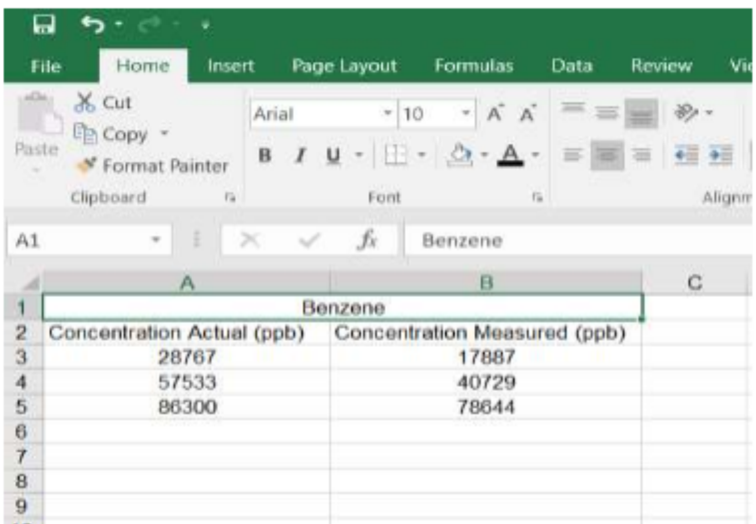


I	J
Date	St. Dev H2S
3/30/2021 7:53	2.88099
3/30/2021 7:53	2.773164
3/30/2021 7:53	0.591101
3/30/2021 7:53	-0.462989
3/30/2021 7:53	0.991255
3/30/2021 7:53	1.899688
3/30/2021 7:53	2.711683
3/30/2021 7:53	3.967894
3/30/2021 7:53	4.169445
3/30/2021 7:53	2.653945
3/30/2021 7:53	2.007729
3/30/2021 7:53	1.829956
3/30/2021 7:53	1.671349
3/30/2021 7:53	1.741967
3/30/2021 7:53	0.322809
3/30/2021 7:53	0.34242
3/30/2021 7:53	1.259144
3/30/2021 7:53	2.147356
3/30/2021 7:54	3.247037
3/30/2021 7:54	4.614673
3/30/2021 7:54	4.427669
3/30/2021 7:54	3.827226
3/30/2021 7:54	3.240819
3/30/2021 7:54	1.260791
3/30/2021 7:54	-0.297759
	=STDEV(J2:J26)

Calculating Measurement Linearity in Microsoft Excel

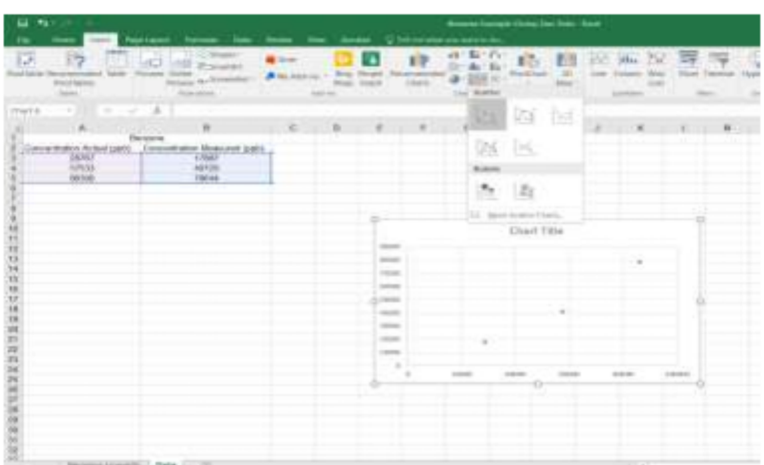
This procedure specifically refers to the linearity of the monitor for a specific target gas over a range of concentrations. Determining the concentration linearity of the instrument requires challenging the monitor with at least three varying concentrations of the target gas. At each of these concentrations, a measurement of the target gas concentration is made using standard analytical software. The results of each measured quantity are plotted against the known concentration values on a scatterplot. A linear regression or best fit calculation is performed for the resulting line. A corresponding correlation coefficient (R^2) is calculated which measures how close the data are to the straight or fitted line. The concentration linearity of the instruments should be archived and used for comparison purposes. An instrument's linearity should not be statistically significantly different from prior checks and should not vary in a systematic way over time.

In a new Excel worksheet, create two columns, one for the actual c1, c2, and c3 cell concentrations and one for the measured results. By default, Excel will plot the column to the left on the x-axis (independent variable), and the column to the right on the y-axis (dependent variable).

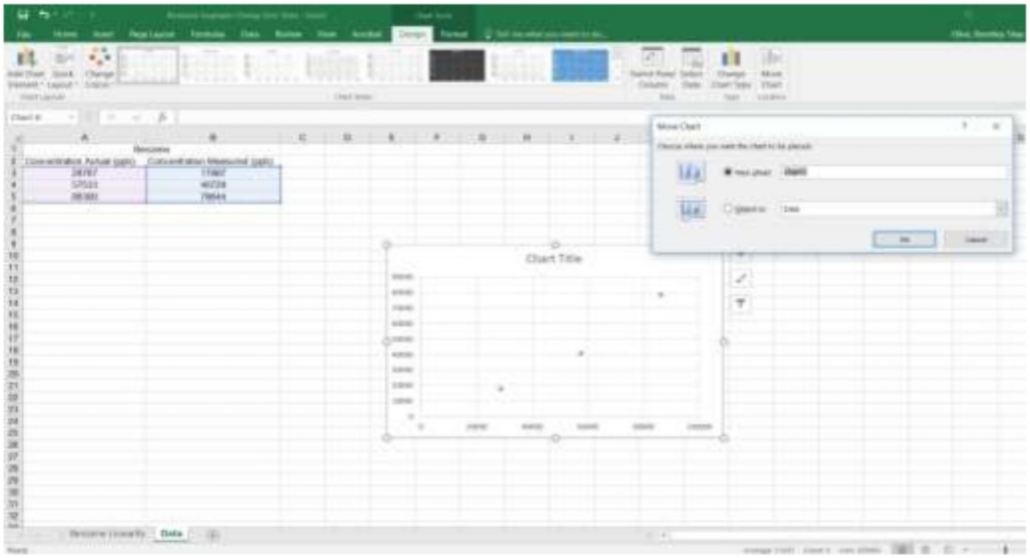


	A	B
1	Benzene	
2	Concentration Actual (ppb)	Concentration Measured (ppb)
3	28767	17887
4	57533	40729
5	86300	78644

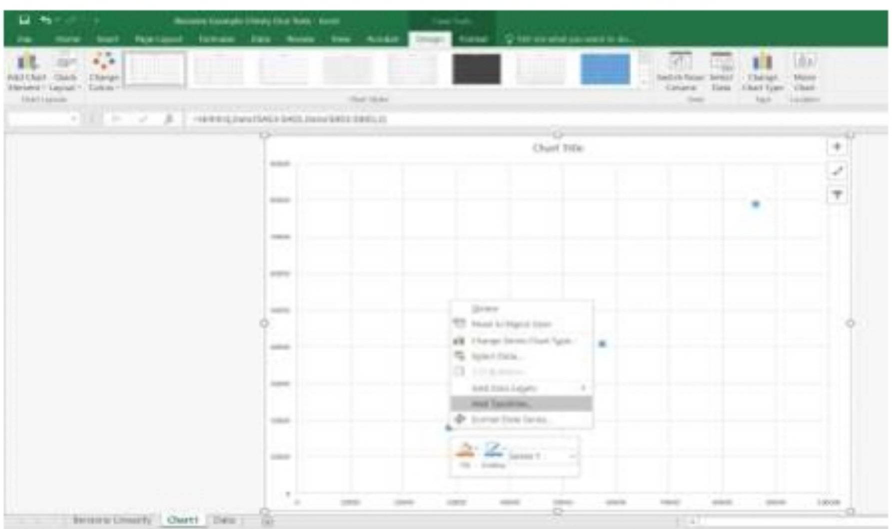
Highlight the two columns and choose "Insert", "Scatter".



A scatterplot will be inserted into the active spreadsheet tab. If desired, the newly created graph can be selected, and by clicking "Move Chart", the graph will be moved to a new tab and enlarged.



Right click on any of the plotted points and select "Add Trendline".



An option bar will appear on the right-hand side of the screen. If not selected by default, select "linear" from the list of options, and check the box for "Display R-squared value on chart". An R-squared value of 1 equates to a perfect linear correlation. In general, values at or above 0.9 are desirable when a linear instrument response is assumed to be the case. The PLS software can compensate for non-linear instrument responses at higher concentrations when reference spectra at corresponding concentrations are collected and entered into the algorithm.

1. Additional options can be selected such as displaying the straight-line equation.

on the chart, as well as adding axis titles, adjusting gridlines, and formatting the plot area by either double clicking or right-clicking on various options.

Record and archive the R-squared value for the specific concentration linearity check. Compare the results to previous checks to determine if there is a significant difference in instrument performance as compared to past linearity checks.

Appendix C - SOP: Corrective Action Procedure

Follow Appendix C - Required Procedures for Determining Failure Cause and Associated Corrective Action Procedures contained in the latest version of the Quality Assurance Project Plan for MRC

Appendix D – Data Generation Worksheets

- Insert data into the blue fields will automatically calculate the baseline offset, average, standard deviation, relative standard deviation, and accuracy for the last 26 data values.

[redacted]

Summary data from the data processing worksheet is presented in the Data Summary Worksheet

[redacted]

Master Standard Operation Procedure (MSOP)-004-OAM

Monitoring System Operation and Maintenance

Contents

1.0 - SOP Description:

The purpose of the document is to present the specific operation and maintenance procedures needed to maintain compliance with the fence line air monitoring system with Bay Area Air Quality Management District (BAAQMD) Regulation 12, Rule 15 (Rule 12-15) and manufacturer recommendation. The specific procedures used to perform these checks are shown in Table 1.and apply to all instruments at MRC. The MQO for operation and maintenance is to maintain compliance with all manufacturers' recommended operation and maintenance activities contained in the specific operational manuals supplied by the manufacturer. Data collection and transfer procedures are covered in MSOP-001-SOC, data validation procedures are covered in MSOP-002-DVC and system challenges used to document calibration are covered in MSOP-003-SCC. The specific operation and maintenance checks (OAMs) for the air monitoring systems are described in Table 4.1 of the latest version of the Quality Assurance Project Plan for the Martinez Refining Company Fence-Line Monitoring Program (QAPP for MRC).

2.0 - Summary of Method

Instrument operation, maintenance and repair interventions are carried out as required, guided by manufacturer's recommendations. In addition, specific ongoing assessments of instrument error signals and data trends are used to identify times when equipment maintenance is needed. Finally, preventive maintenance is conducted based on the schedules provided by the instrument manufacturer. Specific procedures associated with operation, maintenance, and repair of instruments are included in system specific operation manuals for each type of analyzer installed as part of the fence line air monitoring program.

3.0 - Definitions

Non-conformance - Non-fulfilment of a requirement.

Requirement - A need or expectation that is stated, generally implied, or obligatory.

Correction - Action taken to eliminate a detected non-conformity.

Corrective Action - Action taken to eliminate the cause of a detected non-conformance or other undesirable situation in the management system or process, so as to prevent recurrence.

Management Team - Includes the Managing Director, Manager and General Managers or authorized designates.

Root Cause analysis - A root cause analysis is conducted to determine the real cause (not symptoms or explanations) of non-conformities. The root cause is the reason why a problem started in the first place.

4.0 - Health & Safety Warnings

If a field technician is dispatched to the field to perform operation and maintenance activities, they should follow all the required safety protocols required by the client. This includes all site-specific training as required by the Occupational Safety Council of America and general site-specific training requirements. In addition, before a field technician goes on-site, a job safety analysis will be performed. This will include a site-specific walk-through of the tasks to be performed so specific hazards can be identified and mitigated.

5.0 – Cautions

Site specific cautions will be included in the job safety analysis provided to all technicians who enter the refinery and are kept in the individuals training files.

6.0 – Interferences

There are no specific interferences associated with this MSOP.

7.0 - Personnel Qualifications/Responsibilities

Complete job descriptions are available from Argos Scientific. General items are provided below and are also described in the latest version of the QAPP for MRC.

Field Technicians / Contract Technicians

It is the responsibility of all Technicians/Contract Technicians to visit sites when needed to assist in system challenges, where necessary, troubleshooting issues and performing corrective actions. Appropriate refinery staff will be notified prior to entering the refinery.

- Qualification of field technicians include refinery-specific training provided by accredited training agencies. Instrument specific training is provided by the technical experts who have undergone vendor-specific training for each analyser or are recognized experts in the operation and maintenance of that equipment. The Training Coordinator will document and verify staff have successfully completed the training.

On-call Technician

It is the responsibility of these staff to respond to any notification provided by the real-time monitoring software regarding equipment malfunctions and begin the process of troubleshooting the issue.

- Qualification of the On-call Technician include specific training on how to remotely connect to affected sites and the basics of computer and instrument operation necessary to troubleshoot and address issues that can be corrected remotely.

Data Analyst – Analyzes data to ensure data quality objectives are met by reviewing data on a periodic basis to ensure all data related flags are addressed, validating detection of gases above predetermined action thresholds. remotely performing calibration checks of instruments described in this MSOP and performing final validation of field data or getting guidance on issues from technical experts on specific instrumentation data validation.

- Qualification of the Data Analyst include graduation with a degree in data analysis or similar field and training in the specifics of data management and analysis of equipment in use at MRC.

Senior Data Analyst – Reviews program elements to ensure AMP, SOPs, and QAPPs are being followed by reviewing activities to ensure all elements of program are being followed and assisting in the annual audit of programs.

- Qualification of the Senior Data Analyst includes the same as the Data Analyst plus at least four years of experience working with data generated by air monitoring equipment and EPA data quality expectations and guidance.

Subject Matter Expert – Investigates instances where the data analysist, based on training and experience, is unable to determine data validity and provides input on issues that may be causing instrument issues.

- Qualifications of the Subject Matter Expert include at least 10 years of open path monitoring experience as well as specific training and education on the data generation and operation of all equipment employed at MRC. This may be accomplished either by going through vendor specific training or extensive knowledge and experience.

Senior Manager, Reporting – Ensures contractor reporting requirements of the QAPP are met and reviews all data on at least a quarterly basis. Ensures that documents associated with the QAPP are controlled by managing and reviewing routine reports and filings, reviewing storing, distributing, tracking and archiving company documents, distributing controlled files to MRC as required in the QAPP, managing paper files and ensuring adherence to deadlines.

- Qualification of the Senior Manager Reporting include a combination of education with at least four years of direct experience with open path technologies

8.0 - Equipment and Supplies

Equipment and supplies associated with the activity are addressed in the instrument specific operations manuals.

9.0 - Procedure

9.1 Description of Procedure

This procedure outlines the processes used to determine basic activities associated with the operations and maintenance of air monitoring systems. The specific steps associated with analyzer operation and maintenance are included in the operational manuals associated with each instrument. The sections below present the specific process used to perform operation and maintenance activities.

9.2 Operation and Maintenance Open-path TDL Air Monitoring System

A detailed description of the instrument specific tasks associated with the operation and maintenance of the AirOptic TDL air monitoring system is included in the FLM-OTDL-UGUI-001 AirOptic TDL User Guide. Sections 4 and 5 of the User Guide describe specific activities associated with equipment startup and operation. Section 6 of the User Guide presents routine maintenance and instrument trouble shooting.

9.2.1 Instrument Setup and Operation

Instrument Setup:

The purpose of the initial alignment check is to ensure the system is operating with the same level of light signal as was present when the system shipped from the factory. If the light level is lower than factory specification, a work order is created to resolve the issue. The specific steps associated with the system setup include the following:

[redacted]

Instrument Operation

The specific steps associated with getting the system in full operating mode include:

[redacted]

If the system fails to pass the calibration check, a work order is created to resolve the issue.

9.2.2 Routine Maintenance

As previously mentioned, the routine maintenance for the AirOptic TDL air monitoring system follows specific manufacturer guidance that is referenced in Section 5 of the instrument user guide and is performed as part of a routine maintenance schedule. The specific items associated with routine maintenance are:

- System Re-alignment
- Cleaning the Analyzer Optics
- Cleaning the Retroreflector
- Detector Replacement

Cleaning of analyzer optics and the retroreflectors are done based on monthly inspections of the optical components that occur during system alignment checks. Replacement of the light detector occurs on an as-needed basis. Once routine maintenance is completed, the systems undergo a bump check to ensure the system meets Rule 12-15 data quality checks. If the system fails a bump check, a work order is created to resolve the issue. Work orders are produced if the maintenance does not follow a set schedule and are based on system performance.

9.2.3 Non-routine Maintenance

Non-routine maintenance occurs whenever the system is determined to be operating outside the operating parameters needed to meet BAAQMD Rule 12-15 requirements. When this occurs a work order is created to determine the source and the issue and to initiate the repair of the system. The assessment of issues associated with non-routine maintenance are covered in MSOP-001 which covers system operation checks.

9.3 Operation and Maintenance Open-path UVDOAS Air Monitoring System

A detailed description of the instrument specific tasks associated with the operation and maintenance of the Argos UV DOAS air monitoring system is included in the FLM-OTDL-UGUI-001 Argos UV DOAS User Guide. Sections 4 and 5 of the User Guide describe specific activities associated with equipment startup and operation. Section 6 of the User Guide presents routine maintenance and instrument trouble shooting.

9.3.1 Instrument Setup and Operation

Instrument Setup:

The purpose of the initial alignment check is to ensure the system is operating with the same level of light signal as was present when the system shipped from the factory. If the light level is lower than factory specification, a work order is created to resolve the issue. The specific steps associated with the system setup include the following:

[redacted]

Instrument Operation

The specific steps associated with getting the system in full operating mode include:

[redacted]

If the system fails to pass the calibration check, a work order is created to resolve the issue.

9.3.2 Routine Maintenance

As previously mentioned, the routine maintenance for the Argos UVDOAS air monitoring system follows specific manufacturer guidance that is referenced in Section 6 of the instrument user guide and is performed as part of a routine maintenance schedule. The specific items associated with routine maintenance are:

- System Re-alignment
- Cleaning the Analyzer Optics
- Cleaning the Optics
- Light Source Replacement

Cleaning of analyzer optics is done based on monthly inspections of the optical components that occur during system alignment checks. Replacement of the light source occurs on an as-needed basis. Once routine maintenance is completed, the systems undergo a bump check to ensure the system meets Rule 12-15 data quality checks. If the system fails a bump check, a work order is created to resolve the issue. . Work orders are produced if the maintenance does not follow a set schedule and are based on system performance.

9.3.3 Non-routine Maintenance

Non-routine maintenance occurs whenever the system is determined to be operating outside the operating parameters needed to meet BAAQMD Rule 12-15 requirements. When this occurs a work order is created to determine the source and the issue and to initiate the repair of the system. The assessment of issues associated with non-routine maintenance are covered in MSOP-001 which covers system operation checks.

9.4 Operation and Maintenance Kassay Extractive FTIR Air Monitoring System

A detailed description of the instrument specific tasks associated with the operation and maintenance of the Argos UV DOAS air monitoring system is included in the FLM-OTDL-UGUI-001 Kassay Extractive FTIR User Guide. Sections 1 through 3 of the User Guide describe specific activities associated with equipment startup and operation. Section 4 of the User Guide presents routine maintenance, which is performed as part of a routine maintenance schedule. and instrument trouble shooting.

9.4.1 Instrument Setup and Operation

Instrument Setup:

The purpose of the initial system check is to ensure the system is operating with the same level of light signal as was present when the system shipped from the factory. If the light level is lower than factory specification, a work order is created to resolve the issue. The specific steps associated with the system setup include the following:

[redacted]

Instrument Operation

The specific steps associated with getting the system in full operating mode include:

[redacted]

If the system fails to pass the calibration check, a work order is created to resolve the issue.

9.4.2 Routine Maintenance

As previously mentioned, the routine maintenance for the Kassay air monitoring system follows specific manufacturer guidance that is referenced in Section 5 of the instrument user guide. The specific items associated with routine maintenance are:

[redacted]

Replacement of the light source occurs on an as-needed basis. Once routine maintenance is completed, the systems undergo a bump check to ensure the system meets Rule 12-15 data quality checks. If the system fails a bump check, a work order is created to resolve the issue. In the case of replacement of the internal lasers, the system will undergo a full method recertification that includes a bump check at the end of the procedure to ensure the system meets Rule 12-15 data quality checks. . Work orders are produced if the maintenance does not follow a set schedule and are based on system performance.

9.4.3 Non-routine Maintenance

Non-routine maintenance occurs whenever the system is determined to be operating outside the operating parameters needed to meet BAAQMD Rule 12-15 requirements. When this occurs a work order is created to determine the source and the issue and to initiate the repair of the system. The assessment of issues associated with non-routine maintenance are covered in MSOP-001 which covers system operation checks.

9.5 Operation and Maintenance Organic Gas Detector (OGD)_Air Monitoring System

A detailed description of the instrument specific tasks associated with the operation and maintenance of the Argos UV DOAS air monitoring system is included in the FLM-OTDL-UGUI-001 Organic Gas Detector User Guide. Sections 4 and 5 of the User Guide describe specific activities associated with equipment startup and operation. Section 7 of the User Guide presents routine maintenance and instrument trouble shooting.

9.4.1 Instrument Setup and Operation

Instrument Setup:

The purpose of the initial system check is to ensure the system is operating with the same level of light signal as was present when the system shipped from the factory. If the light level is lower than factory specification, a work order is created to resolve the issue. The specific steps associated with the system setup include the following:

[redacted]

Instrument Operation

The specific steps associated with getting the system in full operating mode include:

[redacted]

If the system fails to pass the calibration check, a work order is created to resolve the issue.

9.4.2 Routine Maintenance

As previously mentioned, the routine maintenance for the OGD air monitoring system follows specific manufacturer guidance that is referenced in Section 7 of the instrument user guide and is performed as part of a routine maintenance schedule. The specific items associated with routine maintenance are:

[redacted]

Filter changes and lamp cleaning are to occur on a quarterly basis. Once routine maintenance is completed, the systems undergo a bump check to ensure the system meets Rule 12-15 data quality checks. If the system fails a bump check, a work order is created to resolve the issue.

9.4.3 Non-routine Maintenance

Non-routine maintenance occurs whenever the system is determined to be operating outside the operating parameters needed to meet BAAQMD Rule 12-15 requirements. When this occurs a work order is created to determine the source and the issue and to initiate the repair of the system. The assessment of issues associated with non-routine maintenance are covered in MSOP-001 which covers system operation checks.

10.0 - Instrument or Method Calibration and Standardization

All gases used to challenge the system will include calibration certificates from the gas supplier that state the gases are NIST Traceable, the measured concentration of the gas and the measurement error associated with the analysis.

11.0 - Sample Collection

Sample collection follows the specific data collection procedures listed is the instrument specific user manuals for each technology.

12.0 - Sample Handling and Preservation

There are no specific sampling and preservation requirements for this procedure.

13.0 - Sample Preparation and Analysis

There are no specific sample preparation and analysis requirements for this procedure.

14.0 – Troubleshooting

See Section 9.0 for specific troubleshooting requirements.

15.0 - Data Acquisition, Calculations, & Data Reduction Requirements

Calculations and data reduction requirements associated with bump and calibration checks are addressed in MSOP-003.

16.0 - Computer Hardware & Software

Hardware or software requirements associated with this SOP are contained in the instrument specific operations manuals.

17.0 Data and Records Management

Data records and field sheets will be submitted by the field technician. A data summary report will be provided by the data analyst of the calibration and system challenge activities.

18.0 - Quality Control and Quality Assurance Section

After the field portion of the activity is completed, the Technical Manager will generate a written report. The draft of the written report is first peer-reviewed for technical content by the Team Leader or by a member of the operations staff. The final report is completed and transmitted to the Document Control Officer.

19.0 - Reference Section

- Argos Scientific Operations Manual for Open-path Air Monitoring System
- Environmental Technology Verification Program (Advanced Monitoring Systems Pilot) – Test/QA Plan for Verification of Optical Open Path Monitors

[redacted]	[redacted]	Technical Supervisor	Technical Manager (AQM)
[redacted]	[redacted]	August 2022	08/29/22
[redacted]	[redacted]		

Alarm Response Procedures Guide

V2.0

June 2023

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Contents

* To jump to a page in the contents, ctrl+click the titles above.

i. Remote Desktop Connections

[redacted]

[redacted]

[redacted]

[redacted]

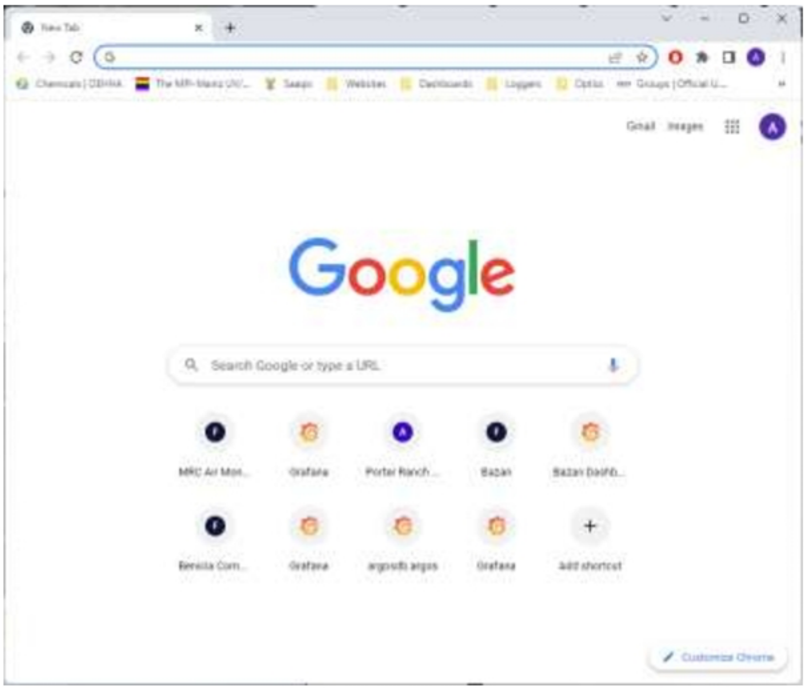
[redacted]

[redacted]

[redacted]

[redacted]

[redacted]



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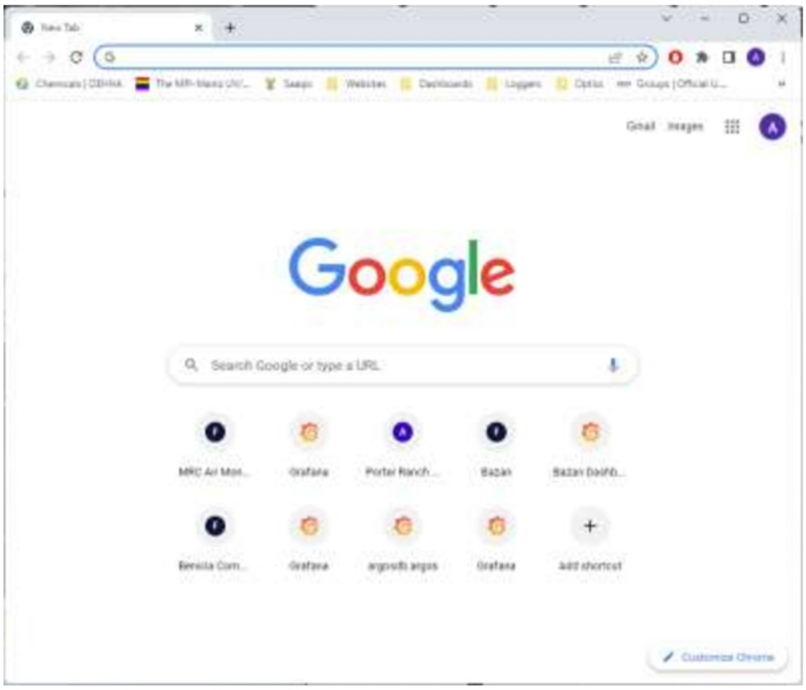

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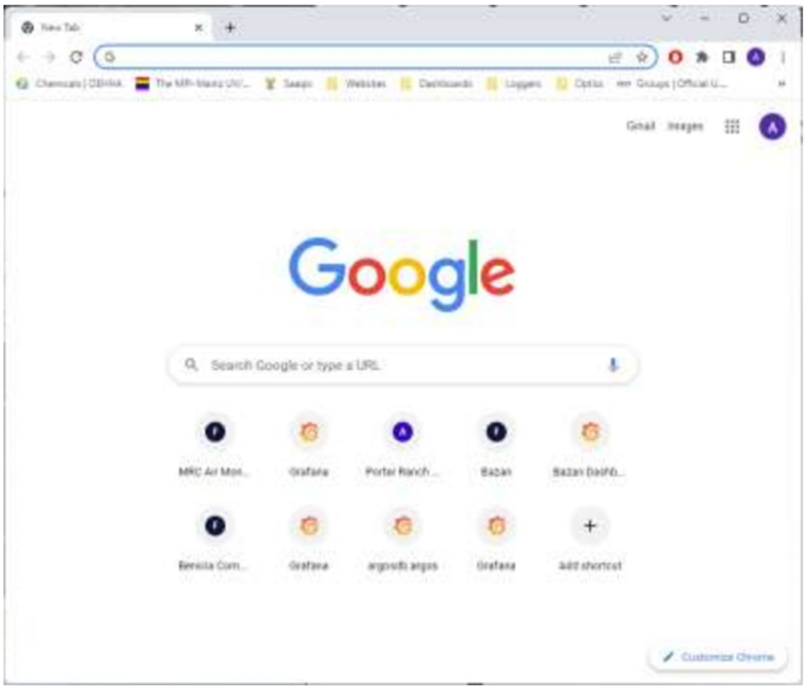


[redacted]

- [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

1 UV DOAS Open Path Systems

Argos UV Quant

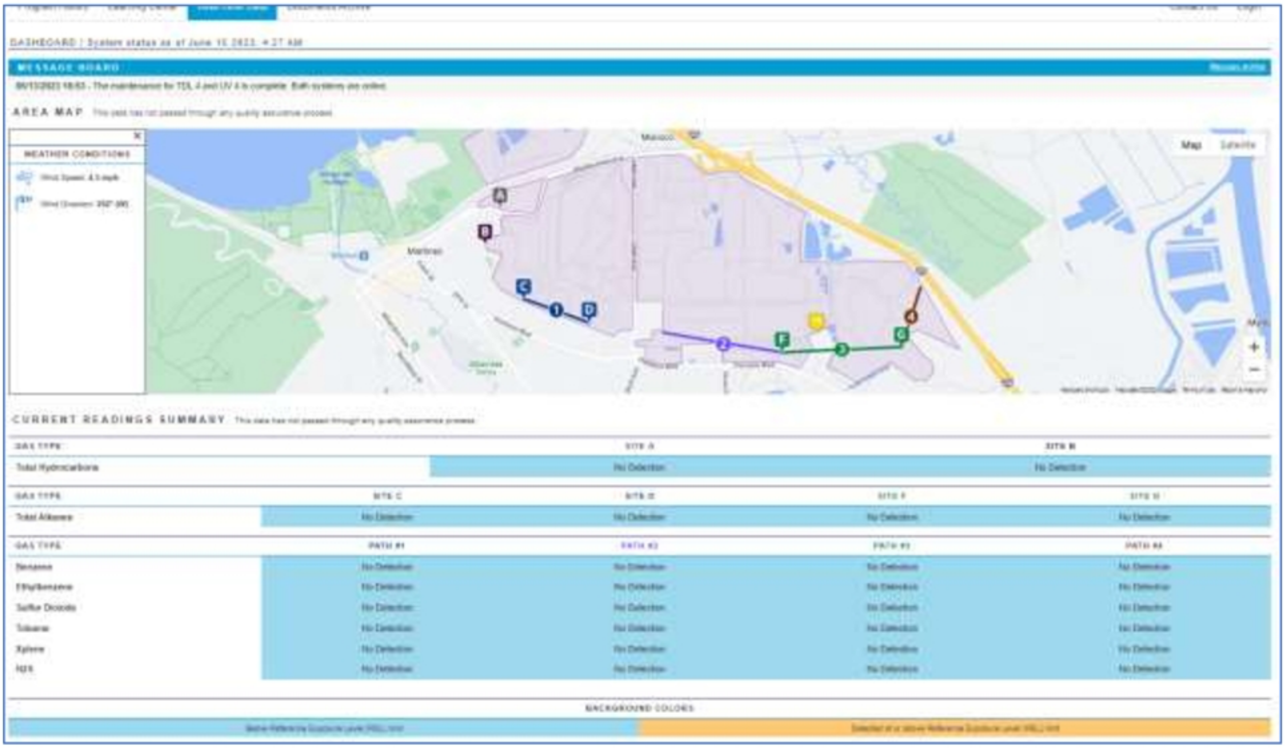
[redacted]

System Down and Missing/No Data Alert

Flow chart summary

[redacted]

[redacted]



[redacted]

[redacted]

[redacted]

2. Corrective Actions – NB Note down details of issues found and corrective steps taken

[redacted]

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b. Is UV Quant open

[redacted]

[redacted]

c. Is the program frozen

[redacted]

[redacted]

d. Are there any error messages

[redacted]

ERROR MESSAGE IMAGE

[redacted]

[redacted]

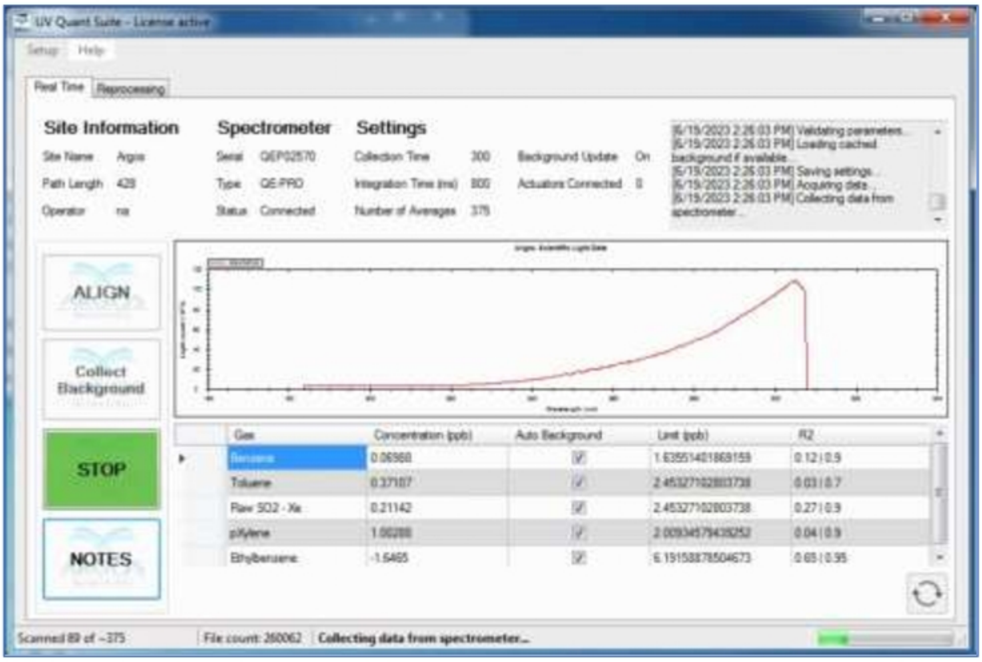
[redacted]

[redacted]

[redacted]

[redacted]

[redacted]



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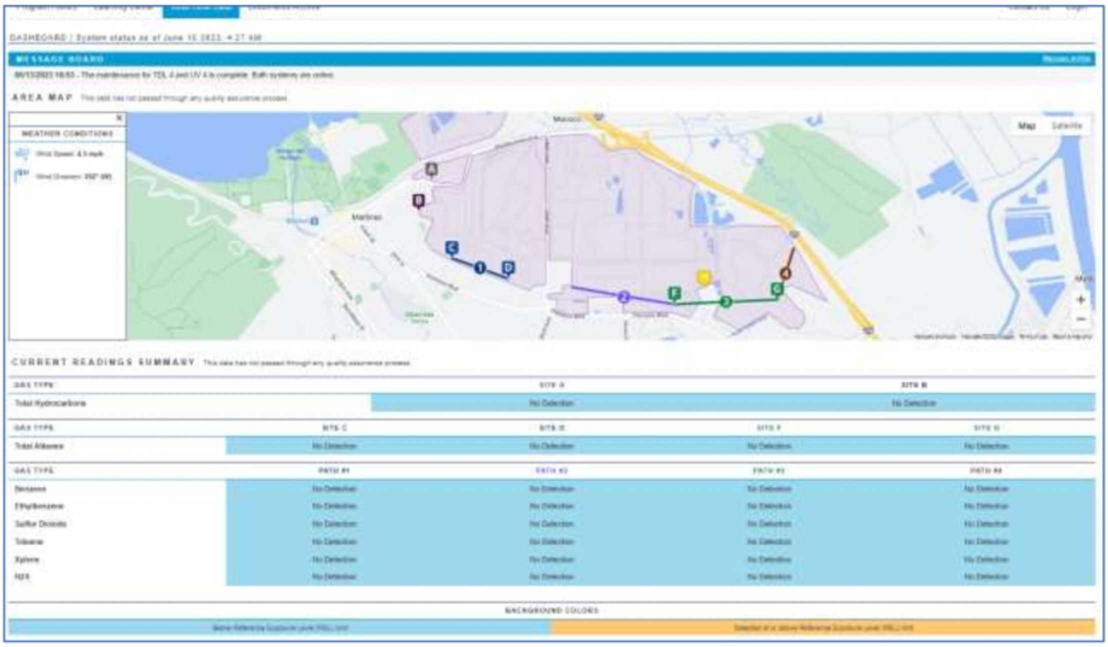

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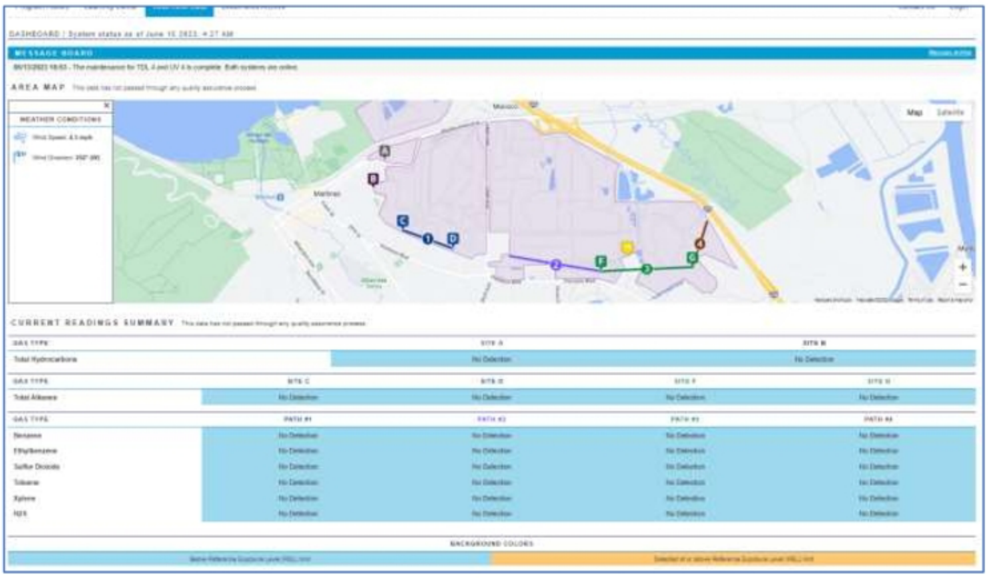

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Flowchart Summary

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

2. Corrective Actions

Diagnosis Tool:

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

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APPENDIX A – Sites and Equipment

[redacted]

APPENDIX B – Site PC Connections

MRC

[redacted]

APPENDIX C – Site Managers

[redacted]

APPENDIX D – [redacted] and Locations

[redacted]

APPENDIX E [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Argos open- path UV User Guide

[redacted]

User guide

Rev 2.

[redacted]

Argos open- path UV User Guide

Contents

Argos open- path UV User Guide

[redacted]

1. General information

The Argos open path system uses ultraviolet light to measure the concentration of known chemical compounds in the atmosphere through a process called spectroscopy. It operates from a standard 110VAC outlet and outputs data to the logging computer via USB.

2. General specifications

[redacted]	
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]

[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]

Physical parameters	
Dimensions L x W x H	
Material	Aluminum
Weight	

3. Physical description

The Argos UV and UVDOAS can be easily installed and integrated alongside existing instrumentation and their control systems. It is designed with standard connection terminals and hardware.

[redacted]

4. Installation and startup

Safety information

[redacted]

Electrical safety

[redacted]

[redacted]

4.1 Connecting to the analyzer

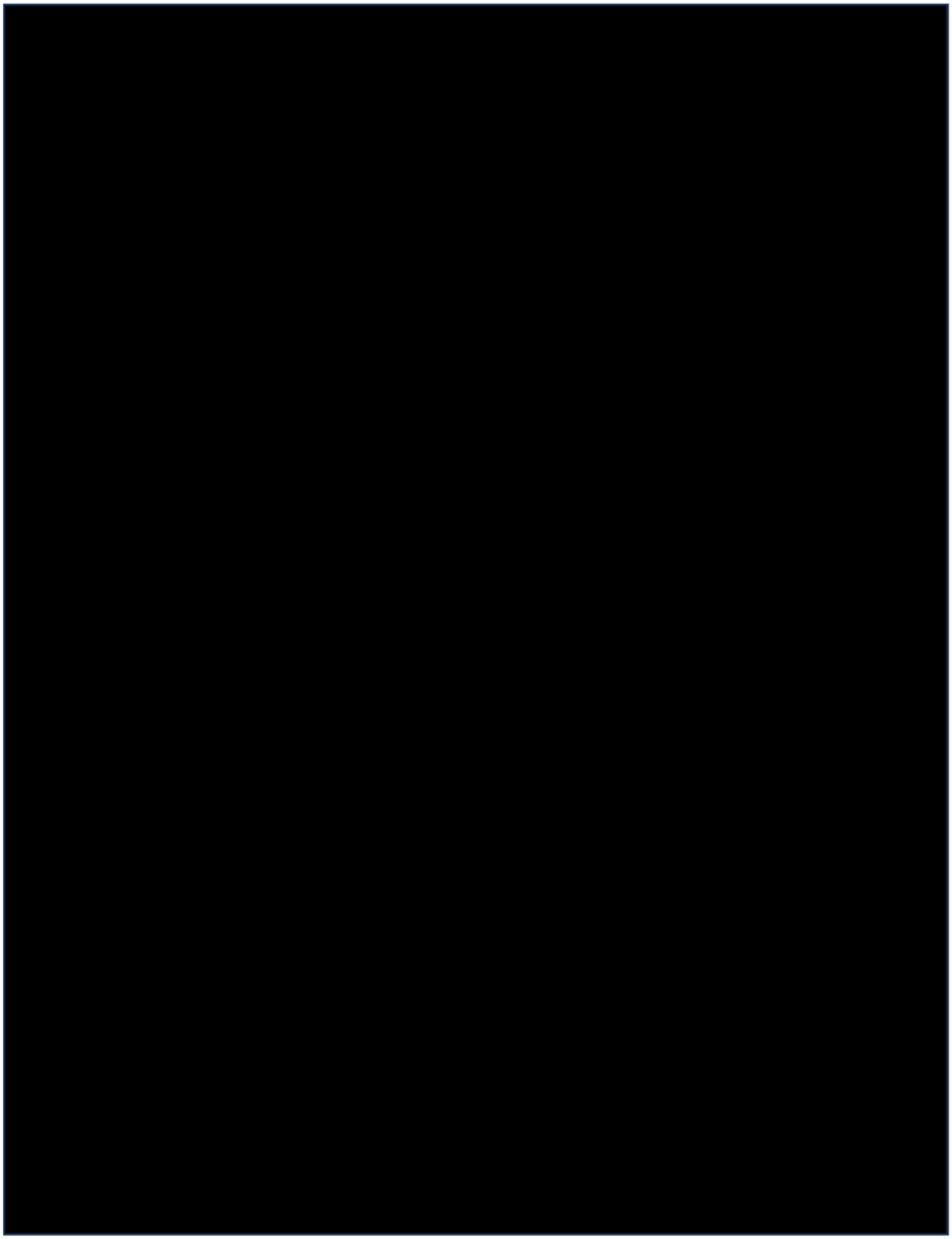
[redacted]

[redacted]

mains

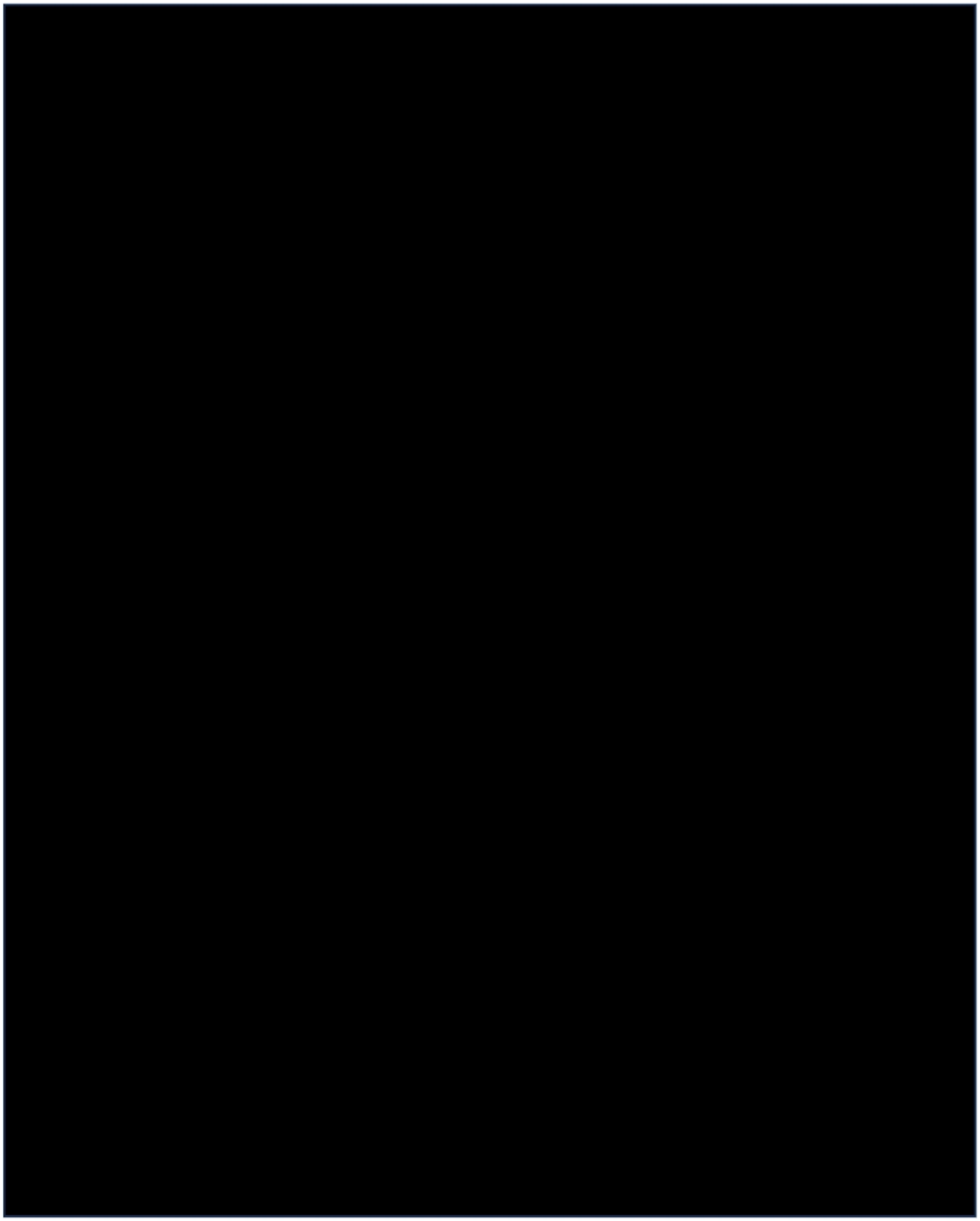
- For deployment of the system in the field, make sure all code requirements are met. If installing the UV systems on tripods, make sure they are on level and tied/weighted down.

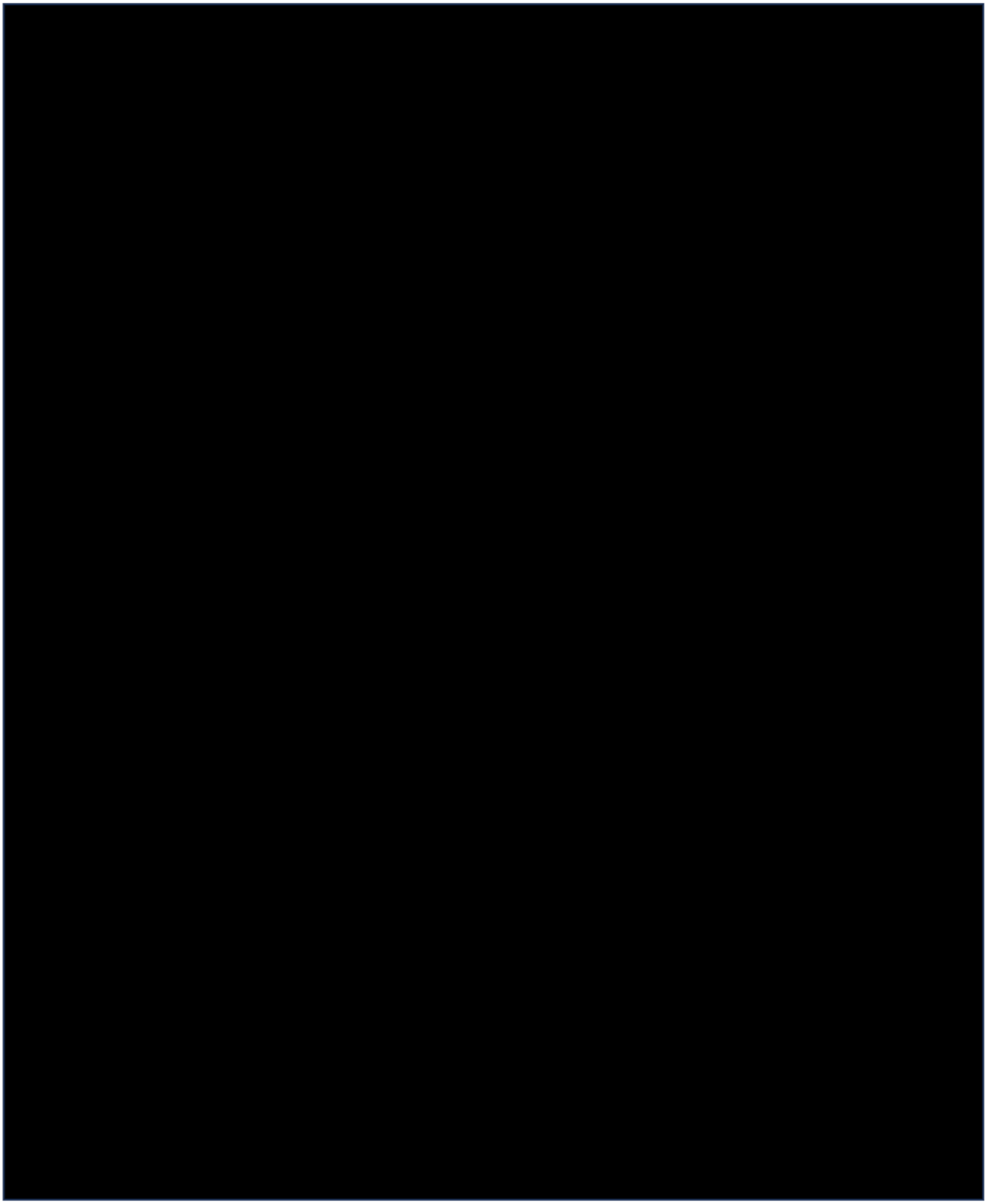
[redacted]



UV RECEIVER long path GEN 3 top-down view showing components.

[redacted]





4.2 Set up the UVQuant software

The software can be installed on the PC with an executable file (.exe) supplied through Argos. The installation requires an active internet connection to install the runtime prerequisites [redacted] package. Check if your PC is 32 or 64 bit prior to installation. [redacted].

[redacted].

3.

5.0 System Operation

5.1 PURPOSE

This document describes the operation of the Argos UV Air Survey Monitor. The following procedure is designed to give the operator a working knowledge of the monitor's basic function and limitations.

5.2 SCOPE AND APPLICABILITY

This procedure is used to describe the utilization of the UV air monitor for survey of organic and inorganic compounds and as an ancillary tool for field monitoring. [redacted].

5.3 METHOD SUMMARY

The Argos UV air is a portable, open-path air survey tool designed for real-time detection of organic and inorganic compounds using a UV transmitter [redacted] and high-resolution spectrometer that collects light and saves the raw spectra. The light b[redacted]. Compounds present in the beam path that are absorbent[redacted]0 nanometers absorb light at particular wavelengths and at levels proportional to the amount of gas present. The UV system is connected to a laptop computer via Universal Serial Bus (USB) cable, to display gas concentrations in part per billion by volume (ppbv) on a real-time basis using Argos UVS Quant software. Data from the spectrometer is stored i[redacted] file that provides the capability to re-analyze the data for the presence other compounds of interest. Field checks are preformed both prior to and after data collection.

5.4 LIMITATIONS

5.4.1 Compound identification and quantitation are limited t[redacted] If an unknown gas is detected a search of UV library spectra can be used to identify the compound. Based on this i[redacted].

5.4.2 The [redacted] is specifically designed to minimize the effects caused by the presence of additional compounds in the sample.

5.4.3 The selection of target gases should be limited to those that are thought to be present in the ambient air. [redacted].

5.4.4 The quality of the sample spectrum is limited by the quality of the background spectrum. Perform a suitable background analysis to increase the confidence of field measurements.

5.4.5 A single-point calibration check of two compounds ([redacted] is performed instead of a multi-point check. QA standards are available for all gases listed in the compound library.

5.4.6 [redacted].

5.5 SAFETY

5.5.1 The UV System contains an ultra-violet light source that may cause eye injury after prolonged exposure. Always wear UVA/B/C eye protection at all times when the protective cover is removed or when looking directly into the UV source from the source platform.

5.5.2 Never allow rain or water to come in contact with a hot UV source, as this can cause the glass envelope of the blub to explode and/or result in electrocution.

5.5.3 Read and understand the material safety data sheets (MSDS) for all chemicals used for calibration and analysis of this instrument.

5.5.4 [redacted]. When in doubt, atmosphere must be tested before using the instrument in potentially explosive atmospheres.

5.6 EQUIPMENT AND REAGENTS

- UV Air Monitoring system
- Laptop computer with UV Quant
- QC Lollipop (glass cell filled with gas standards)
- UV eye protection

5.7 PROCEDURE

5.7.1 UV Monitor Set-Up

5.7.1.1 [redacted]

5.7.1.2 [redacted]

5.7.1.3 [redacted]

5.7.1.4 Open the UV Quant Control Program by [redacted]

[redacted]

5.7.1.5 Before Data Collection begins, the site information should be updated. To do this move the mouse to the UV Quant Setup menu and select Site Information from the options.

[redacted]

[redacted]r:

[redacted]

[redacted] It is recommended that a project logbook be used to document monitoring activities such as site locations, odor characteristics, observations, conformational canister samples, etc.

When operating a monitor, the only three fields that will be accessible will be the Sit[redacted].

5.7.1.6 Once the site information [redacted].

[redacted]

5.7.1.7 The last item that needs to be setup data collection time. To do this select

[redacted]

[redacted]

5.8 Collecting a Background

A clean air background should always be collected before sampling begins. To do this, [redacted]

Background Collect Button

[redacted]

When the system has complete taking a background [redacted] the [redacted]

[redacted]

5.9 Continuous Monitoring

[redacted]

The UV Quant software is designed to assist the operator to know when the system is working correctly. Before starting the continuous monitoring software, the operator shoul[redacted]ach [redacted]at is [redacted] the [redacted].

5.9.1 [redacted]

[redacted]

5.9.2 Starting the Continuous Monitoring Software

To start the Continuous Monitoring Software, click on [redacted]:

[redacted]

[redacted]

5.9.3 Checking System Operation

[redacted]

5.9.4 Real-time Monitoring - No Detects

[redacted]

If there is no detection of a gas during the real-time monitoring the Concentration values in PPB [redacted]

5.9.5 Real-time Monitoring - Detections

[redacted]

If there is a detection of a gas during the real-time monitoring the Concentration values in PPB will be h[redacted]

5.9.10 SHORTHAND STARTUP PROCEDURE

[redacted]

[redacted]

6. Maintenance

Please note that all maintenance must be performed in accordance with site safety practices and communicated to the on call personnel. The message board must be updated before and after the work to reflect the status of the job and to note reason for system downtime.

6.1 Lamp and filter changes

[redacted] **POWER DOWN AND ISOLATE ALL SOURCES WHEN PERFORMING WORK ON THE ELECTRICAL COMPONENTS.**

Materials list :

[redacted]

[redacted]

[redacted]

6. Now is a good time to clean the optics and optimize the signal.

6.2 Cleaning the optics

[redacted]

Materials list :

- Spray bottle of clean water
- Spray bottle of soapy water
- Terry cloths and clean microfiber towels

If continuing from the last guide, simply apply [redacted]

[redacted]

6.3 Optimizing alignment of source

Materials list :

- Laptop to interface with auto positioner software

1. Use remote desktop from the laptop to launch the [redacted]

[redacted]

2. Click the button labeled start to connect the [redacted]

3. Once connected, [redacted].

[redacted].

[redacted].

6. [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

6.4 optimizing alignment of the receiver

Materials list :

- Laptop to [redacted]

[redacted]

[redacted].

[redacted]

[redacted].
[redacted].
[redacted]

[redacted]

5. The align window will look like this [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

6.5 [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

6.6 Spectrometer changes

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

7.0 – System Calibration

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

8.0 Training and Initial Demonstration of Analytical Capabilities (IDAC)

Before an analyst may perform this procedure without the oversight of a senior analyst, all aspects of the method must be learned and performed proficiently. Specific requirements shall include, but are not limited to, proficient demonstration of the following.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

9.0 Spare Parts and Consumable List

UV SOURCE	UV RECEIVER	UVDOAS
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]		
[redacted]		

Appendices – Maintenance Check Sheets

Appendix A – FLM-OPUV-MCHK-1

Maintenance Check sheet for Argos [redacted]

[redacted]

Appendix B – FLM-OPUV-MCHK-2

Argos check sheet for UV window and [redacted]

[redacted]

Appendix C – FLM-OPUV-MCHK-3

Argos check sheet for Argos UV lamp and filter replacement

[redacted]

FLM-OTDL-UGUI-001 AirOptic TDL User Guide

User Guide

Rev. 1

October 2023

Created by Dillon Buffi

Contents

Section 1. Air Optics TDL user's guide

Air Optics TDL user's guide

1. General information

The Air Optics TDL (tunable diode laser) is an infrared gas analyzer that we use to measure H2S, [redacted]. It operates from a standard 110VAC outlet and outputs data via [redacted] A PC is used to configure and interface with the analyzer during setup and QAQC procedures.

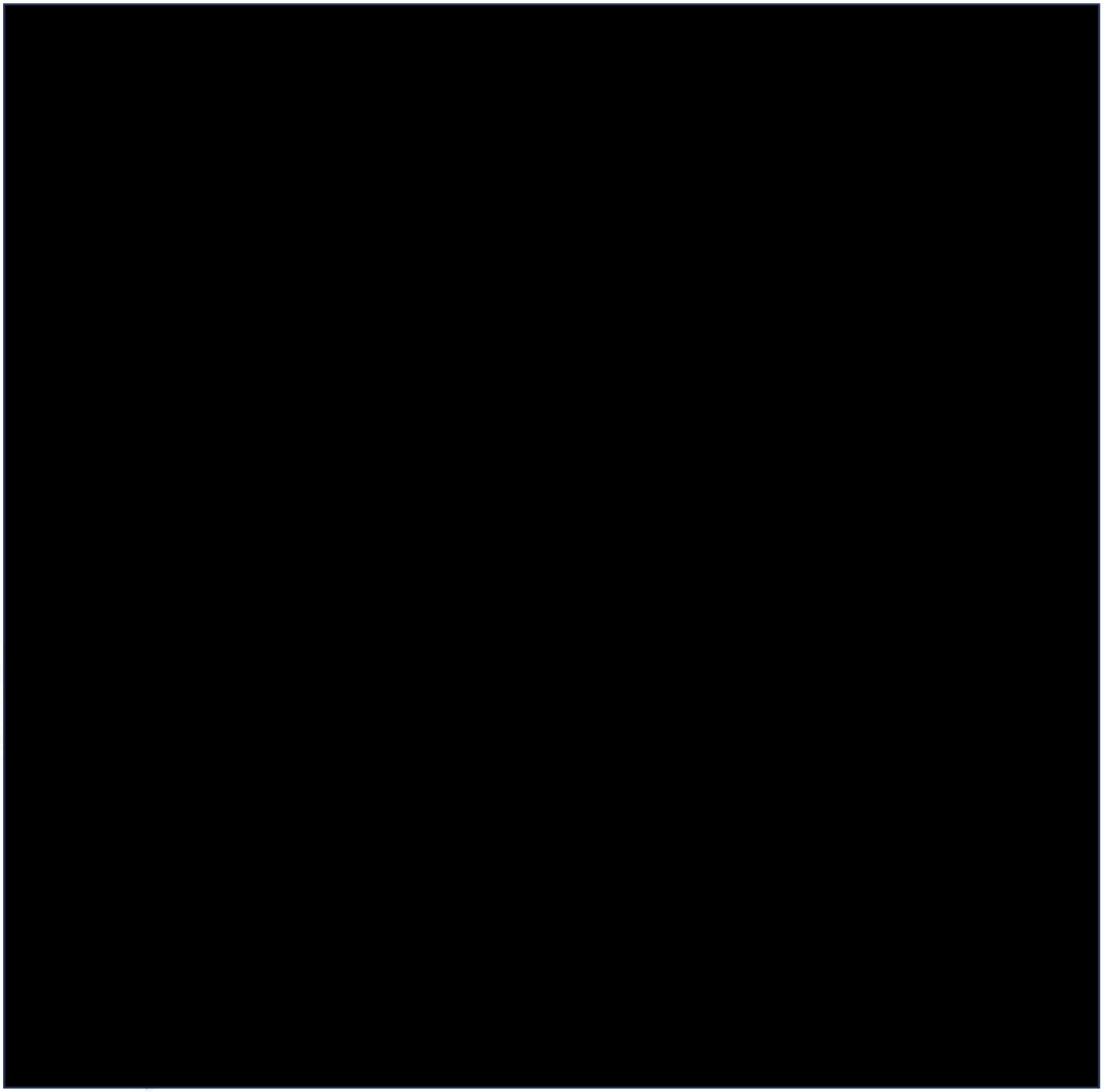
2. General specifications

Basic Parameters	
Principle	[redacted]
Sensor	[redacted]
Sampling	[redacted]
Working current	[redacted]
Power consumption	[redacted]
Analog output	[redacted]
IR rating	[redacted]
Mechanical interface	[redacted]
Installation	[redacted]
User interface	[redacted]
Calibration	[redacted]

Environmental parameters	
Temperature	[redacted]
Humidity	[redacted]
Pressure	[redacted]
[redacted]	
Display	[redacted]
[redacted]	
Dimensions L x W x H	[redacted]
Material	[redacted]
Weight	[redacted]

3. Physical description

The Airoptics TDL can be easily installed and integrated with the control system. [redacted]



4 . Installation and startup

Safety information

Airoptics TDL is classified as a [redacted]

Electrical safety

Mounting or unmounting of the instrument must be performed with the [redacted]

4.1 Connecting to the TDL Analyzer

[redacted].

[redacted]

[redacted]

[redacted]

[redacted]

- On the laptop/PC, go to Windows settings and select [redacted].

[redacted]

[redacted] Under” [redacted].

[redacted]

[redacted].

[redacted]

[redacted]”

[redacted]

[redacted].

[redacted].

[redacted]

Setting Parameters for alignment

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

- [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

- [redacted]
  - [redacted]
  - [redacted]
- [redacted]
  - [redacted]
  - [redacted]

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- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]

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[redacted]’

[redacted]

[redacted].
[redacted]

[redacted]

[redacted]

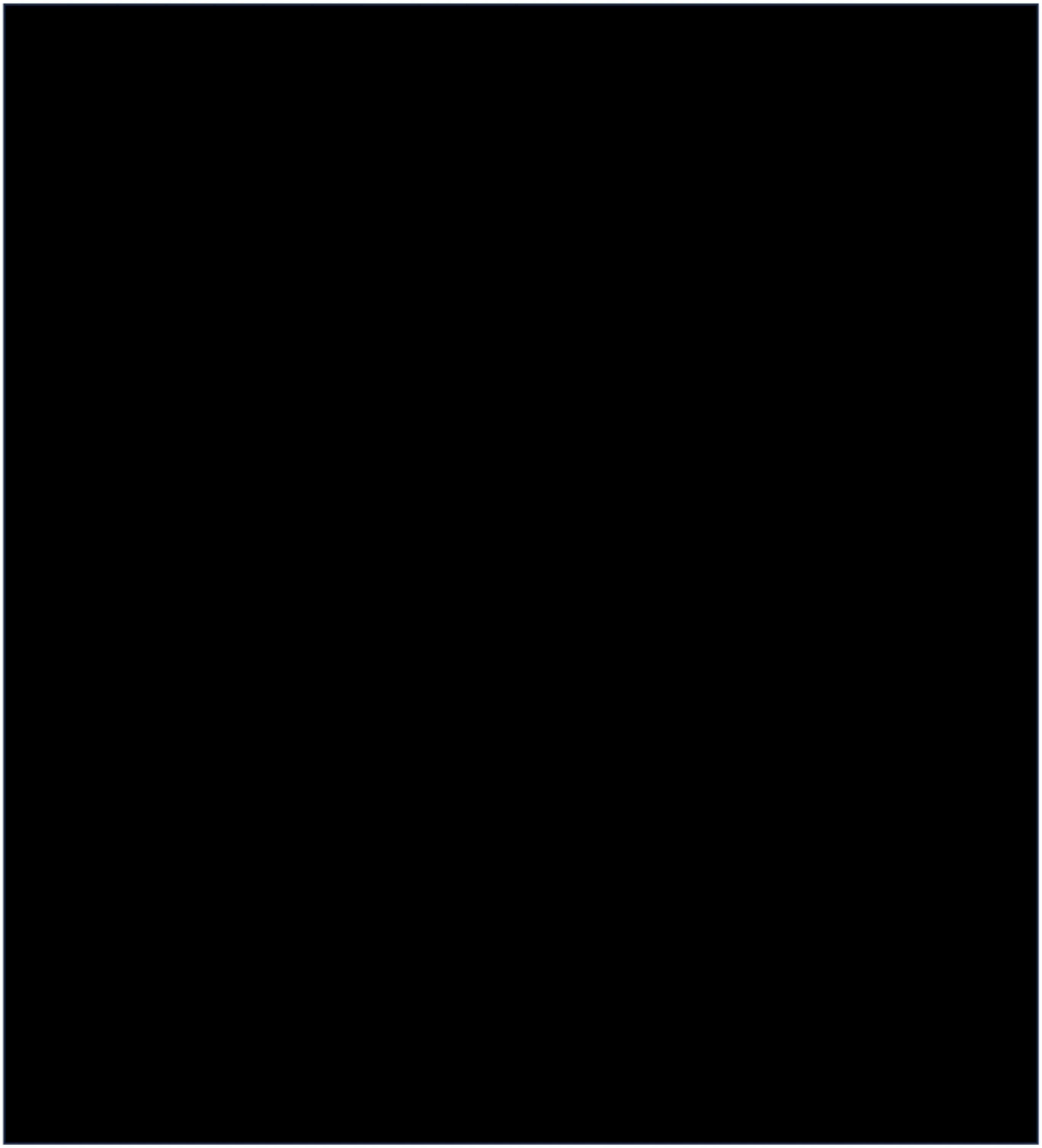
[redacted].

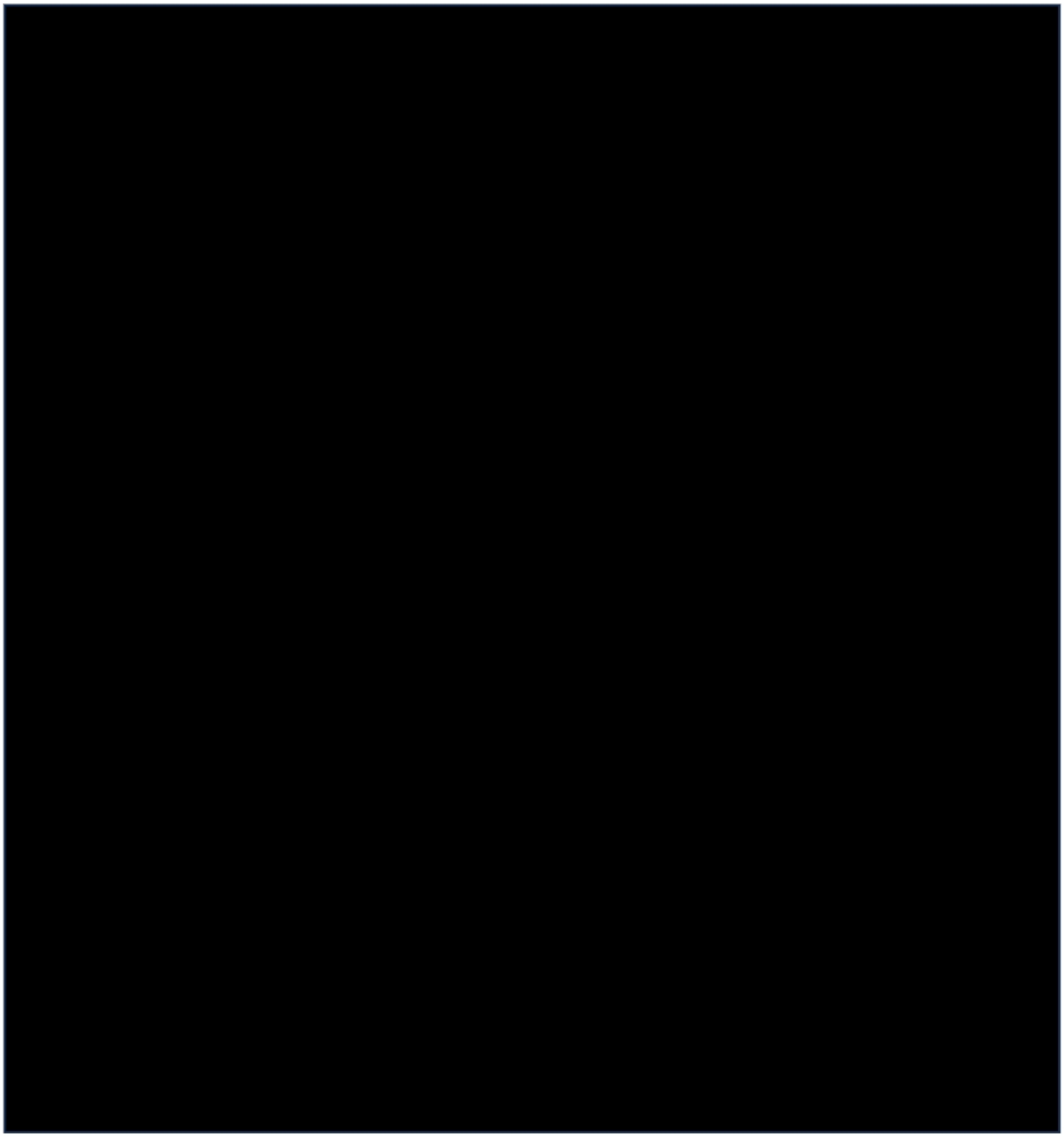
[redacted].

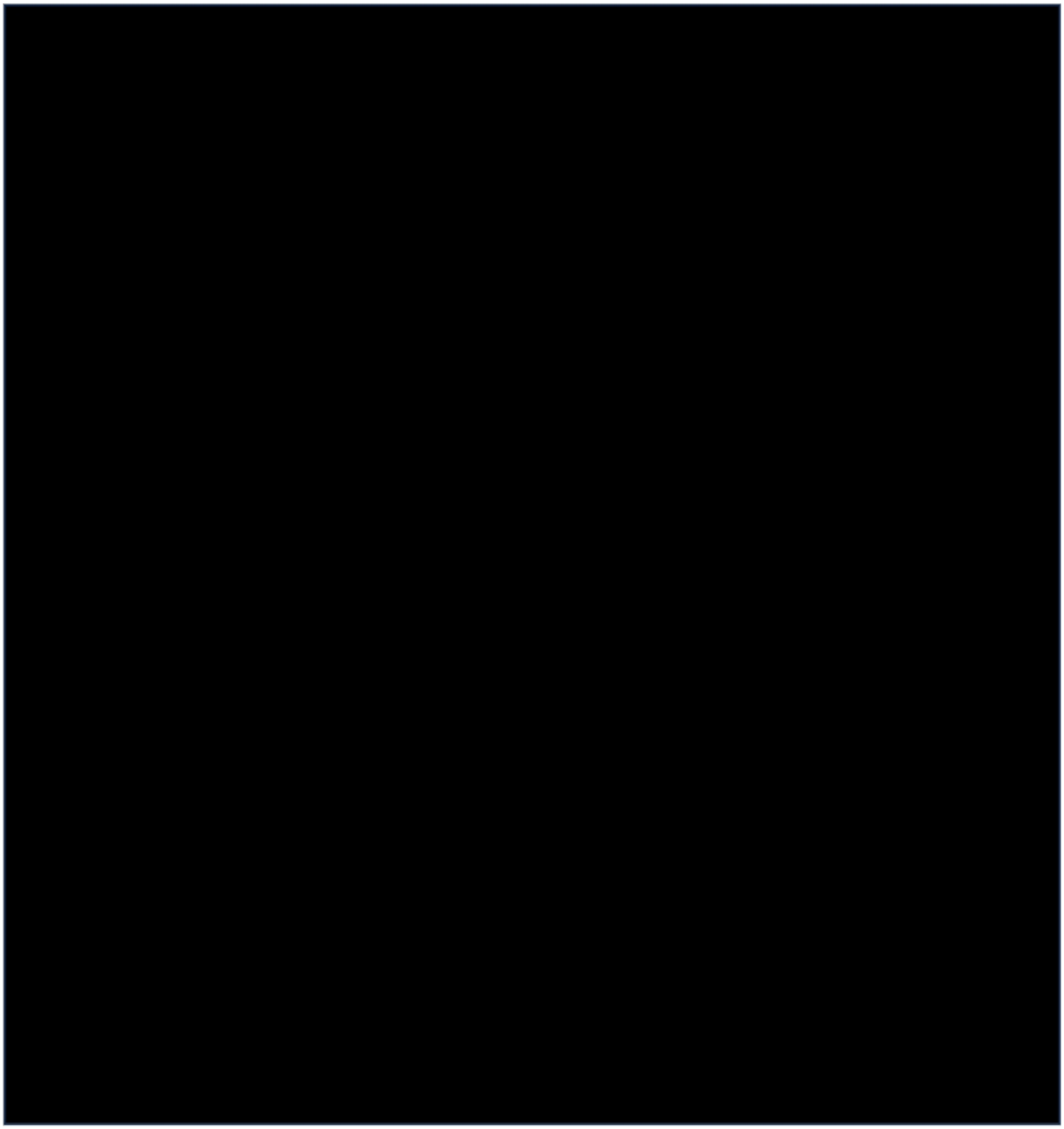
[redacted]

4.2 Initial alignment

[redacted]







5 System Operation

5.7 Optimizing alignment

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted].

[redacted]

[redacted]

[redacted]

[redacted]s.

[redacted]

[redacted]

[redacted]

[redacted]

- Fig. 4. – view through scope [redacted].

[redacted]

- Fig. 5. – GasEye software, showing MDL(left) and laser transmission (right)

5.7.2 [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Performance standards reference chart

To state the values required for operation. As outlined in the QAPP.

Path	Path 1	Path 2	Path 3	Path 4
Transmission	1%<	1%<	1%<	1%<
MDL	30ppb<	50ppb<	50ppb<	30ppb<

When performing alignments, it is common to see the values fluctuate over time. It is important to note that the onstream efficiency standards are based on a 5-minute average and can accommodate fluctuations. Alignment must be carried out in a manner as to provide the most robust signal integrity that can withstand minor fluctuations and maintain uptime.

6 . Maintenance

6.1 cleaning optics – [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

- figure 2. Cloth protecting laser

[redacted].

[redacted]

- figure 3. [redacted]

[redacted]

[redacted]

- figure 4. Mist with [redacted] solution

[redacted]

- figure 5. Second rinse with water.

8. For heavier buildup or if there is still visible particulate, repeat steps 4-7.

[redacted]

[redacted]

- [redacted].

6.2 cleaning optics – [redacted]

[redacted]

- figure 1. Retroreflector – showing dirt on mirror surface.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

6.3 [redacted] - **POWER OFF TDL BEFOFE ANY REPAIRS INVOLVING ELECTRONIC COMPONENTS.**

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

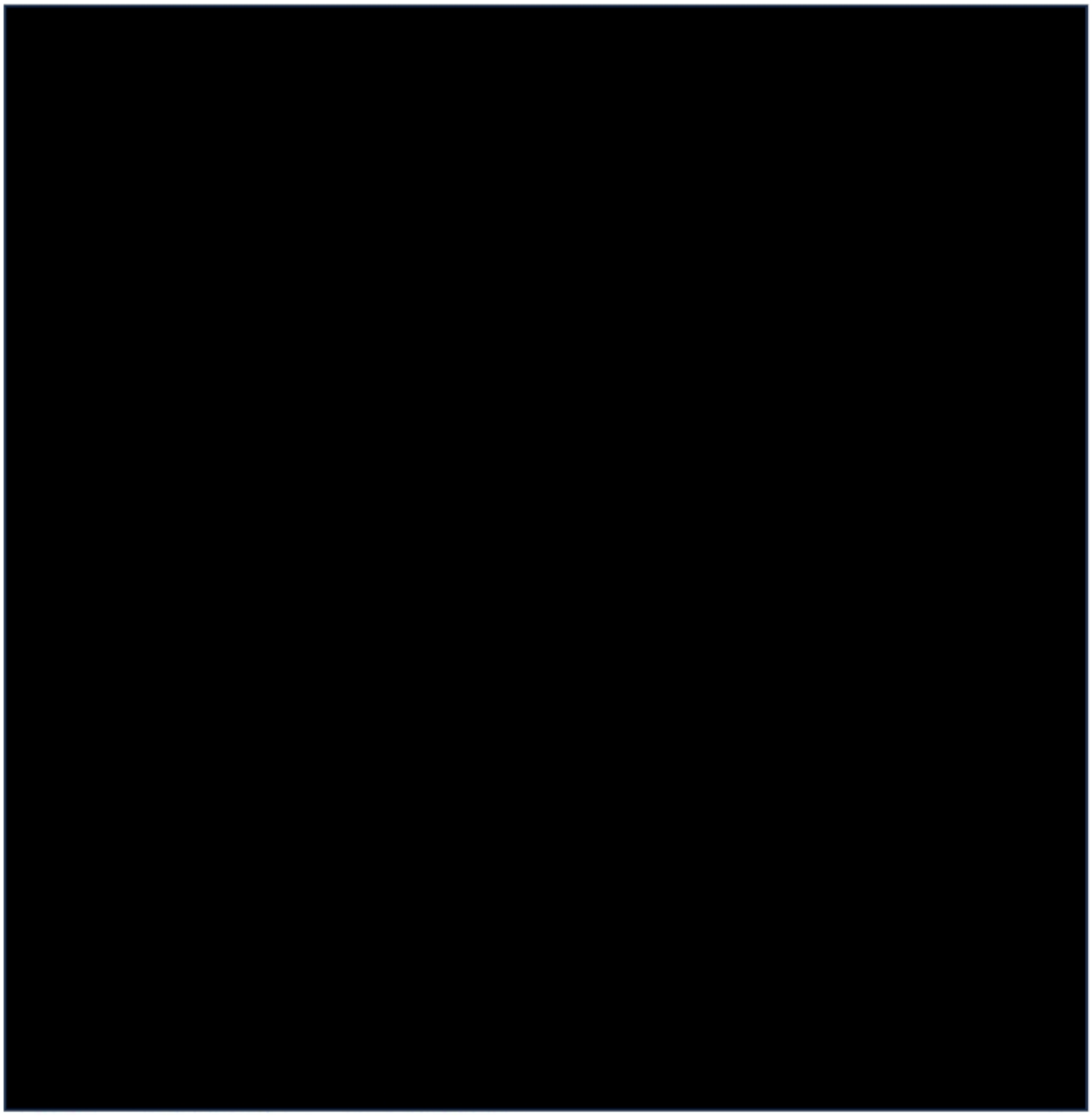
[redacted]

[redacted]

[redacted] the [redacted]

6.4 Troubleshooting overview

The system status is indicated by two LEDs [redacted] the transmitter unit, next to the display. In the table below the possible modes of operation are presented. Please note that during the start-up procedure [redacted]



6.5 To set [redacted]ng to on

[redacted]NG_RESET wa
[redacted]e below:

In summary the instructions are:

Normal operation:

[redacted] ON
[redacted] position

If you want [redacted]geing

[redacted]OFF
[redacted] seconds
[redacted] OFF
[redacted] ON

7. System Calibrations

7.1 Field Calibration

The TDL analyzers must be routinely calibrated in the field to meet monthly and quarterly performance reports. A general outline of the calibration requirements is as follows:

Monthly	Quarterly
Signal transmission and MDL	Signal transmission and MDL
Single point span test	Multi point span test

For H2s Span tests, the required concentrations are as follows:

Path	Monthly	Quarterly
1	[redacted]	[redacted]

2	[redacted]	[redacted]
3	[redacted]	[redacted]
4	[redacted]	[redacted]

[redacted] To span test the analyzer, the flow cell must [redacted].
[redacted]

[redacted]

[redacted]

[redacted]e
[redacted])
[redacted].

[redacted]

- [redacted].

[redacted]

[redacted],

[redacted]r
[redacted],
[redacted].
[redacted]y.
[redacted].
[redacted]i
[redacted]e
[redacted]

[redacted]

Saving data

Following span testing, the data must be saved for review and reporting.

- Click the save icon shaped like a floppy disk to save the data set.

[redacted]

- A dialog box will appear asking if you are sure you want to save and that the session will be paused. Click yes.

[redacted]

- Another dialog box will appear in which you can input the name, group of series and any additional comments you need for the data series. The example shows the file naming format we use for routine QAQC data series. The Group of series can be selected from the drop down menu. Click save.

[redacted]

- This shows the series was successfully saved.

[redacted]

- Next we will save to [redacted] for our data analysts to review. Click the underlined arrow to begin.

[redacted]

[redacted] A dialog box will appear asking if [redacted]

[redacted] Another dialog box will appear in which you can enter [redacted]

[redacted]

[redacted]

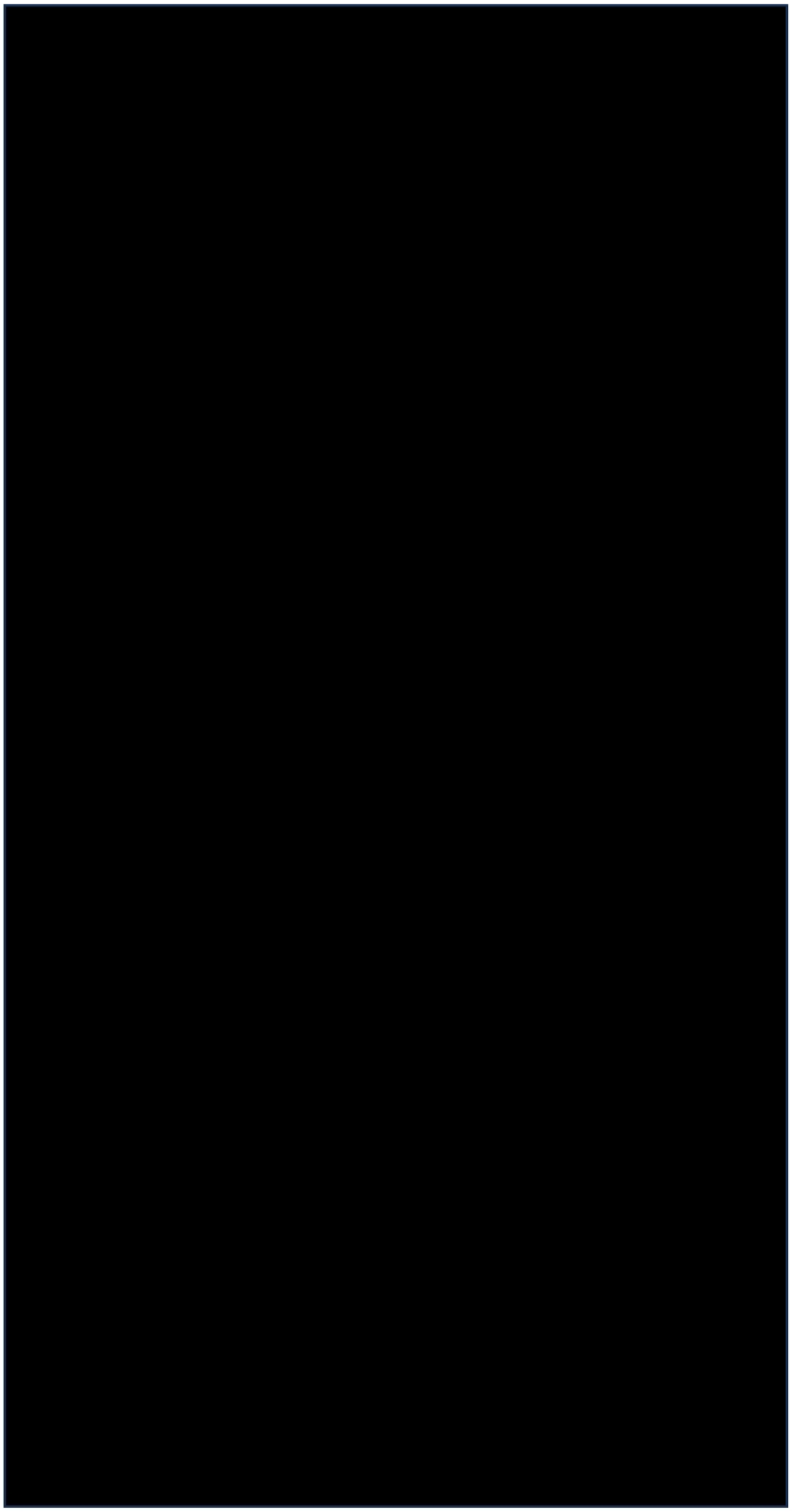
7. Training and initial demonstration of analytical capabilities (IDAC)

9. Spare parts and consumables list

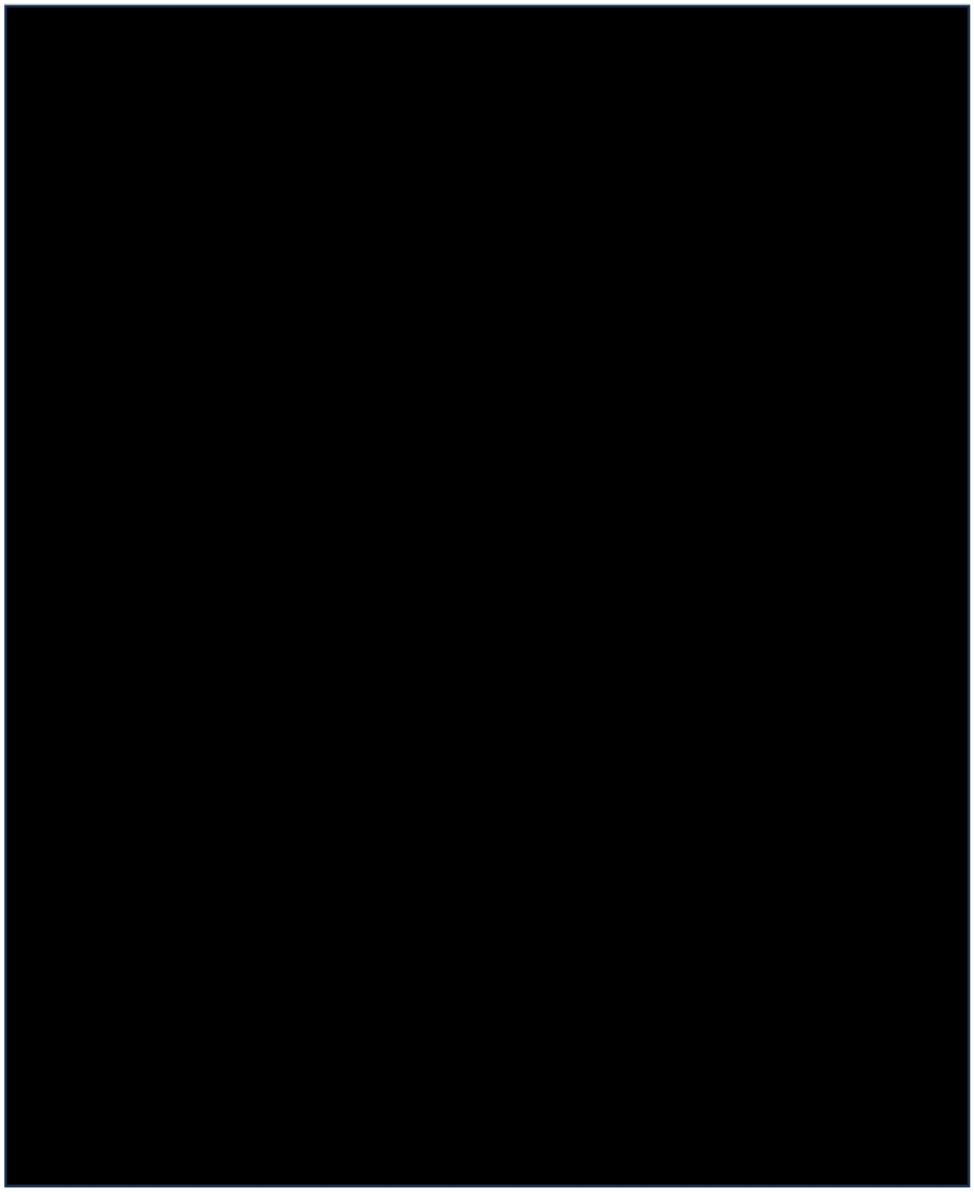
[redacted]	[redacted]	[redacted]	
		[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]		[redacted]	[redacted]
[redacted]		[redacted]	[redacted]
[redacted]		[redacted]	[redacted]

10 Flow charts

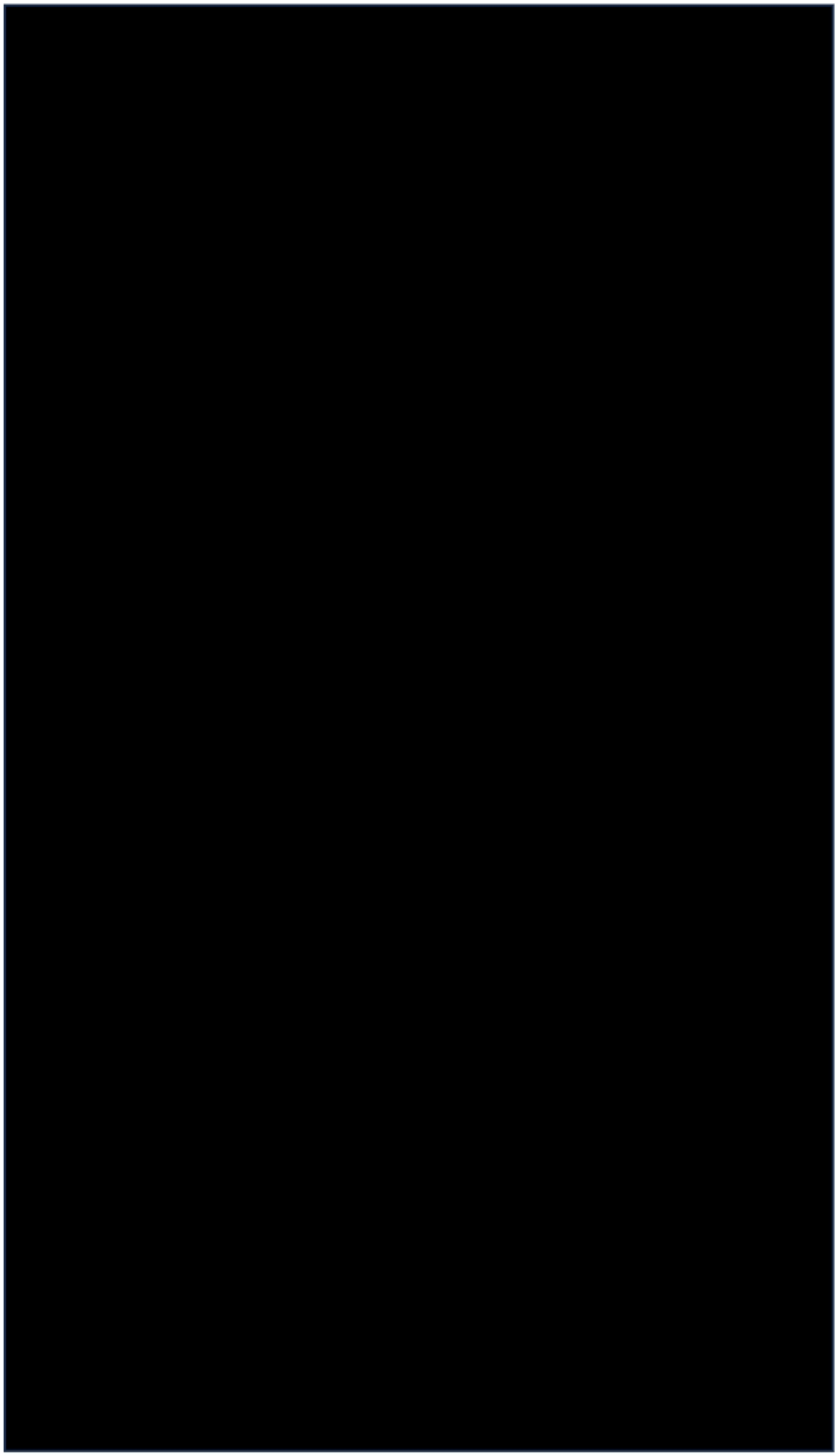
10.1 Calibrations



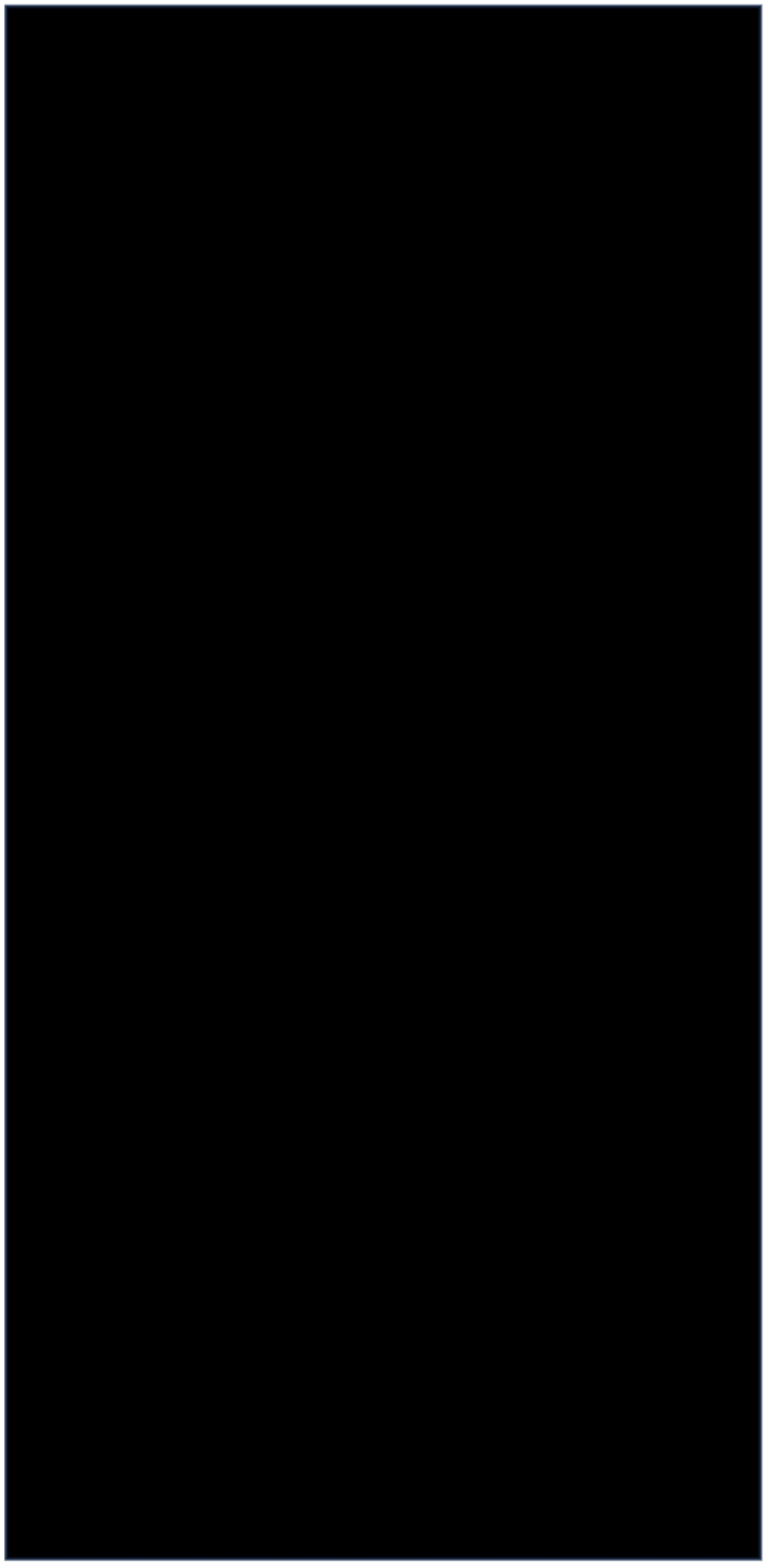
10.2 Alignments



10.3 Retro cleaning



10.4 detector replacement



Ram2000 G2 EX-FTIR

User Guide

Rev. 1

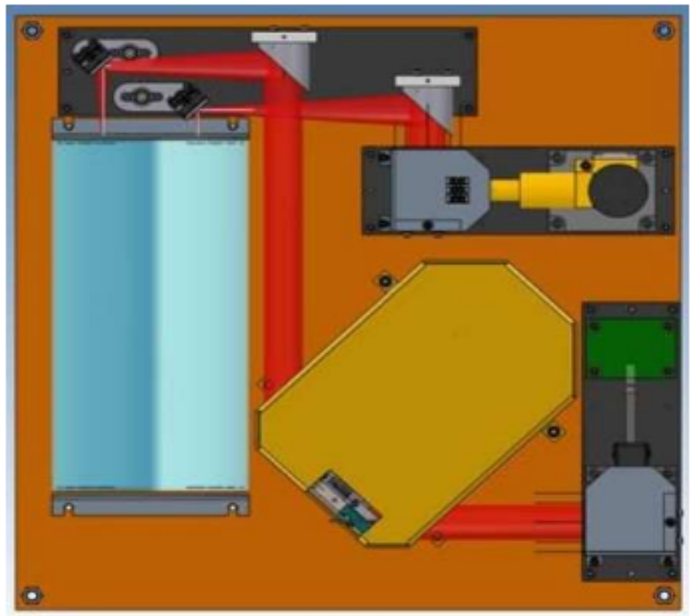
November 2023

Compiled by Dillon Buffi

Contents

Section 1. Ram 2000 G2 EX user's guide

RAM2000 G2 Extractive FTIR
Quick Set-Up Guide



September 2019

Use of Document

This document is a general guideline which identifies major components and describes basic assembly steps for KASSAYs Extractive (EX-FTIR) analyzer. The information within should be used in conjuncture with factory training, supporting documentation and consultation with KASSAY. Supporting documentation includes: software manual, computer manuals, and manuals specific to accessories (pump, temp controller, etc.)

The owner/user/operator should be familiar with the contents of this document before powering on the system.

Recommend Training

The RAM2000 EX-FTIR should be operated by personnel who have knowledge and understanding of the scientific principals of chemical absorption spectroscopy and have received factory training specific to the EX-FTIR spectrometer. Two levels of factory training should be considered:

1) Operator training: Covers aspects of instrument setup, installation, operation, and basic troubleshooting. Applications and limitations are described with guidance on performance metrics.

2) Repair & Maintenance training: Covers In-depth troubleshooting, maintenance and repair procedures, and spare parts.

Factory training is necessary to understand the scientific fundamentals of the FTIR measurement technique, limitations of analysis (applications), and to maintain and repair the equipment.

Warranty

All RAM2000 systems include a standard 1 year warranty. An additional copy of KASSAYs standard equipment warranty can be supplied by the sales associate upon request.

Site Requirements

The RAM2000 EX-FTIR should be installed based on the following considerations

1) A stable platform capable of supporting 100 lbs and isolated from movement and vibration is necessary to support the analyzer. Components that cause heat, vibration, or shock should be isolated from the spectrometer platform.

2) A covering is necessary to protect the FTIR cabinet, power controller, cables and tubing from exposure to precipitation and sunlight.

3) A temperature range of -15° to 45° Celcius is necessary for stable operation (15-35C is recommended shelter temperature range for long term installations).

4) A constant steady power supply with an in-line filtered power strip or similar is required.

5) An air inlet filter is necessary to prevent particulate matter from entering the tubing or gas cell.

6) A non-corrosive environment - corrosive air should never enter the cell or instrument enclosure.

7) Components should be installed far from sources of dirt dust, magnetic fields, moisture, and high winds.

Specifications

Extractive

Gas Cell 10 meter multi-pass gas cell, 2 liter glass body, ambient temperature & pressure Heated cover assembly (up to 45C) with temperature controller for feedback
Flow fittings for input and output
Vacuum and Pressure gauge

Interferometer Continuous scan Michelson interferometer
0.5cm-1 standard (1, 2, 4, 8, 16, 32 cm-1 by request)
VCSEL laser frequency sampling index
High-throughput 38mm beamsplitter, ZnSe (non hydroscopic)

Spectral Range: 700 - 4,500 cm-1 for cryogenincally cooled
1800 - 4500 cm-1 for TE or RT-MCT

Source: Proprietary ceramic element at 1200° Celsius max temp

Detector: Mercury Cadmium Telluride (MCT) detector element
Options: Room Tem (RT), Thermo Electric (TE), Liquid Nitrogen (LN2) dewar, or Cryogenic (CR) by closed-Loop sterling engine cryocooler

ADC: 18-bit integrated with embedded controller
On-board module with both RS-232 and Ethernet access

Pre-Amp: Dual-stage, variable gain, software controllable.

Power Input: 110 or 220 VAC (factory set)

COM Ethernet to MS Windows-based PC

Software: RMMSoft™: Windows™ 7 or Windows™ 10 compatible

Library: 250 (0.5 cm-1) Infrared Chemicals with capability to import additional

Detection:	Detection limits for chemicals measured by open-path FTIR systems will depend on the chemical, gas stream conditions (humidity and temperature) and whether interfering chemicals are present. The range of detection limits for a 10-meter gas cell is from 1 to 300 ppb for most infrared active chemicals. Contact representative for specific application.
Operating Temperature:	Indoor (shelter) temperature limits for RAM2000: -15° to 45° Celsius. *For best performance during long-term installations, the recommended indoor shelter temperature range is 15° to 35° Celsius.*

Introduction to RAM2000 G2 EX-FTIR

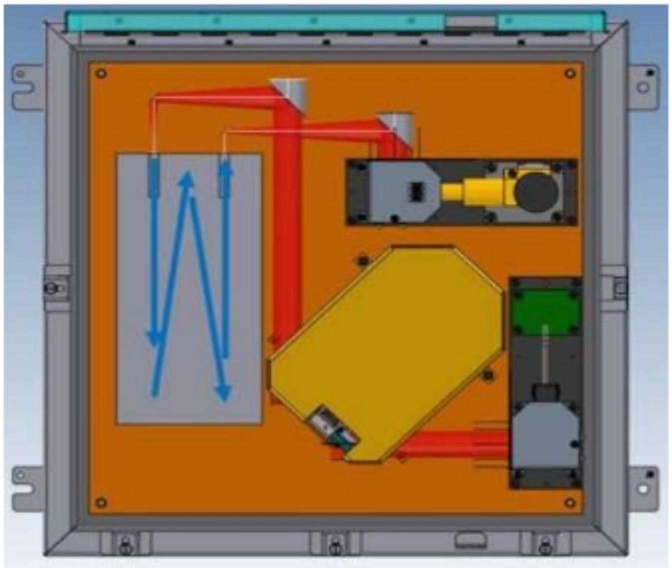
The RAM2000 G2 EX-FTIR is a scanning FTIR spectrometer with a high temperature infrared source, multi-pass sample cell and detector. FTIR describes the spectrometer style: Fourier-Transform InfraRed. The 'EX' in the name stands for 'Extractive' which is the way the air is *extracted* from the ambient into the sample fixture used to hold the gas.

The RAM2000 G2 EX-FTIR is designed to accept an air stream of sample gas into the extractive cell and measure the gas concentration of user selected target chemicals. A sophisticated software program receives spectral data from the EX-FTIR spectrometer and applies user created algorithms to determine quantitative gas concentrations. RMMSoft can be configured by the user to allow the RAM2000 EXFTIR to be operated as a continuous emission monitor (CEM).

Depending on the detector employed, the system can be programmed by the user to detect/monitor gases in PPB to PPM ranges in near real time. The RAM2000 reference library contains hundreds of gases as well as common interferences such as water vapor and carbon dioxide.

Principal of Operation:

Vapor (gas) phase chemicals have polar-covalent bonds that absorb infrared energy at known frequencies. The RAM2000 EX-FTIR projects modulated infrared light energy from the interferometer through an air sample contained in the gas cell and then to a sensitive detector. A digital file known as a sample spectrum is collected by the spectrometer which records energy intensity by wavelength. The sample spectrum is computed with a background spectrum which was recorded in the absence of the target chemical. The resulting absorbance spectrum is processed and compared to a digitally stored reference spectrum to determine concentration information of the target chemical.

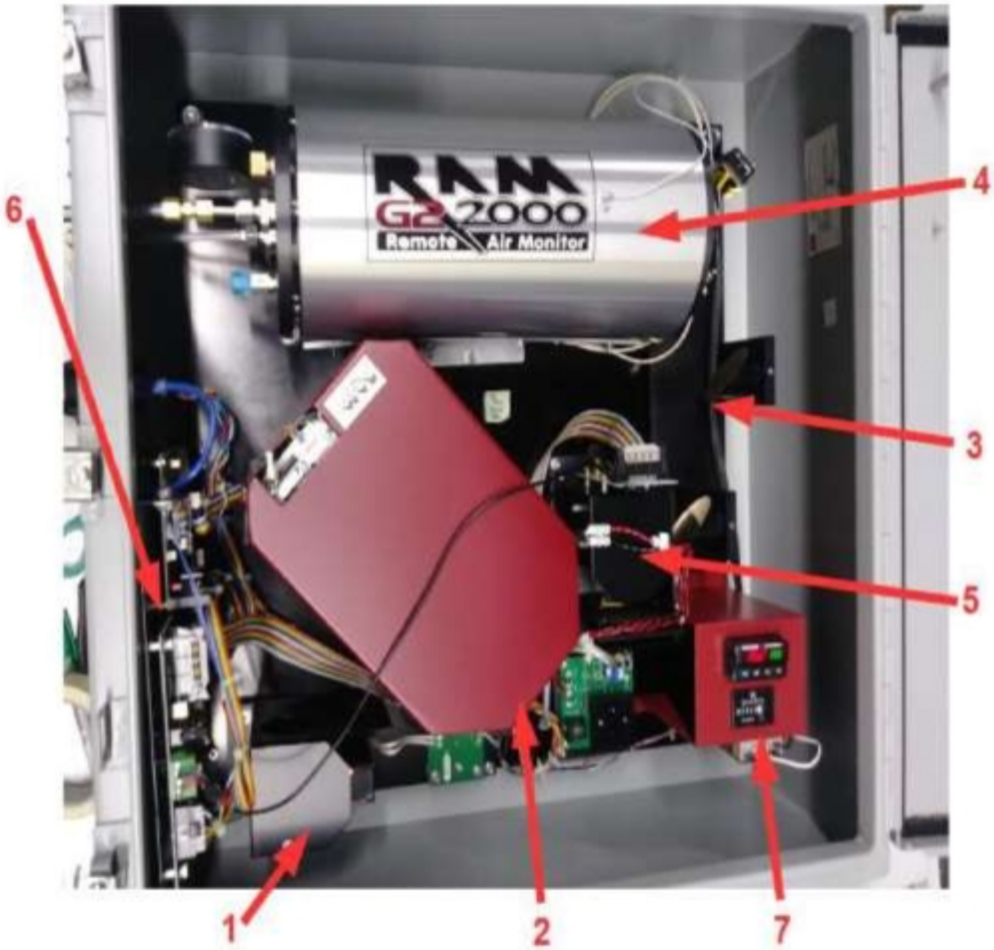


During operation, the user commands the software to control the analyzer to collect data spectra at specific time intervals while air flows through the multi-pass (10 meter) gas cell. Data spectra are analyzed by a user defined method (script) file at unique spectral frequencies. Concentration of user selected chemicals are reported by the software in near real time.

The image shows the IR light energy path from the source to the detector. The Red represents the collimated and focused energy inside the spectrometer bench. The blue represents a simplified light path inside the 10m extractive gas cell.

Hardware Components:

A complete system includes the spectrometer enclosure, power controller, cables, and PC. The site owner delivers the sample air by pump or other positive air-stream. The user should be familiar with the major component names, location, and basic function in order to assemble and operate the system.



1-IR Source
2-Inteferometer
3-Transfer Optic
4-Extractive 10m Cell
5-Detector
6-Circuit Boards
7-Temp Controller

<u>Spectrometer Enclosure</u>

[redacted]

IR Source: The IR source is a proprietary high temperature ceramic fixture that emits infrared energy used to create a spectrum. The temperature of the source is up to 1475° K.

The unit is air cooled. The IR source assembly is a fixture that combines the source, parabolic mirror, heat shield, and temperature stabilization circuit. The IR source assembly delivers a 50mm collimated beam of infrared energy to the interferometer.

Warning: The IR Source fixture is very hot and cause injury if touched.

Interferometer: The interferometer is a scanning Michelson design with a high throughput (38mm) diameter beam splitter. The beam splitter and compensator plate are constructed from ZnSe material (non hydroscopic) for durability. The beam splitter is matched with a compensator optic so that the resulting interferogram is not chirped. The sampling frequency is governed by a vertical-cavity surface emitting laser (VCSEL). Compared to traditional HeNe lasers, VCSEL lasers are smaller, lighter, and less expensive. VCSELs do not require a high voltage power supply and do not get hot. The interferometer collects spectra at 0.5cm-1 resolution and uses a well-matching reference library. The sweep rate for 0.5 cm resolution is approximately 1.7 - 2.2 seconds. The interferometer is thermally stabilized to improve stability and sampling accuracy. The sweep is governed by a programmable motor controller which can be factory adjusted to change sweep speed, distance, and direction.

Transfer optics: A multi fixture plate stages the transfer optics to allow the collimated beam from the interferometer to be steered to/from the 10 meter gas cell. The first OAP mirror focuses the the collimated beam from the interferometer to a flat mirror that direct the beam into the gas cell through a 20mm window. The beam exits the second 20mm cell window and expands from the flat mirror to the second OAP mirror that sends a collimated beam to the detector assembly.

Extractive Multi-pass cell: The gas cell is a chamber with specialized mirrors that direct the beam back-and-forth multiple times. A 10-meter (2 liter) gas cell is standard for ambient air monitoring and allows for 40 beam passes within the cell. The cell has fittings that allow the air stream to be flowed into one side (end) and out the the other. An optional heater jacket covers the cell to allow for the temperature to be heated above ambient temperature.

Detector: The RAM2000-EX FTIR has the options of LN2 cooled, cryogenic cooled, TEcooled, or room temperature MCT detectors. The choice of detectors depends the applications target chemicals and desired detection limits.

LN2 cooled: Lowest MDL's for the the MCT, no electromechanical noise
Sensitivity from 700-4500cm-1

Cryocooled: Sterling engine with cryogenic temperatures
Sensitivity from 700-4500cm-1

TE-cooled : Sensitivity from 1800 - 4500 cm-1 (more stable the RT)
Can be turned on/off with simple RJ plug connector

Room Temp: Sensitivity from 1800 - 4500cm-1
Somewhat affected by ambient temperature

Circuit Boards: Five circuit boards control all aspects of component interaction.

Source

Stabilization: Extends IR source light by power stabilization

Located on the IR Source baseplate

ADC : Coverts analog detector signal from preamp to digital

Includes Netburner module to for Ethernet Com
Located on the Enclosure wall

Pre-amplifier: Amplifies the IR voltage receivved on the MCT detector

Heater PID: Programmable temperature control for the gas cell

Elapsed time: Records analyzer 'on' time base in hours

Power Controller Enclosure

The power controller houses the linear DC power supplies. Four voltages are delivered to the FTIR bench to power the circuit boards. The power controller cabinet has space to house an accessory or additional power supply. For extractive gas cells, an air pump can be installed in the accessory location provided the pump does not put off detrimental vibration or heat.

<u>Power outputs:</u>

+12VDC : Power for interferometer, detector cooler, IR Source.

+15/-15 VDC: Power for ADC circuit board

+5 VDC: Power ADC / Ethernet netburner module.

120VAC Power for Cell heater circuit

<u>Switches:</u>

Main: Allows power to switches A,B,C, Accessory (air pump)

A: Interferometer, cooler, source

B: ADC

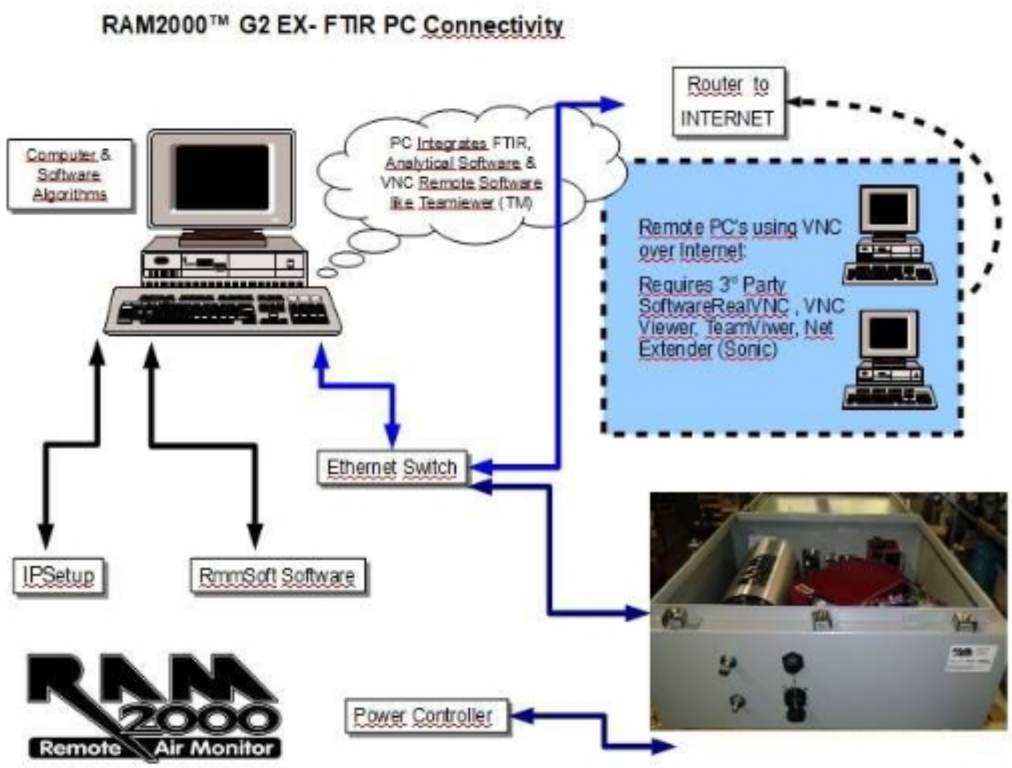
C: Heater

Accessory: Air pump or other

<u>Computer</u>

The RAM2000 EX-FTIR is completely controlled by a PC. The PC should be Win7 or Win10 OS and support Ethernet communication. In the simplest setup, a single Ethernet cable connects the PC to the RAM2000 cabinet. For installations requiring remote connection, a net-switch is suggested to create a LAN that allows the PC and FTIR to be connected to the internet.

Assembly Overview Image: Typical communication control



Assembly

The RAM2000 EX-FTIR is shipped in a crate and should be unpacked and staged before assembly. All components should be visually confirmed and inspected for shipping damage.

A) UNPACKING

Use care to be sure that no components are confused as empty packaging. Note that cables and teflon tubing are very light and could be wrapped in bubble-wrap. Although the system is shipped with protective plastic covering, be sure to inspect for any signs of water intrusion. Save the original crate and shipping foam for future use in case the system has to be shipped at a later date for service.

1. Locate the 200 lb crate with the **EX-FTIR & Power Controller**
2. Remove the **power controller** and set aside.
3. Locate and remove the **cables bag & the teflon line bag**, set aside.
4. Remove foam to reach down and grab **EX-FTIR** from bottom to lift out.
5. Two persons needed to lift the **EX-FTIR** out of crate and set onto bench.

Image 1: RAM2000 EX-FTIR

Image 2: PWR Controller, Cables, Tubing

Image 3: EX-FTIR on Bench

Image 4: Slide and loosen 4 SS Clasps

B) INSPECTION

During shipping, damage can occur. Cables can become loosened, and screws or nuts can fall out, optics can slide, or fixtures could become broken. A careful component inspection can allow quick remedy and prevent additional damage if powered up while broken.

If something looks damaged or out of place, please contact KASSAY immediately.

1. Loosen SS door clasps & slide back to allow door to open.
2. Open spectrometer top door (lid) so that you can see the FTIR bench base & components.
3. Inspect components for any obvious signs of shipping damage.
4. Locate the red inteferometer cover with the RAM2000 sticker on it.
5. Remove the two plastic interferometer lock screws. Save for other shipments.
6. Unpack Power controller (remove top cover to access air pump connections).

Image 5: RAM2000 EX-FTIR Bench

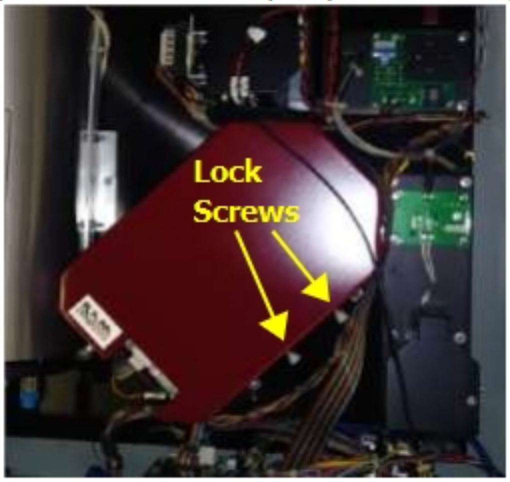


Image 6: Interferometer Lock Screws

Image 7: Power Controller

Image 8: Power Controller with cover off

C) CONNECTIONS

The RAM2000 EX-FTIR has cable connections and two gas cell connections that must be properly configured. The gray 37-pin cable is keyed on both ends so that it can only enter the socket in one rotational orientation.

Note: The pins must slide into the sockets. It is possible to make a mistake and press the pin side of the cable onto the pin side of the bulk connector which could result in damage to the conductors. Be sure that all rocker switches are in the 'OFF' orientation before making any connections.

1. Connect AC line cord to the front of Power controller.
2. Connect socket side of 37 pin gray cable to EX-FTIR (insert keyed slot press in & twist clockwise).
3. Connect pin side of 37 pin gray cable to power controller (insert keyed slot, press in, twist clockwise).
4. Connect Ethernet cable to RAM2000 and to PC.
5. Connect teflon tubing to the bottom Swedgelok of EX-FTIR & hand-tighten (air pulled from pump).
6. Connect other end of tube through power controller besel into the top of air pump (air inlet).
7. AIR FLOW: IN (top)EX-FTIR-> OUT (bottom)-> Tef-Tube -> Air Pump (top)-> Out (bottom) Air Pump.

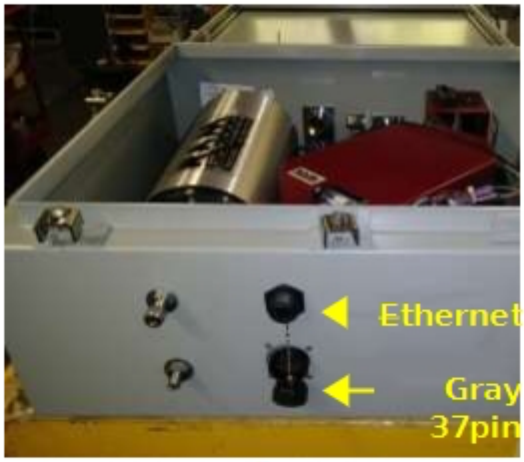


Image 9: Connector locations

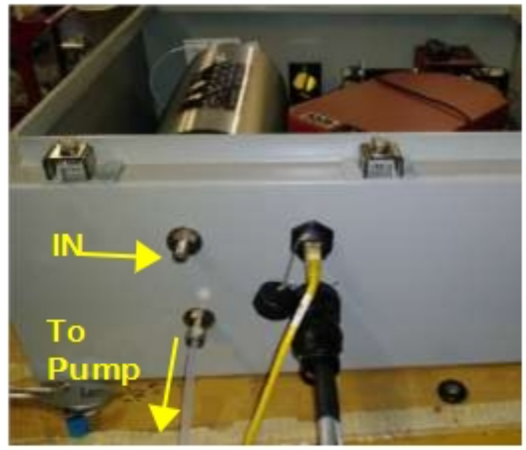


Image 10: EX-FTIR Cables & Teflon Tube

Image 11: Power Controller Connections

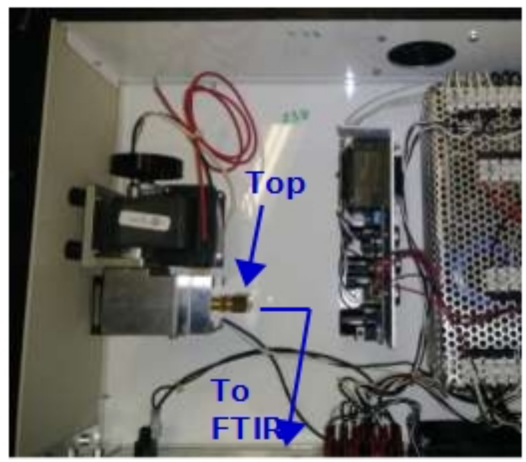


Image 12: Air Pump Tubing (Top of pump)

D) POWER-UP

During power up, it is important to quickly look and listen to system.

[redacted]

CHECKS

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

E) PC & SOFTWARE

In order for the RAM2000 EX-FTIR to communicate to the PC IP settings must be configured. The first step is to determine the PC IP address and network mask. The PC's IP address and MASK must be put into the Netburner module. Once the addresses are correctly configured, the RMMSoft can communicate with the RAM2000 EX-FTIR. (See Appendix for details on figuring the PC interface)

[redacted]

Step 1: Image of IPConfig

[redacted]

Image 12: IPConfig – Note the PC address and Mask in the CMD window

Step 2: Image of IPSetup Utility

[redacted]

*Image 12:IPSETUP- Be sure the first three numbers of the IP addresses of FTIR & PC are the same, but **LAST value must be Unique.***

Step 3: Image of RMMSoft Launched and running alignment

[redacted]

Image 14 :RMMSoft: Run->Alignment (This image uncooled MCT)

Operations

Follow the RMMsoft manual for instruction on data collection and analysis

Please contact: Steve Perry (sperry@kassay.com) cell: 732.979.5192 with any questions.

Appendix: G2 Interface

The GII system is shipped with a factory configured PC and installed software. The following section describes in general how to set up additional PC's.

The RAM2000 G2 system architecture differs from the original system in several ways. The communication link from the RAM2000 to the PC originates from the embedded system controller which is also referred to as a "netburner module." The controller captures the FTIR data and sends it to the PC through a CAT5 (ethernet) cable. “Hand-shaking” protocol between the two systems is accomplished through a TFTP communications link run by the host PC. The below diagram described the devices used to transfer data between the RAM2000 G2 and the PC. The yellow line represents the actual CAT5 cable. The blue line represents the hidden hardware/software used.

[redacted]

The system controller will read and write to the address defined by the TFTP host server. The TFTP server also directs the data to a directory within the host computer to store text and binary (spectra) files which are used by RMMSoft.

Once the interface system is established, there are many possibilities that can be achieved. The RAM2000 can now link to a LAN / WAN via net switches, routers, bridges, and even use wireless communication. No PC board or driver is required, and operating systems can be flexible.

SET UP a new PC interface

Setting up a new communication link between the RAM2000 G2 requires four steps:

[redacted]

Determine the IP address of the PC and gateway

To create a new connection, first determine the IP address of the PC. Both static and dynamic IP addresses are allowable. If routing the RAM2000 into a network switch or router, it is often desirable to set a static IP address for the PC so that the communication link doesn't change. Proper rules need to be followed for IP address assignment. The below example describes how to set up a new PC with a direct CAT5 crossover cable. A crossover cable is an Ethernet cable that is used to connect PC to PC directly. The same steps apply if connected through a network switch or router.

[redacted]

EXAMPLE:

[redacted]

[redacted]

[redacted]

[redacted]

<u>Setting up the RAM2000 G2 embedded system controller (IP Setup netburner module)</u>

The controller can be found when connected to the PC by using a software utility program. The RAM2000 G2 system must be turned on (powered) for the IP address to be broadcast to the IP Setup software.

[redacted]

[redacted]

[redacted]

In the example above [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

The embedded controller (netburner module) values are now set.

Set up the TFTP Server

[redacted]

[redacted]

[redacted]

The TFTP32 software will launch.

Once TFTP32 is started, it will attempt to communicate with RAM2000 G2 controller. [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

When the TFTP and RAM2000 controller are set up correctly, a small placard will flash showing the transfer of the “config.txt” file from the PC to the RAM2000 controller. The correct directory and IP address will be presented in the proper places.

Setting up RMMSoft to communicate to the RAM2000 controller.

[redacted]

[redacted]

[redacted]

To set the TFTP server, [redacted].

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Once the path and address is correct, a small window will flash each time the “Config.txt” file is successfully transferred.

[redacted]

Troubleshooting with [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Manually Launch the [redacted]

[redacted]

[redacted]

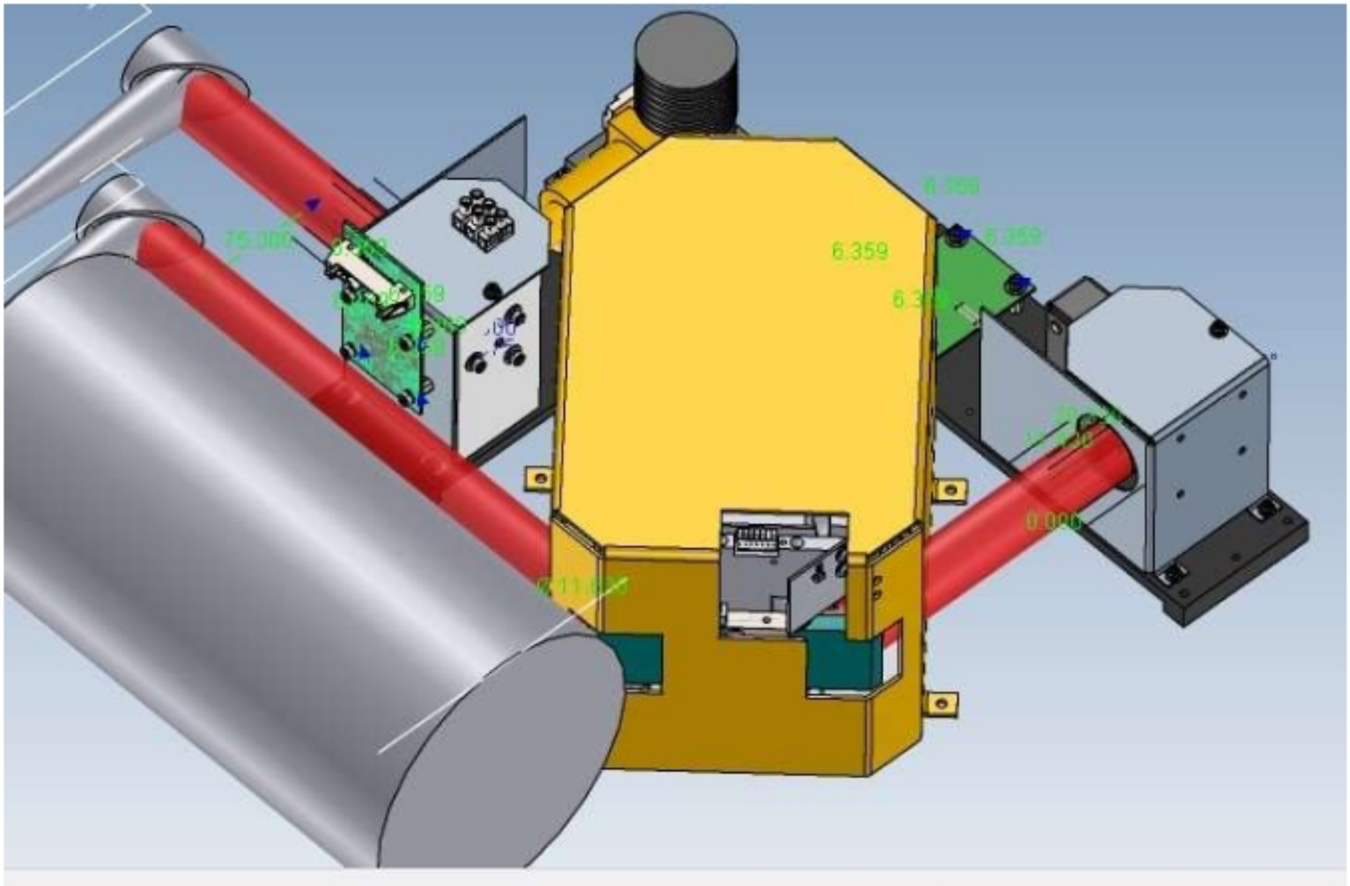
CO[redacted]

[redacted]

Start [redacted]

[redacted]

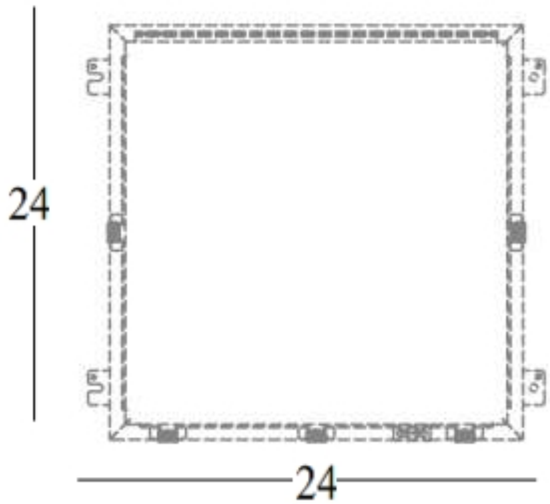
.


6.359

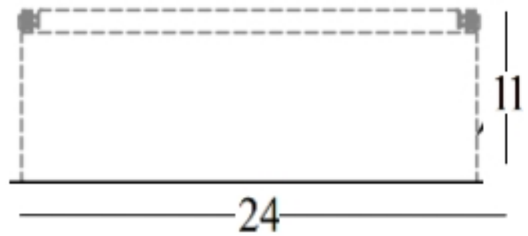
1. **Physical dimensions**

5.1 bench

TOP VIEW



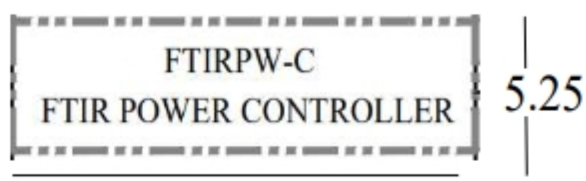
SIDE VIEW



5.2 power supply/ pump assembly

TOP VIEW

SIDE VIEW

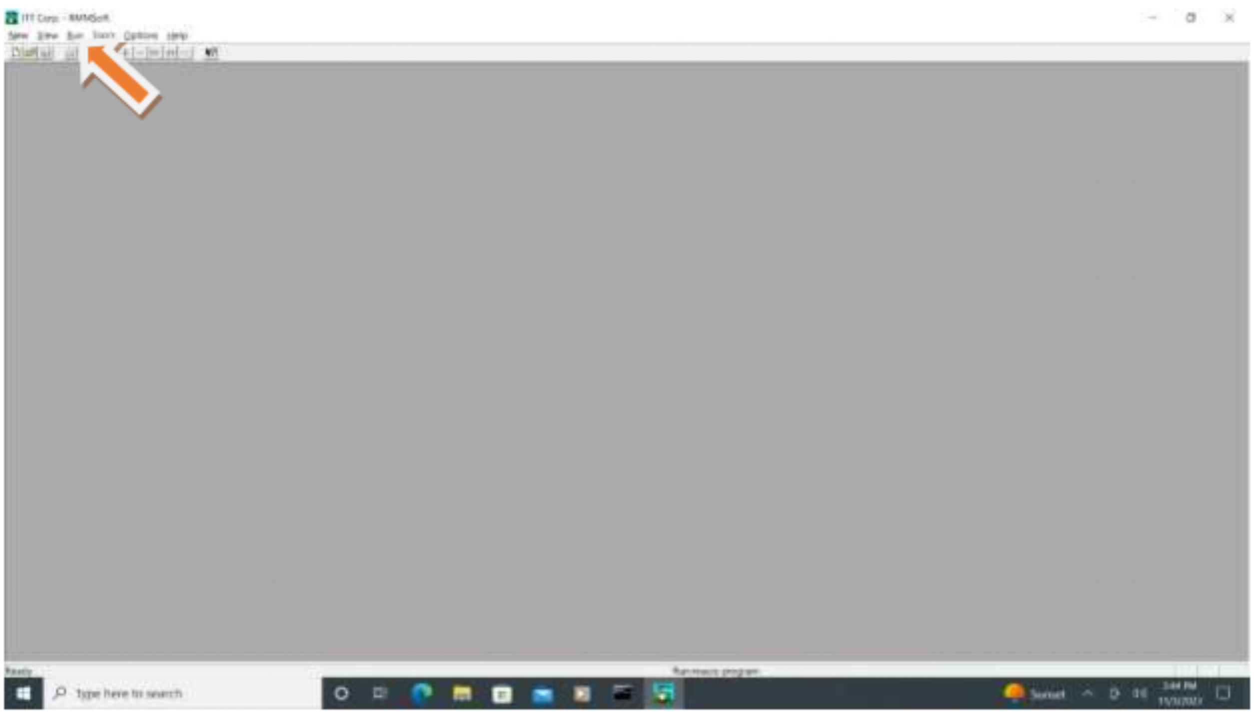


2. Field Operations

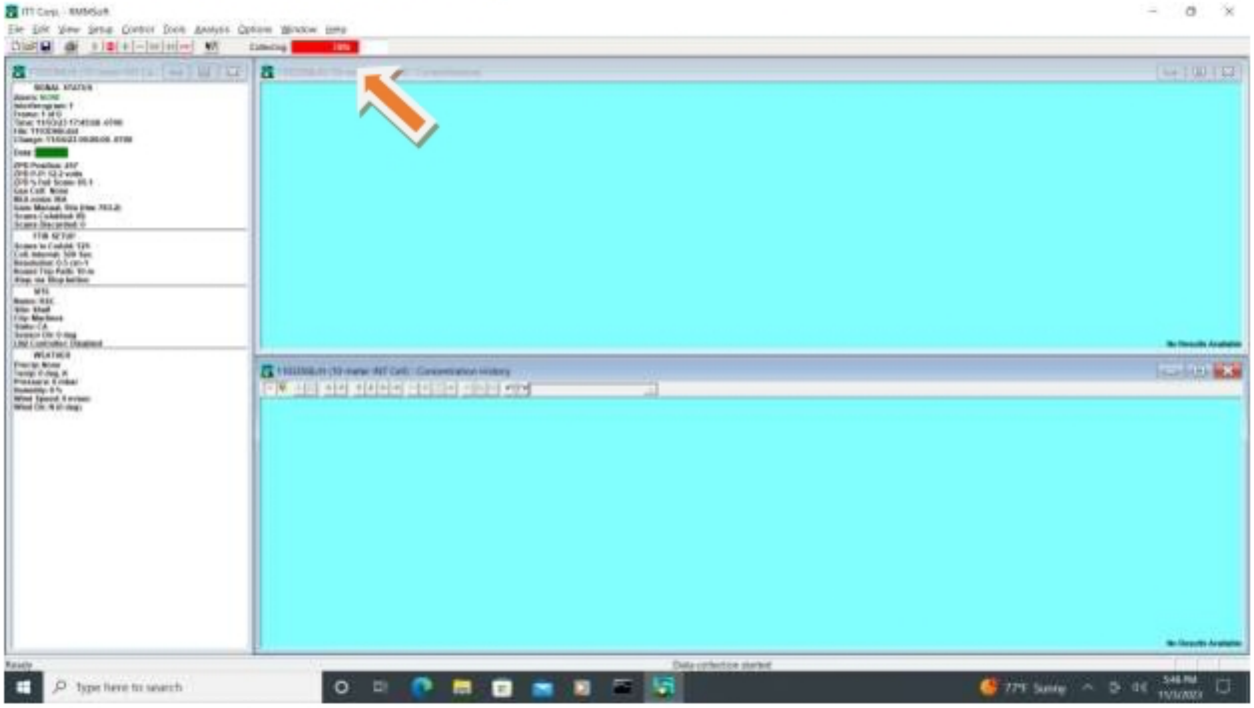
Once the system has been configured for the particular application, routine operation can be carried out with ease. A macro will be used to launch and run the system data collection processes. Consult with the systems administrator to have the software configured for use. Prior to following these steps.

2.1 Running Macro

Upon launching RMMsoft, click run > macro, and select the appropriate file to start. There should only be one macro file in the directory to eliminate guesswork in the field.

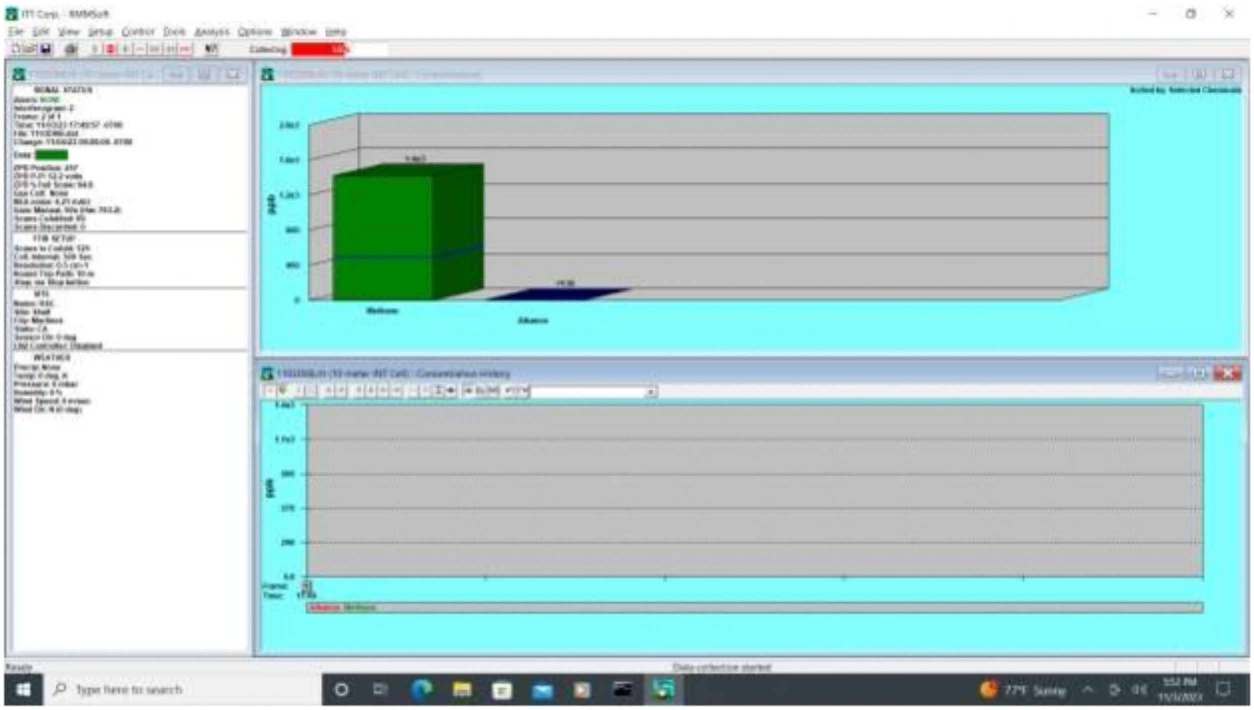


A progress bar will count the percentage of the completed collection cycle. This will be confirmation that the macro is running.



This process for running the macro will be used following all maintenance and QAQC procedures.

Although not required for continued operations, it is good for a technician in training to observe the appearance of the on-screen data following a completed scan cycle. Here we see that the system is displaying measured concentrations of Methane and Alkanes.



3. Calibrations, QAQC

The FTIRs performance needs to be verified periodically to ensure that we meet the requirements of our QAPP (Quality Assurance Performance Plan.) Once a month, we use a NIST traceable permeation tube device to test the FTIRs ability to accurately detect and record data. By following these steps we can perform the task of calibrating the FTIR the same way every time.

3.1 materials list

- VICI Dynacalibrator
- Hexane permeation tubes of a set concentration
- Small crescent wrench
- Laptop

3.2 Routine calibrations description

The calibrations that take place monthly are performed by connecting the dyncalibrator directly to the gas cell of the FTIR and recording the data over the course of about 30 minutes. We must update the website message board prior to the calibrations. Because the levels of the test medium may exceed the alarm threshold, we deactivate the task scheduler z-cron and set the FTIR to test mode on the data logger. The data files are stored on the local PC in a folder marked for that months activity.

3.2 Calibration steps

As a prerequisite for performing QA, [redacted]

[redacted]

[redacted]

[redacted]

4 Maintenance

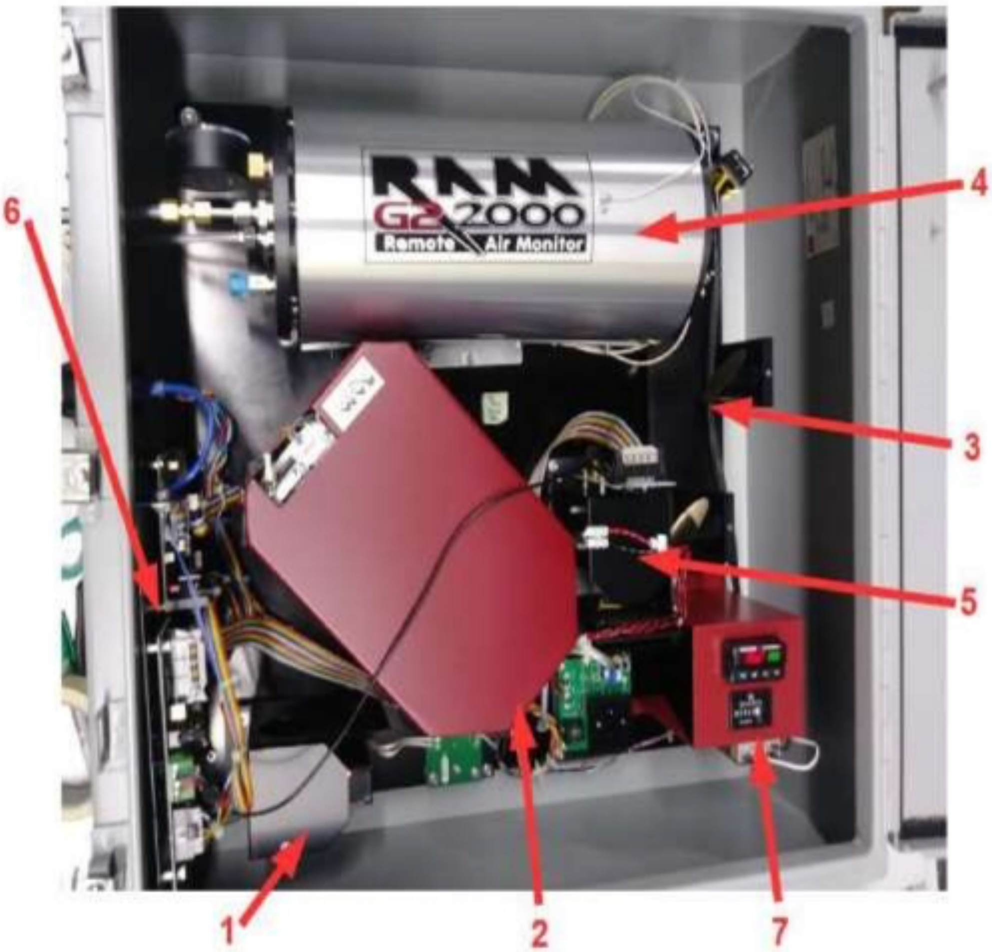
4.1 Manufacturers recommended maintenance intervals.

Component	Recommendation	Component Type	Expected Life	Maintenance Interval	Parameter to Record or Adjust
FTIR Spectrometer					
Interferometer Assembly					
VCSEL Laser	keep inventory	Consumable	9 mos – 2 years	Inspect Monthly	visual brightness and sweep
Index Laser	keep inventory	Consumable	2 years	Inspect Monthly	visual brightness and sweep
Motor Coil		Consumable	2-4 years	Not Inspectable	N/A
Motor Board PCB		Capital Spare		Upon Failure	N/A
Index Laser PCB		Capital Spare		Upon Failure	N/A
VCSEL Laser detector PCB		Capital Spare		Upon Failure	Record: detector voltage DC
Mirrors (1st surface coating)	30-90 day lead time	Consumable – Long life	depends on air quality & dust	Inspect Quarterly	Record: surface quality metric
Beam Splitter	30-90 day lead time	Consumable – Long life	depends on air quality & dust	Inspect Quarterly	Record: surface quality metric
Compensator Optic	30-90 day lead time	Consumable – Long life	depends on air quality & dust	Inspect Quarterly	Record: surface quality metric
Ribbon Cable to PCB		Capital Spare		Upon Failure	N/A
Power Cable (from Bulkhead)		Capital Spare		Upon Failure	N/A
Scan indicator Lamp		Consumable – Long life	5 year	Inspect Quarterly	visual brightness and sweep

Internal Interferometer Alignment					
Alignment of Interferometer mirror				Adjust as needed	Dual pot-adjust rear interferometer
Alignment of VCSEL Detector				Adjust as needed	Single pot adj and detector location
Alignment of VCSEL mirrors				Adjust as needed	interferometer front & top
Alignment of index Laser				Adjust as needed	interferometer top
Laser Wavenumber Calibration				Adjust as needed	record software
Interferometer Heat Stabilization					
Strip Heater		Capital Spare		Upon Failure	sides of red cover
Thermocouple Sensor		Capital Spare		Upon Failure	front side of cover
Watlow Temperature Controller		Capital Spare		Inspect Monthly	Record Temp & Set point
IR Source Plate					
High Temperature IR Source	keep inventory	Consumable	2-5 years	Inspect Monthly	Record hot-spot location
90DEG parabolic Mirror	30-90 day lead time	Consumable – Long life	depends on air quality & dust	Inspect Quarterly	Record: surface quality metric
Ignitor Board PCB	30-90 day lead time	Capital Spare		Upon Failure	
Alignment of Optics				Adjust as needed	Record ZPD P-P Voltage

Steering Beamsplitter	30-90 day lead time	Consumable – Long life	depends on air quality & dust	Inspect Quarterly	
Two-axis adjustment				Adjust as needed	Record ZPD P-P Voltage
Focus Assembly					
90DEG parabolic Mirror	30-90 day lead time	Consumable – Long life	depends on air quality & dust	Inspect Quarterly	Record: surface quality metric
¼ wave flat mirror	30-90 day lead time	Consumable – Long life	depends on air quality & dust	Inspect Quarterly	Record: surface quality metric
igus glides		Capital Spare		Upon Failure	
Detector Assembly					
K-508 Cryocooler	keep inventory	Consumable	12 months needs refurbishment	Inspect Monthly	
90DEG parabolic Mirror	30-90 day lead time	Consumable – Long life	depends on air quality & dust	Inspect Quarterly	Record: surface quality metric
Pre-Amp Circuit PCB		Capital Spare		Upon Failure	
SMA Coax Cable		Capital Spare		Upon Failure	
Alignment of Optics				Adjust as needed	Record ZPD P-P Voltage
ADC / Ethernet Combo Board					
ADC Board		Capital Spare		Upon Failure	
Netburner Module		Capital Spare		Upon Failure	
Ribbon Cable (ADC to PreAmp)		Capital Spare		Upon Failure	
SMA Cable – PreAmp to ADC		Capital Spare		Upon Failure	

Elapsed Time Meter		Capital Spare		Upon Failure	
Power Controller Assembly					
12VDC Power Supply	keep inventory	Consumable – Long life	depends on heat load and input pwr	Inspect Monthly	Record Output Voltage
Tripple output Power Supply	keep inventory	Consumable – Long life	depends on heat load and input pwr	Inspect Monthly	Record Output Voltage
24VDC Power Supply (Moog)	keep inventory	Consumable – Long life	depends on heat load and input pwr	Inspect Monthly	Record Output Voltage
power indicator Lamp (FTIR)	1 week lead time	Consumable – Long life	5 year	Inspect Quarterly	Record on/off
Power indicator Lamp (Moog)	1 week lead time	Consumable – Long life	5 year	Inspect Quarterly	Record on/off
Fan	1 week lead time	Consumable – Long life	5 year	Inspect Quarterly	Record on/off
Fuse	keep inventory	Capital Spare		Upon Failure	
Cable		Capital Spare		Inspect Monthly	cable chaffing or binding
Fan – Filter	1 week lead time	Consumable	depends on air quality & dust	Inspect Monthly	
37-Pin Mil-Spec Cable to FTIR		Capital Spare		Upon Failure	



1-IR Source
2-Inteferometer
3-Transfer Optic
4-Extractive 10m Cell
5-Detector
6-Circuit Boards
7-Temp Controller

4.2 VCSEL laser replacement.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

4.3 Index laser replacement

[redacted]

[redacted]

4.4 IR lamp change

[redacted]

[redacted]

5. Flow charts

5.1 QA calibrations

[redacted]

5.2 VCSEL Replacement

[redacted]

VCSEL replacement continued

[redacted]

5.2 index laser replacement

[redacted]

5.3 IR lamp change

[redacted]

IR lamp change continued

[redacted]

OGD user guide

User guide

Rev. 1 – November 2023

Prepared by D. Buffi

<u>OGD user guide</u>

Contents

6 Installation and startup

6.1 Installation

As specifications vary from make and model, refer to the manufacturer's manual for mechanical installation. The OGD can be installed on a wall or a metal pipe and is designed to work best in a vertical orientation. We take the OGDs analog output through an ADC (analog to digital converter) which then sends it to our router and logger via CAT6.

An example of the MRC OGD signal flow

[redacted]

6.2 Startup

Startup requires that we have all components in the system onsite as well as test gasses to calibrate the sensors and data logger. NOTE – consult the manufacturers manual for specific pinout of the make/model OGD you will be installing.

The required materials are as follows:

Parts	Tools/PPE
[redacted]	[redacted]

1. Connect all components as per the wiring diagram. The WAGO connectors can be used to join the ground wires if the terminal blocks are not practical for the specific installation. Mount all components in a junction box or weather enclosure rated for your application.

2. Power on all components and observe startup. The logger will now need to be configured to see the same gas concentration that the OGD sees. The logger home page looks like this.

[redacted]

3. Click over to the add tab and enter in the information for the ADC. [redacted]

[redacted]

4. The Cal OS (offset) can be set by running zero air and test gas through the OGD while watching concentrations on the analyzer display and the logger data tab. This will be typically be a joint effort between field technician and admin or remote support.

5. Please note that although the concentration of test gas is very low and not flammable, we always treat the process of attaching and operating a gas regulator with the utmost caution. It is important to inspect the regulator and cylinder for signs of wear before using it and to know how it functions. With the test gasses ready for use, we can systematically apply them to the OGD sample inlet and calculate the Cal offset.

6. Once configured and calibrated, the logger view will look like this.

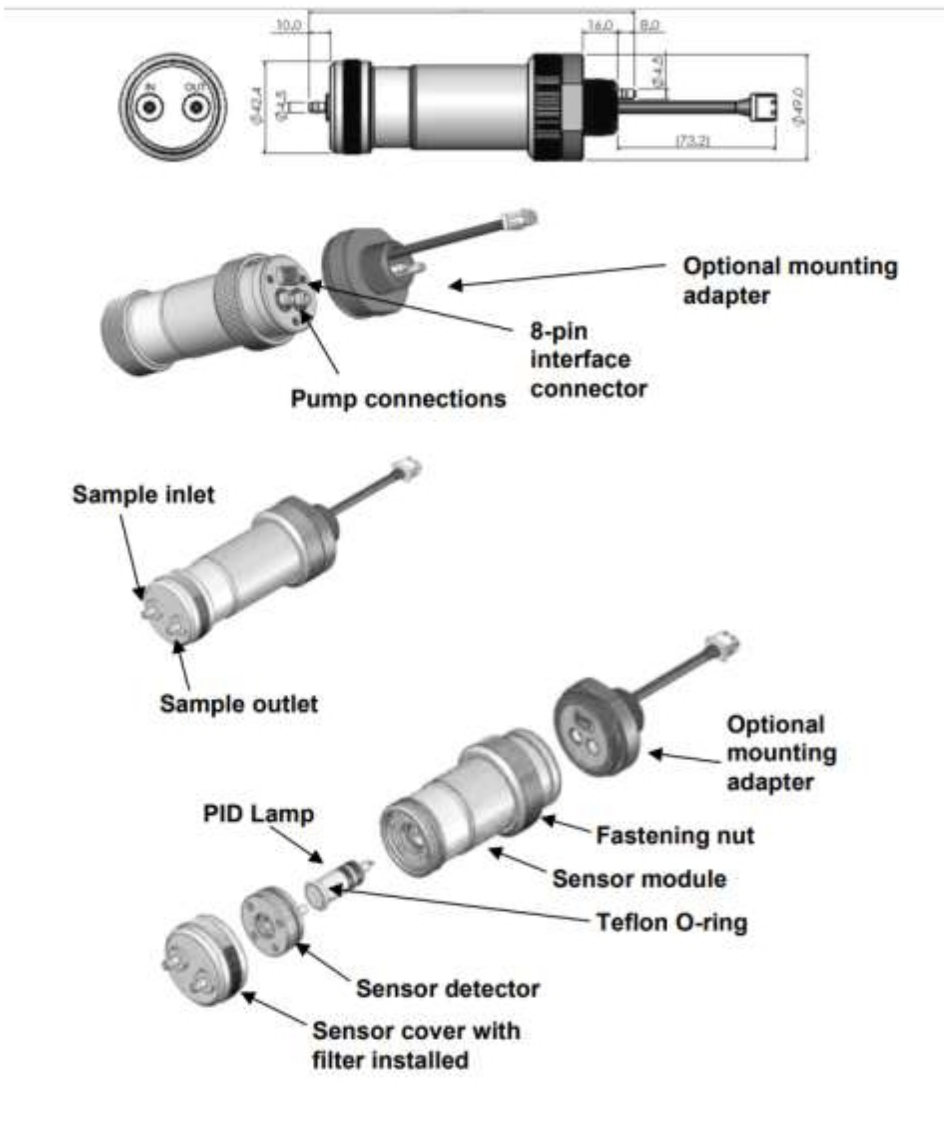
[redacted]

7. To put the logger [redacted]

7 Maintenance

7.1 [redacted] – to be done quarterly

Supplies	Tools/PPE
[redacted]	[redacted]



1. Inform on call that you are beginning the task. Update the message board, halt the z-cron task and switch the logger to test mode.

2. The OGD does not need to be powered down to perform the maintenance. [redacted]

3. The sensor module can be broken down by hand. The exploded view looks like this. [redacted].

[redacted]

This is what a clean sensor module looks like. [redacted]

[redacted]

This is what a clean sensor detector and dust cover look like.

[redacted]

We use external moisture filters on the sample inlet.

[redacted]

And a detail of the electrostatic shield installed on the sensor detector, held on with the contact legs.

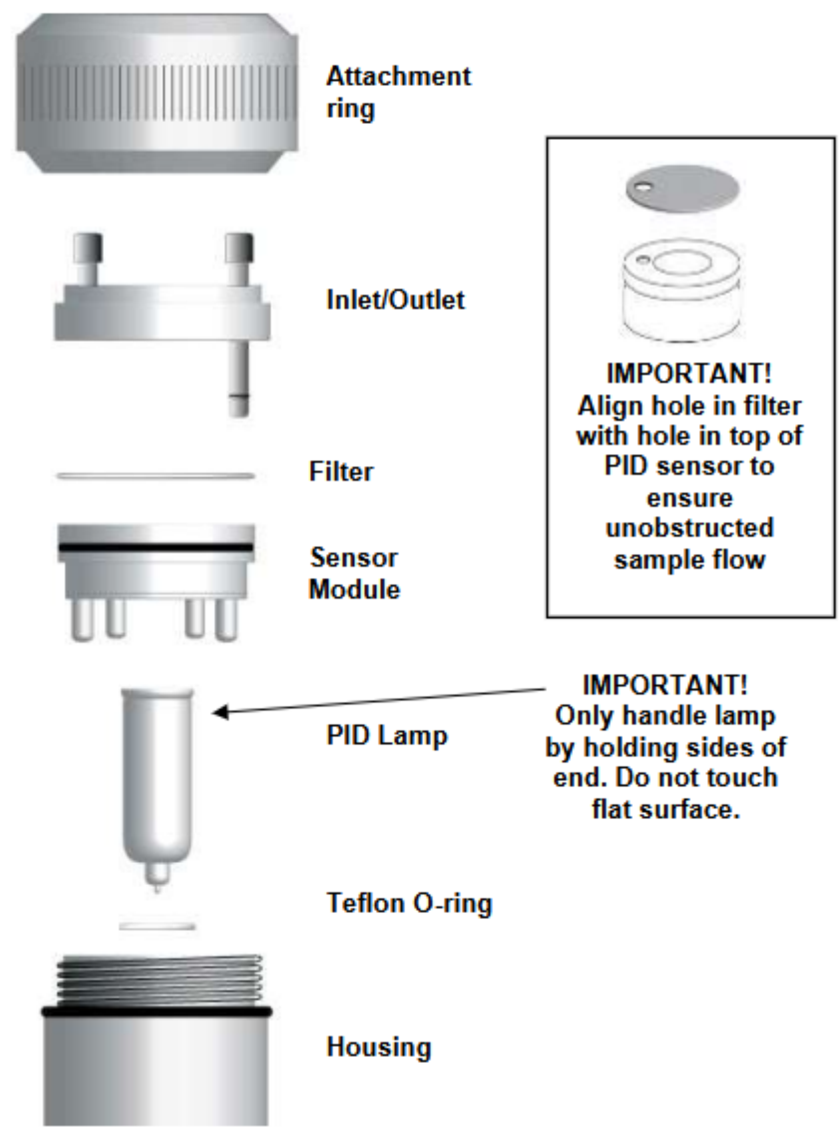
From the manufacturers' manual:

Replacing the Lamp And Filter

The sensor module is shipped with the lamp, sensor, and stainless- filter installed. Periodically check the filter for dirt and contamination, which can impact the reading and response time.

Note: Always turn off power to the DigiPID before checking and servicing any parts. After inspection and/or replacement of parts, recalibrate the instrument.

The lamp and sensor are not interchangeable with parts from other manufacturers; use only Honeywell Analytics replacements. Use of non-Honeywell Analytics components will void the warranty and can compromise the safe performance of this product.



Replacing The Sensor's Teflon UV Shield

On the underside of the sensor module is a Teflon UV Shield that should be replaced every 90 days, in order to ensure sensor accuracy.

1. Dismantle the DigiPID as shown, and remove the Sensor Module. [redacted]

[redacted]

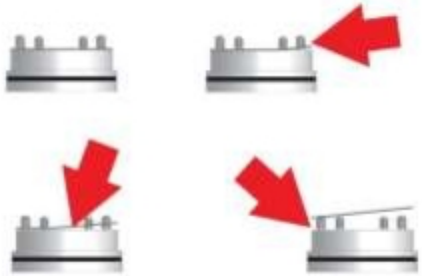
[redacted]

[redacted]

[redacted]

5. [redacted]

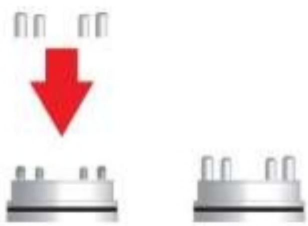
[redacted]



[redacted]

[redacted]

[redacted]



[redacted]

[redacted]

Sensor & Lamp Cleaning/Replacement

Clean the PID sensor module, the lamp and housing only if:

[redacted]

[redacted]

[redacted]

Cleaning The PID Sensor

Place the entire PID Sensor Module [redacted]

[redacted]

[redacted]

Cleaning The Lamp Housing Or Changing The Lamp

If the lamp does not turn on, the instrument will display an error message to indicate replacement of the lamp may be required.

1. If the lamp is operational, clean the lamp window surface and the lamp housing by wiping it with isopropanol using a cotton swab using moderate pressure. After cleaning, hold the lamp up to the light at an angle to detect any remaining film. Repeat the process until the lamp window is clean. Never use water solutions to clean the lamp. Dry the lamp and the lamp housing thoroughly after cleaning.

   CAUTION: Never touch the window surface with the fingers or anything else that may leave a film. Never use acetone or aqueous solutions.

[redacted]

[redacted]

[redacted]

7.2 pump replacement

We can replace the pump in the OGD [redacted]

[redacted]	[redacted]
[redacted]	[redacted]

After powering down the OGD. Follow the steps to take it out of service. [redacted]

[redacted]

[redacted]

6. The pump is shown [redacted].

[redacted]

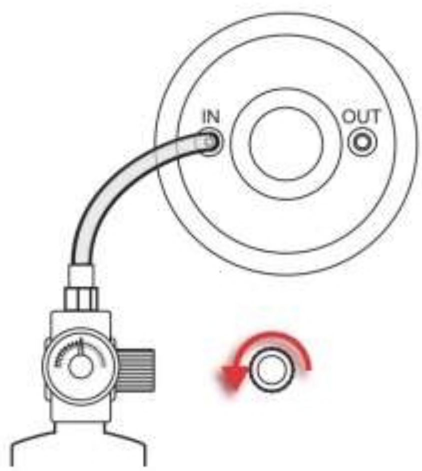
8. QAQC calibrations

WARNING

The calibration of all newly purchased Honeywell Analytics instruments should be tested by exposing the sensor(s) to a known concentration calibration gas before the instrument is used or put into service. For maximum safety, the accuracy of the RAEGuard 2 PID should be checked by exposing the sensor to a known concentration calibration gas.

The RAEGuard 2 PID is calibrated using a two-point calibration process. First, use a "zero gas." Then use a "span gas" containing a known concentration of a standard reference gas, to set the second point of reference.

Note: Zero calibration must be performed before span calibration.

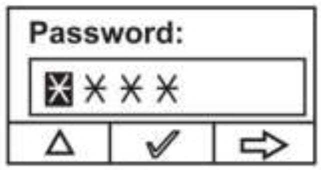


RAEGuard 2 PID connected to gas bottle.

To perform a calibration, you need a cylinder of zero gas and a cylinder of span gas.

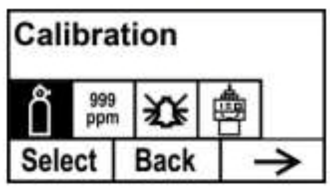
Zero calibrations

1. Connect the zero gas cylinder to the gas inlet ("IN") port on the RAEGuard 2 PID.
2. In measurement mode, use the magnet key to press [+], [-], and then [MODE] in sequence.
3. Input your password, followed by [-].

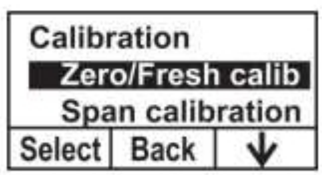


The instrument enters the calibration menu.

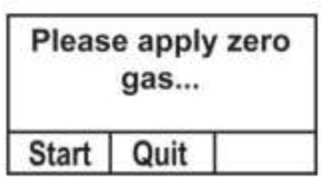
4. Press [+] to enter the Calibration menu.



5. Press [-] until "Zero/Fresh calibration" is highlighted.



Press [+], and this screen appears:



6. Start the gas flow.

7. Press [+]. A countdown screen is shown as the calibration is performed:

Zeroing... 30		
		Abort

Note: You may abort the calibration during the countdown by pressing [-]. If you stop the calibration, the process stops and this screen is displayed before the menu screen is shown:

Zero aborted!		

8. Once the calibration is complete, this screen is shown:

Zero is done! Reading=0.0ppm		
		Abort

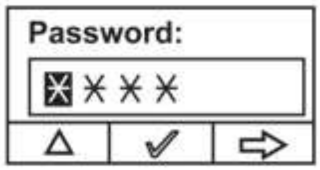
9. If the calibration is not successful, and you see the "Zero Calibration Failed" message, check that the inlet is not blocked and that there are no other problems before retrying.

Note: After zero/fresh calibration is complete, and with zero gas still applied, copy the numbers shown in the display and add these to the current Zero Offset.

1. Connect the calibration gas cylinder to the gas inlet ("IN") port on the RAEGuard 2 PID.

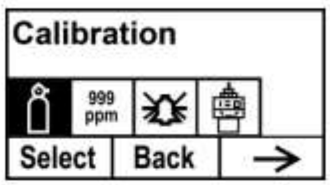
   Note: Make sure the labeled concentration of calibration gas matches the value that is set in the RAEGuard 2 PID.

2. If the RAEGuard 2 PID is not already in Programming Mode, use the magnet key to press [+], [-], and then [MODE] in sequence.
3. Input your password, followed by [-].

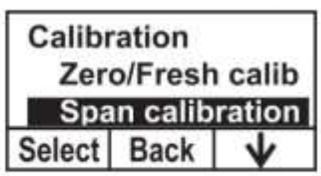


The instrument enters the calibration menu.

4. Press [+] to enter the Calibration menu.



5. Press [-] until "Span calibration" is highlighted.



6. Press [+], and this screen appears:

C.Gas=Isobutene Span=100.0ppm Please apply gas1		
Start	Quit	

7. Start the gas flow.

8. Press [+]. A countdown screen is shown as the calibration is performed:

C.Gas=... Span=100.0ppm Calibration... 30		
		Abort

Note: You may abort the calibration during the countdown by pressing [-]. If you stop the calibration, the process stops and this screen is displayed before the menu screen is shown:

Span Low aborted!		

9. Once the calibration is complete, this screen is shown:

Span Low is done! Reading=100.0ppm		
		Abort

10. If the calibration is not successful, and you see the "Span Low Failed!" message, check that the inlet is not blocked, the sensor or lamp are not fouled or damaged, and there are no other problems before retrying.