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	

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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

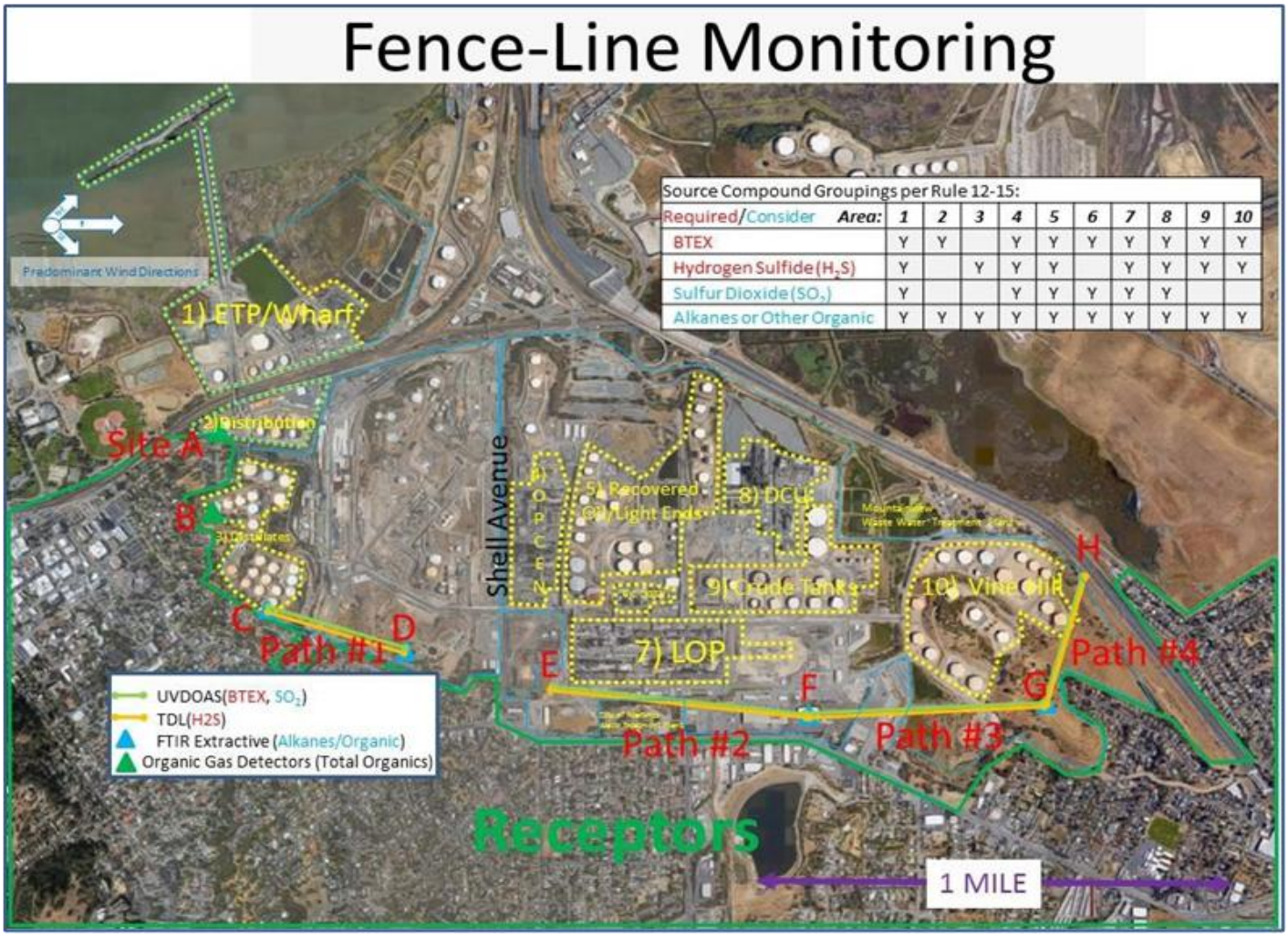


Table 1.1 - Monitoring Site Locations

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

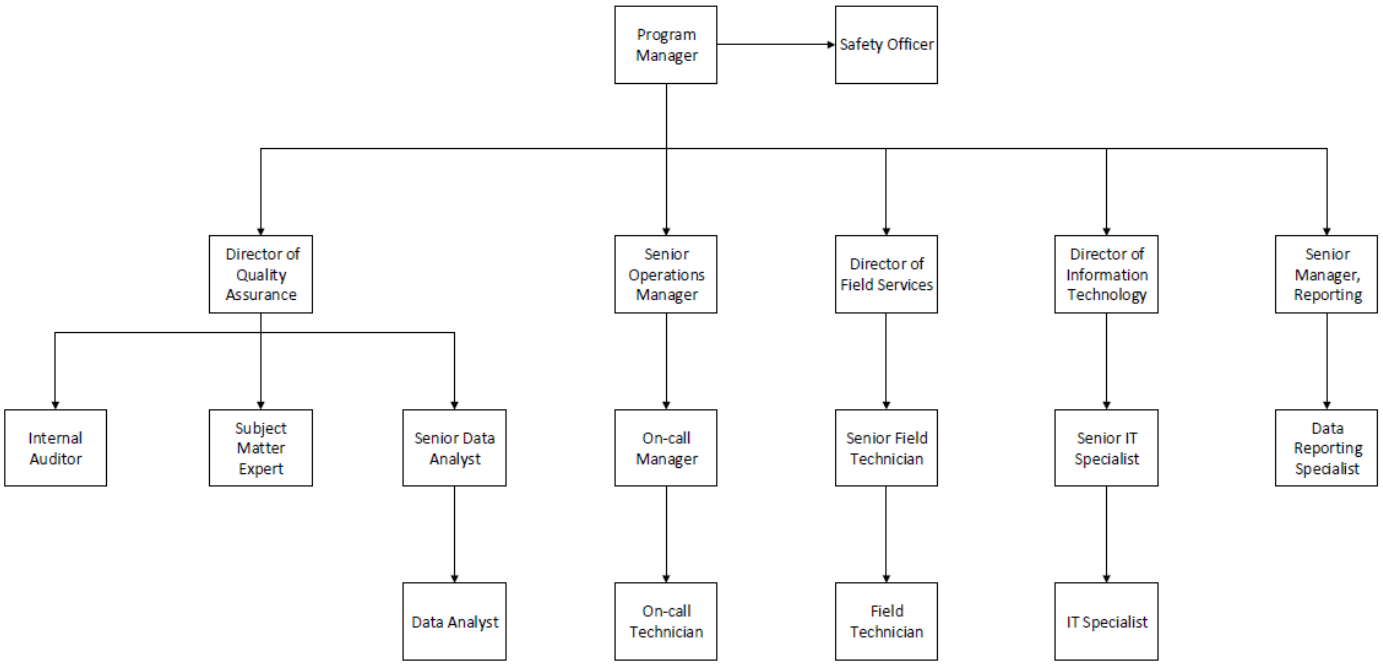
Point Source Monitor	Detection Limits	
	MDL (ppb)	**UDL** (ppb)
Total Alkanes	75	4,200
Total Organics	10	100,000

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.

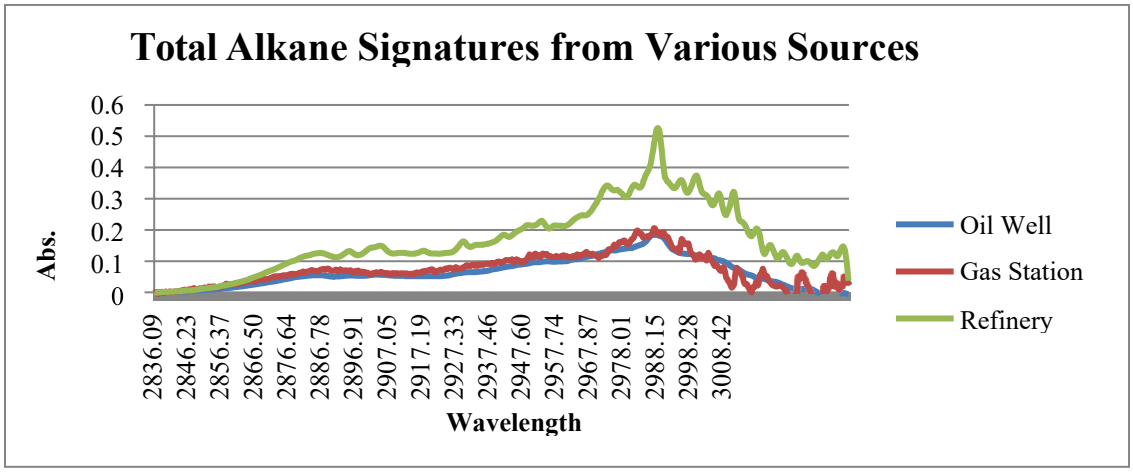
The data output includes the quantified results of all gases in the light spectra, which can be used as real-time performance checks. For example, quantified results for ozone should track ozone concentrations collected by BAAQMD at various stations located throughout the Bay Area. Since the system quantifies 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 $\leq$ 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 $\leq$ 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 $\leq$ 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 $\leq$ 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 $\geq$ 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 $\leq$ 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 $\leq$ 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 $\leq$ 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 $\leq$ 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 $\leq$ 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 $\leq$ 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 $\leq$ 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 $\leq$ 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

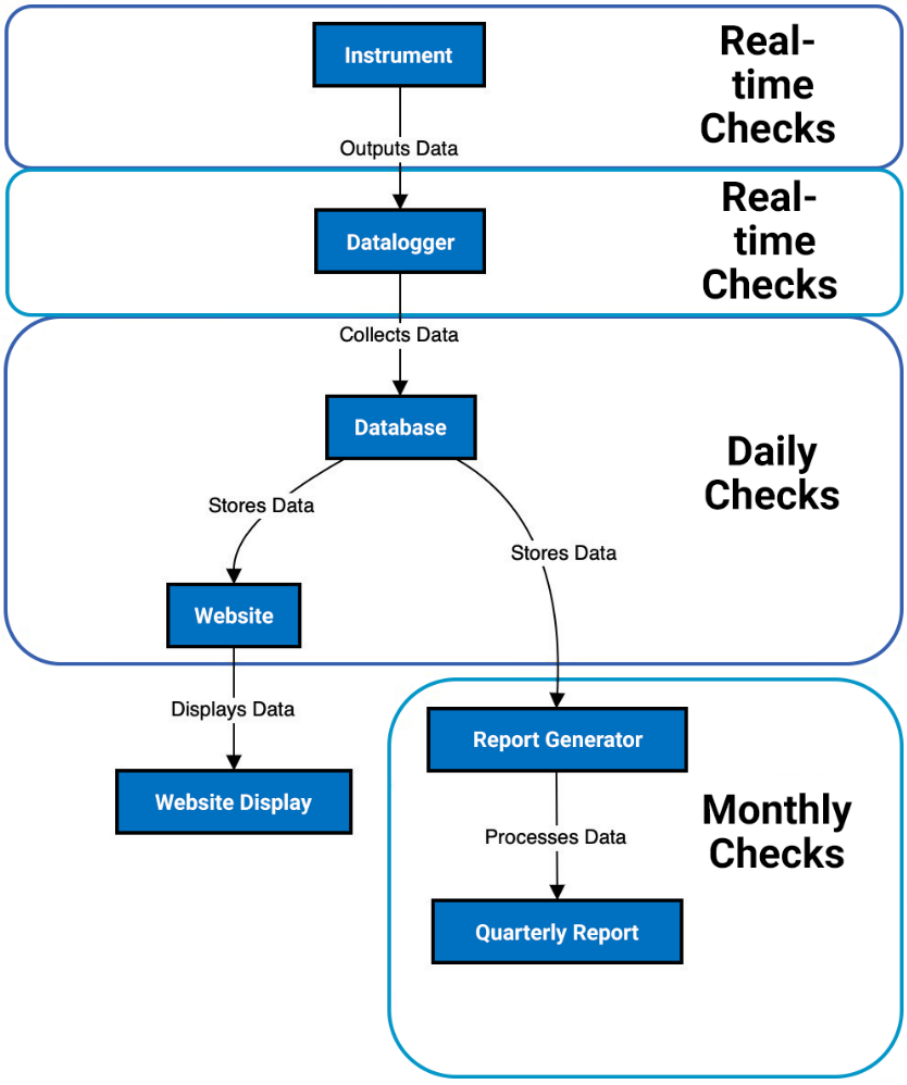
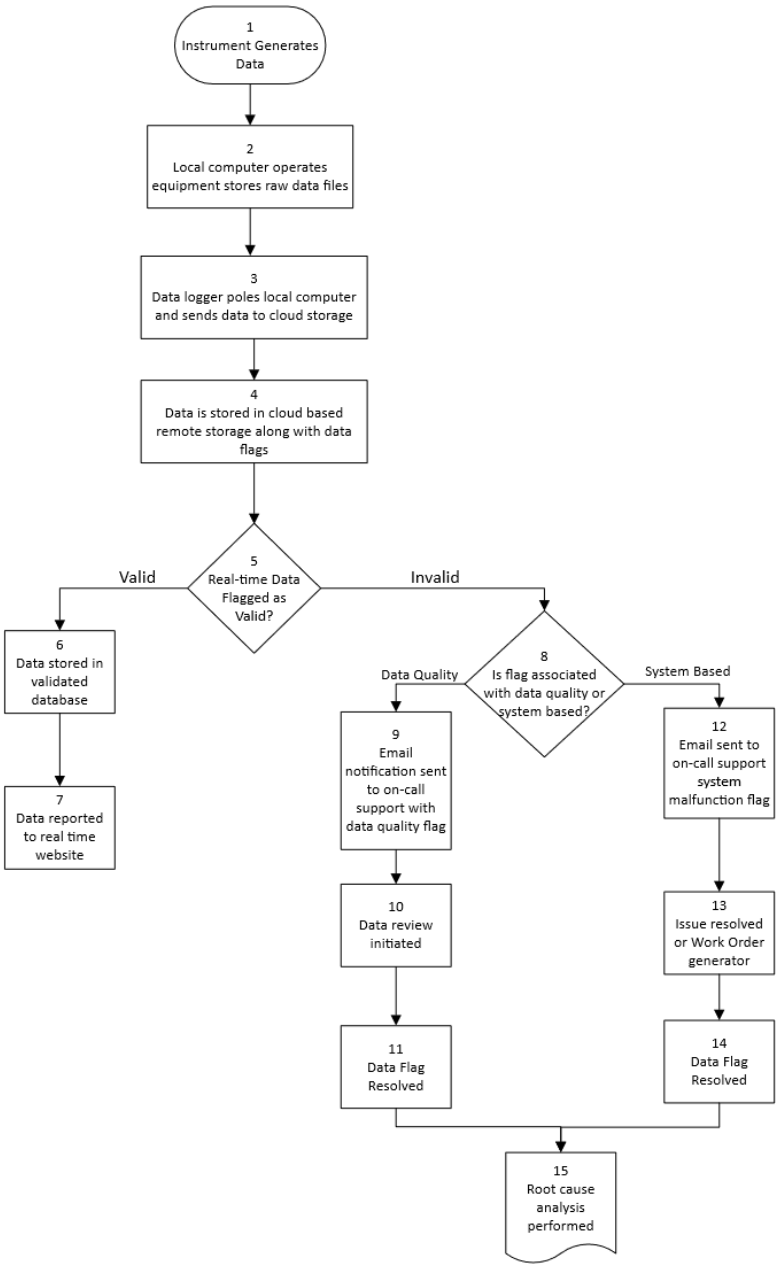


Figure 5.2 – Detailed Data Flow

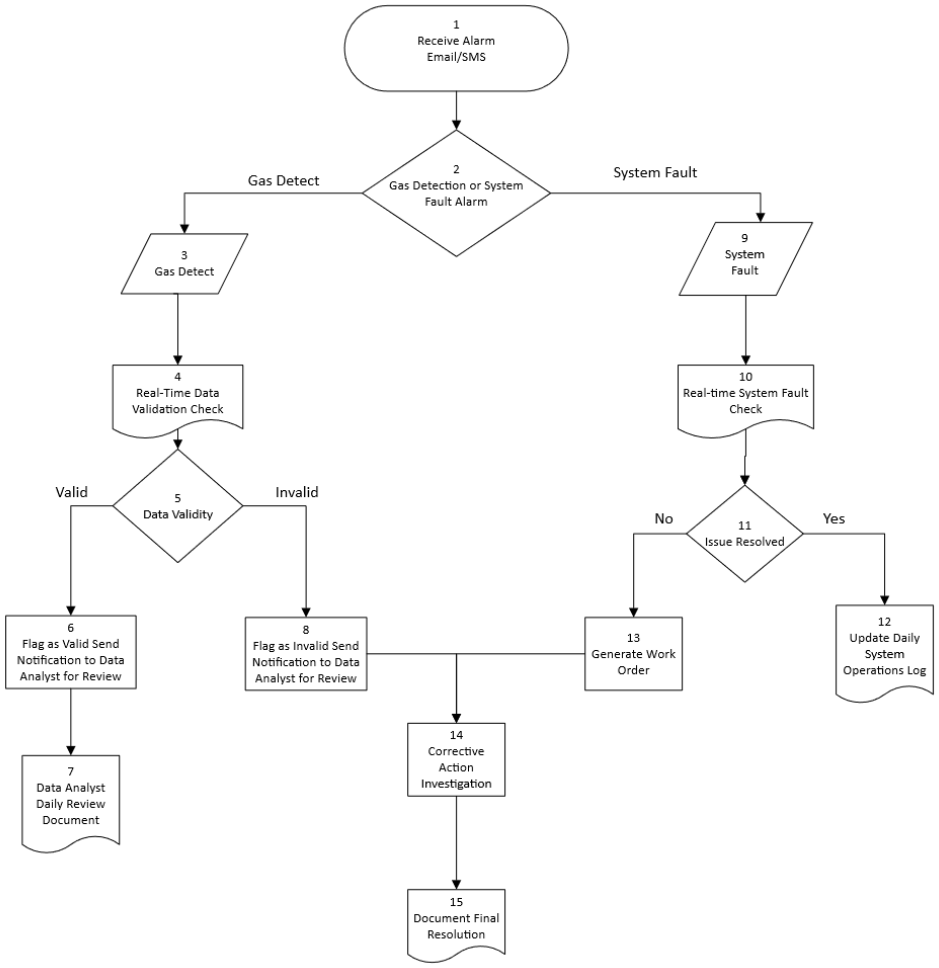


Data Flagging

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