

Quality Assurance Project Plan for the Shell Martinez Refinery Fence-Line Monitoring Program

Revision 3

Shell Martinez Refinery

Project Manager Date

Quality Assurance Manager Date

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Distribution List

Shell Martinez:

Program Manager -

Contractor:

Program Manager

Quality Assurance Manager

Data Processing Manager

Field Technician

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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

MQO – Measurement Quality Objectives

PPB - Parts Per Billion

QA/QC – Quality Assurance / Quality Control

OEHHA – Office of Environmental Health Hazard Assessment

MET – Meteorological Station.

QAPP – Quality Assurance Project Plan

SMBC – Shell Martinez Business Center (Main Office Building)

SMR – Shell Martinez Refinery

SO₂ – Sulfur Dioxide

TDL – Tunable Diode Laser

TRI – Toxic Release Inventory

UV-DOAS – Ultraviolet Differential Optical Absorption Spectroscopy

UDL – Upper Detection Limit

Section 1 - Fence-Line Monitoring Overview

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

Description of the Fence-Line Monitoring Program

A complete description of the Fence-Line Monitoring program is included in the Shell Air Monitoring Plan. The program is comprised of open-path air monitoring systems for the detection and quantification of benzene, ethylbenzene, hydrogen sulfide, sulfur dioxide, toluene, and xylene. Total Alkanes are measured using extractive FTIR air monitoring systems. Total Organics are measured with Organic Gas Detectors. Meteorological conditions are measured using EPA compliant MET equipment. Figure 1.1 presents a map of the refinery showing the locations of the air monitoring equipment. Table 1.1 presents the site location for each piece of equipment.

Figure 1.1 - Map of Fence-line Monitoring Program

Fence-Line Monitoring

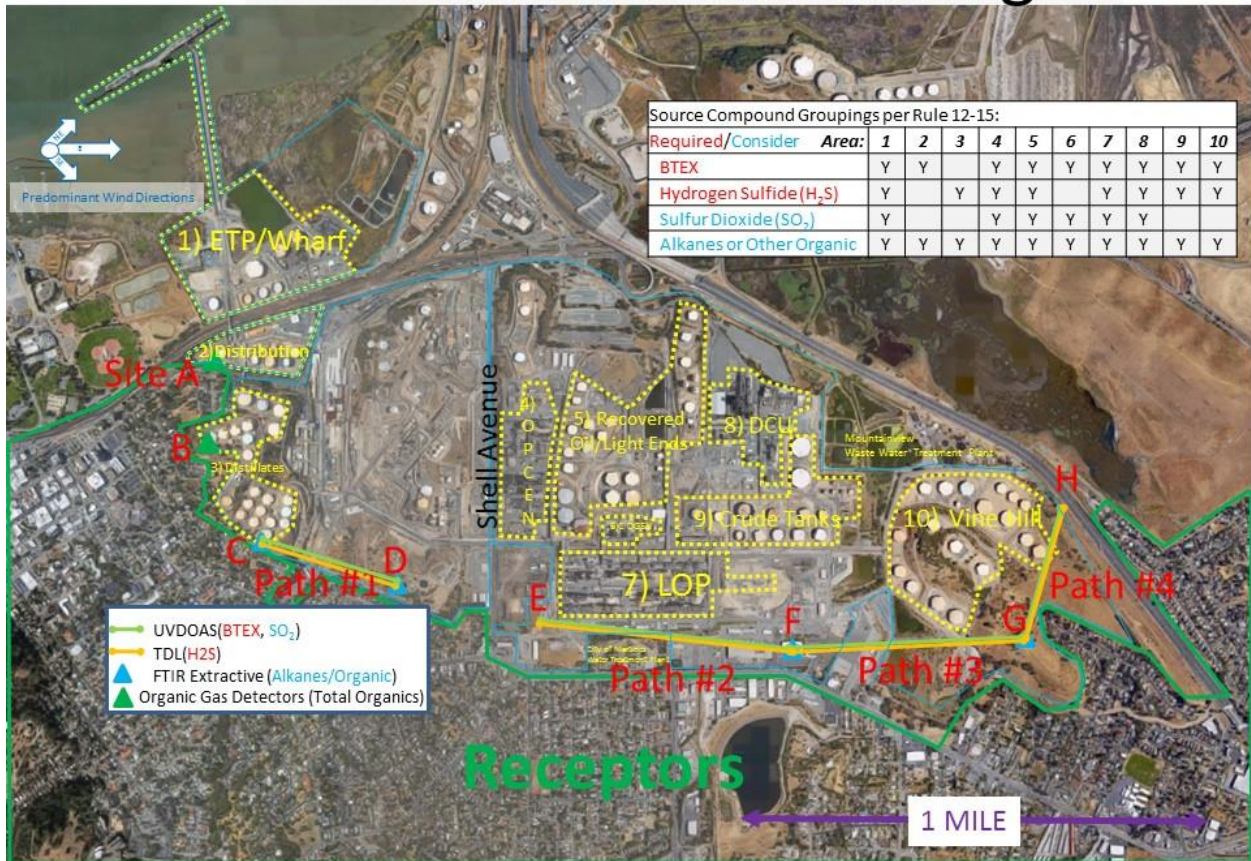


Table 1.1 - Monitoring Site Locations

Site # Name	GPS (North)	GPS (West)	Elevation (Feet)	Instrument
Site A	38°01'19.77"N	122°07'45.22"W	35	Organic Gas Detector
Site B	38°01'10.47"N	122°07'45.20"W	175	Organic Gas Detector
Site C S Distillates	38°00'59.26"N	122°07'35.22"W	164	UV DOAS Source FTIR Extractive TDL Reflector
Site D Firewater Tanks	38°00'55.23"N	122°07'17.78"W	211	UV DOAS Receiver FTIR Extractive TDL Base Unit
Site E SW LOP	38°00'51.08"N	122°06'56.10"W	91	UV DOAS Source TDL Reflector
Site F SMBC	38°00'47.72"N	122°06'23.41"W	80	Two (2) UV DOAS Receivers Two (2) TDL Base Units FTIR Extractive
Site G Vine Hill	38°00'48.69"N	122°05'49.60"W	237	UV DOAS Source, Receiver TDL Base Unit, Reflectors FTIR Extractive
Site H I-680	38°01'01.66"N	122°05'44.38"W	102	UV DOAS Source TDL Reflector

All air monitoring equipment specified for the SMR fence-line system are specified to collect data on five-minute averages. All air monitoring equipment specified for the SMR will meet a minimum of 75% completeness on an hourly basis 90% of the time based on annual quarters. Atmospheric conditions beyond the control of the refinery that affect accurate measurements, such as dense fog, shall not be counted against data completeness requirements if appropriate meteorological measurements document time periods when these conditions exist. Data from the monitoring stations will be transmitted to an Internet website where the real-time results can be viewed by the public. The real-time website page will be incorporated into a larger website that will present additional resources to assist in the interpretation of the data. Tables 1.2 and 1.3 summarize the gases included in the fence-line program and the technology used to detect them along with the lower and upper detection limits (LDL and UDL). LDL for the data generated by the equipment are normally set to be at least 2 times the manufacturer's claimed detection limit. This is done to minimize the occurrence of false detections being reported to the real-time public website as these lower limits are often generated under ideal conditions and if the system is operating in less than ideal conditions (such as when there's fog or rain) the system will generate false detections.

Table 1.2 – Detection Limits for Gasses Monitored by Open-Path Systems

	Path 1		Path 2		Path 3		Path 4	
Distance (m)	445		810		825		435	
Gas	LDL (ppb)	UDL (ppb)	LDL (ppb)	UDL (ppb)	LDL (ppb)	UDL (ppb)	LDL (ppb)	UDL (ppb)
H ₂ S ¹	100	65,000	100	65,000	100	65,000	100	65,000
Benzene	0.8	5,483	0.5	3,012	0.4	2,958	0.9	5,609
Exthyl Benzene	4.5	5,483	2.5	3,012	2.4	2,958	4.6	5,609
Sulfur Dioxide	4.0	2,202	2.2	1,210	2.2	1,188	4.1	2,253
Toluene	1.8	2,742	1.0	1,506	1.0	1,479	1.8	2,805
Xylene	1.0	2,742	0.5	1,506	0.5	1,479	1.0	2,805

1 – H₂S detection limits are based on 2 times the claimed capability (to avoid false detection) of a monitor being developed by a manufacturer and expected to be launched in the 2nd half of 2017. This manufacturer currently does not claim adjustment to the detection limit for path length. If this monitor cannot be validated as suitable for the application requirements, the alternate TDL available on the market has a higher LDL that is currently unknown as that manufacturer is in the process of revising upward the guaranteed detection limit previously claimed.

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

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

Section 2 – Project Management

Fence-Line Monitoring Task Organization

The program is organized between the Shell Martinez Refinery and the contractor tasked with operating and maintaining the systems. Figure 2.1 shows the organizational structure for the Monitoring Program.

Key Shell Personnel

Program Manager - The Program Manager is responsible for managing the work performed by the contractor operating and maintaining the fence-line system. This will include overseeing the contractor's operation and maintenance of the fence-line monitoring system and ensuring the program is operated in a safe manner.

Key Contractor Personnel

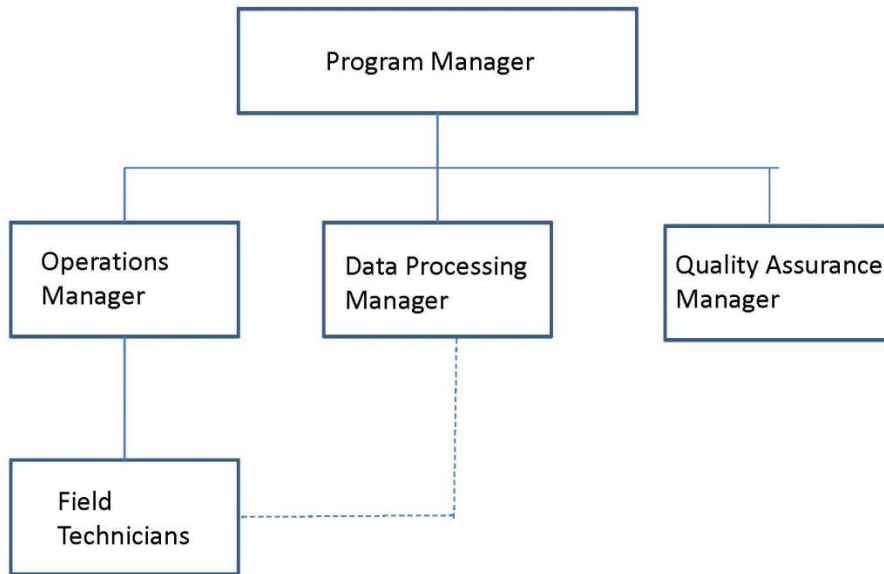
Contractor Program Manager - The Contractor Program Manager is responsible for overseeing the day to day operation of the fence-line program and is the primary interface between the contractor staff and Shell staff. Other duties include ensuring all contractor personnel perform all work in a safe manner and follow all standard operating procedures associated with the fence-line monitoring program.

Contractor Quality Assurance Manager – The Quality Assurance Manager is responsible for ensuring all Standard Operating Procedures are updated and maintained. Additional responsibilities include maintaining all records associated with the real-time monitoring databases as well as summarizing and storing all data quality records associated with the fence-line monitoring program.

Contractor Data Processing Manager – The Contractor Data Processing Manager is responsible for ensuring the data quality objectives, the measurement quality objectives, and on-stream efficiency statistics are met for the fence-line monitoring program.

Contractor Field Technician - The Contractor Field Technician is responsible for the day-to-day operation of the fence-line monitoring system including following an equipment operation verification and maintenance schedule to assure data quality.

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



Personnel Qualification and Training

The operators of the monitoring equipment shall be trained in the operation, maintenance, and operation verification of the equipment as well as have resources to troubleshoot any technical issues. All personnel will undergo annual equipment specific refresher training. Training will be provided by an instructor who has undergone vendor specific training for each analyzer. The Quality Assurance Manager will document the training and verify field technicians have successfully completed the training.

Section 3 - Data Generation and Acquisition

Sample Collection Methods

Samples will be collected using UV-DOAS air monitors for the measurement of Benzene, Ethylbenzene, Sulfur Dioxide, Toluene, and Xylene. Tunable Diode Laser air monitoring systems will be used for the measurement of Hydrogen Sulfide. Extractive FTIRs will be used for the measurement of total alkanes. Organic Gas Detectors will be used for total organics.

Sample Analysis Method

Each analyzer has a vendor specific method for collecting and quantifying data. A description of each specific analytic method is listed below:

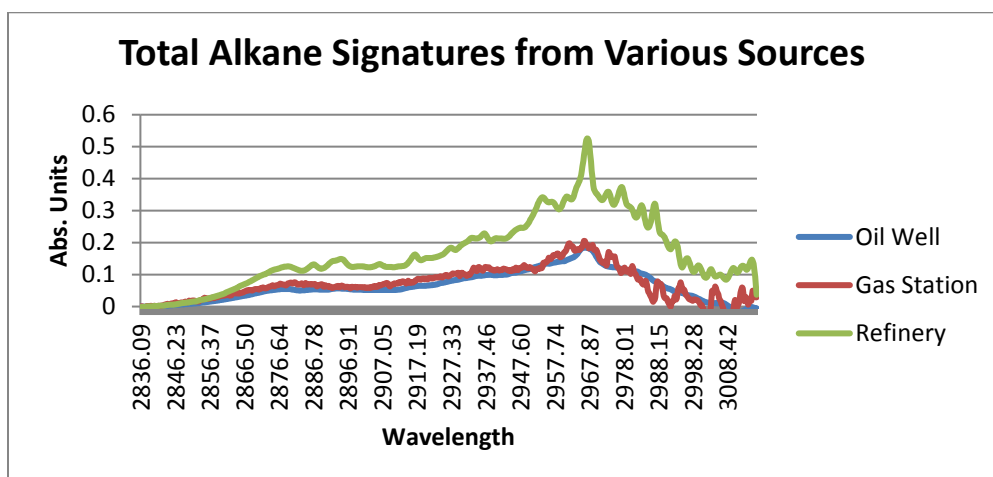
Open-path Tunable Diode Laser

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

Extractive FTIR

The FTIR air-monitoring system is a point sample air monitor that can be used for fence-line monitoring applications. The unit has the capability to detect total non-methane hydrocarbons on a real-time basis while minimizing the impact of gases that interfere with alkane measurement such as water vapor and methane gas. The analytical method employed by the FTIR is a multiple regression technique that separates the total amount of light absorbance by the various gases and outputs a result for each gas. In the case of alkanes, this includes the contribution of interfering gases such as water vapor and methane. The system also has the ability to distinguish between various sources of alkanes. Figure 3.1 shows the different types of spectral signatures for various sources of alkanes. The system has the ability of undergoing data and quality assurance checks in the field by monitoring known ambient gases or by using gas standards. Total Alkanes (regardless of source) will be displayed on the website, however, during the monthly QA process, the data may be identified as not originating from the refinery depending on its spectral signature.

Figure 3.1 - Spectral Signature of Alkanes From Various Sources



Open-path UV DOAS

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

Organic Gas Detector

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

Meteorological Station

The West Side MET Station will provide real time wind 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.

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Section – 4 Quality Assurance / Quality Control

Throughout the measurement process, each analyzer will be checked for data quality at a level respective of the Data Quality Objectives (DQOs) of the Fence-line Monitoring Program. The specific DQOs for the Monitoring Program include:

- Ensuring the data obtained from the fence-line systems meets the quality standards for presentation to the public
- Ensuring the data obtained from the fence-line systems meets the quality standards for presentation to the BAAQMD

Accordingly, Measurement Quality Objectives (MQOs) are presented to evaluate the measurement process to ensure the total measurement uncertainty is within the range prescribed by the DQOs. Whenever possible, MQOs will use measurement protocols specified in the Environmental Protection Agency, Environmental Technology Verification Program (ETV) Verification Protocol for Optical Remote Sensors:

https://archive.epa.gov/nrmrl/archive-etv/web/pdf/01_vp_openpath.pdf

These protocols are valid for open-path air monitoring technologies as well as the extractive FTIR air monitoring equipment which operates using the same measurement techniques. Each MQO includes specific performance criteria to evaluate whether the objective is met. If an analyzer fails an MQO, corrective action will be initiated to address the issue. A summary of the MQO's are listed in Table 4.1.

Table 4-1 - Summary of Measurement Quality Objectives

Equipment Type	Gases	Continuous Check	Monthly Checks	Quarterly Check	Annual Check
Tunable Diode Laser	H ₂ S	Check internal Error Flags in Data File	Single Point Gas Span Check	Three Point Validation	Annual Service
		Monitor Signal Level from Unit	Detection Limit Check	Precision and Accuracy Check	
FTIR	Alkanes	Monitor Ambient Methane to Verify the Concentration is Above 1.7 ppm.	Single Point Gas	Three Point Validation	Annual Service
		Monitor Signal Level from Unit	Detection Limit Check	Precision and Accuracy Check	
OPUV	BTEX, SO ₂	Monitor Signal Level From Unit	Single Point Gas	Three Point Validation	Annual Service
			Detection Limit Check	Precision and Accuracy Check	
Organic Gas Detectors	Total Organics	Monitor System Error Code		Gas Check	Annual Service including Recalibration
Met Station	Wind Speed, Wind Direction, Temp, and RH Rain Gauge	Monitor Output From Unit			Meets EPA's Prevention of Significant Deterioration Guidelines

Measurement Quality Objectives - Tunable Diode Laser

Measurement Quality Objective TDL1 – Continuous Check Internal Error Flags

Frequency: Continuous

Description: When the Tunable Diode Laser records data, it includes internal status flags that record whether the data point is considered to be valid.

Measurement Quality Objective: Status flags will be evaluated to assist in assessing whether the TDL air monitoring equipment is operating within manufacturer specifications.

Acceptance Criteria: If the status flags read “normal” no additional action is necessary. If the status flags output an error code, the contractor will be notified the system is not working correctly.

Corrective Action: Upon notification that the system has generated an error flag, the contractor will begin the process of the troubleshooting the system to determine the cause of the error flag and correct the problem.

Measurement Quality Objective TDL2 – Signal Strength Check

Frequency: Continuous

Description: Data quality for Open-path TDLs is directly related to the amount of light signal coming into the light detector. This MQO checks the real-time data to ensure the signal is high enough to produce valid data.

Measurement Quality Objective: Light signal coming into the light detector will be measured and recorded at the end of each data measurement.

Acceptance Criteria: The measurement will be considered valid if the light signal is greater than 10% of the full-scale value.

Corrective Action: If the light signal is below 10% of the full-scale value, an email will be generated and sent to the Contractor Program Manager who will evaluate the cause of the low signal. If the low signal is due to weather related events, no further action will be taken. If the low signal is not weather related, a technician will be dispatched to perform maintenance on the system including a system realignment and cleaning the optical components of the system if necessary.

Measurement Quality Objective TDL3 - Quantification Check

Frequency: Monthly

Description: A QA/QC cell with a known concentration of H₂S gas will be inserted into the TDL. The value generated by the analyzer will be compared to the known value of the gas cell.

Measurement Quality Objective: The measurement quality objective is to compare the real-time results of the TDL software to a validation check using a calibration cell with a known concentration of gas.

Acceptance Criteria: The measure will be considered passing if the quantified result is within 25% of the expected value.

Corrective Action: If the system fails the gas quantification check, the electronic records saved during the test will be sent to the equipment manufacturer or their representative to troubleshoot the issue.

Measurement Quality Objective TDL4 - Detection Limit Test

Frequency: Monthly

Description: Using the method outlined in EPA's ETV Test Protocol for open-path air monitoring systems, the lower detection limit (LDL) will be measured for the TDL air monitoring system.

Measurement Quality Objective: The MQO is to determine the detection limits utilizing the method outlined in the EPA'S ETV Test Protocol. The specific procedure used to measure the detection limits is as follows:

With no gas present in the light beam, a series of 26 single-beam spectra are taken using the appropriate averaging time (5 min). The single-beam spectra are used to create absorption spectra, using each single beam spectrum as the background for the next spectrum. The absorption spectra are created by using the first and second single-beam spectra, the second and third, the third and fourth, etc. The resulting 25 absorption spectra are analyzed for the target gas. The LDL is defined as two times the standard deviation of the calculated concentrations.

Acceptance Criteria: This MQO will be considered to have been met if the calculated detection limits for hydrogen sulfide are less than or equal to 100 ppb.

Corrective Action: If the system fails the detection limit check, the electronic records saved during the test will be sent to the equipment manufacturer or their representative to troubleshoot the issue.

Measurement Quality Objective TDL5 - Three Point Linearity Check

Frequency: Quarterly

Description: Determining the concentration linearity of the monitor requires challenging the monitor with a target gas at several concentration levels while the instrument operational parameters remain constant. At each concentration, the monitor response will be recorded and compared to the concentration of gas inserted into the beam path. Linearity will be evaluated by comparing the infrared cell gas concentration from the open-path measurement to the input target gas concentration.

Measurement Quality Objective: The measurement quality objective is to compare the real-time measured values of the TDL software to three calibration cells with known concentrations of gas. The measurement will be used to validate the linearity of the TDLs response to varying concentrations of the gas. The linearity of the TDLs will be tracked by comparing the response to prior quarterly linearity checks.

Acceptance Criteria: The MQO will be met if the measured linearity does not differ in a statistically significant manner from prior linearity measurements.

Corrective Action: If the system fails the detection limit check, the electronic records saved during the test will be sent to the equipment manufacturer or their representative to troubleshoot the issue.

Measurement Quality Objective TDL6 - Precision Check

Frequency: Quarterly

Description: The precision of the monitor is a quantification of its ability to make repeatable measurements when challenged with the same gas sample inserted in the beam using a sample cell.

Measurement Quality Objective: The objective is to determine the precision of the TDL air monitoring system and compare the measured result to historical measurements. If the results differ in a statistically significant manner, corrective actions will be initiated. The procedure for determining the precision of the TDL is as follows:

H₂S gas will be introduced into the cell and 25 single-beam spectra of the target gas will be obtained. The collected spectra will be analyzed for the target gas. The relative standard deviation of this set of measurements is the precision at the target gas concentration and given by the following formula:

$$RSD = \left| \frac{\sigma}{\bar{T}} \right| \times 100$$

Where:

RSD is the Relative Standard Deviation

σ is the Standard Deviation of the measurements
 \bar{T} Is the average value of the measurements

Acceptance Criteria: The MQO will be met if the measured precision does not differ in a statistically significant manner from prior accuracy measurements.

Corrective Action: If the system fails the precision check, the electronic records saved during the test will be sent to the equipment manufacturer or their representative to troubleshoot the issue.

Measurement Quality Objective TDL7 - Accuracy Check

Frequency: Quarterly

Description: The accuracy of the monitors will be evaluated for target gases by inserting a gas cell into the beam path with a known concentration of a target gas and comparing gas cell concentration to the concentration measured by the open path monitor.

Measurement Quality Objective: The objective is to determine the accuracy of the TDL air monitoring system and compare the measured result to historical measurements. If the results differ in a statistically significant manner, corrective actions will be initiated. The procedure for measuring the accuracy of the TDL is as follows:

The relative accuracy (A) of the monitor with respect to the reference gas is assessed using the following formula:

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

Where:

A is the accuracy of each measurement

\overline{R} is the average value of the reference gas

\overline{T} is the average value of the measurements

Acceptance Criteria: The MQO will be met if the measured accuracy does not differ in a statistically significant manner from prior accuracy measurements.

Corrective Action: If the system fails the accuracy check, the electronic records saved during the test will be sent to the equipment manufacturer or their representative to troubleshoot the issue.

Measurement Quality Objectives Extractive FTIR

Measurement Quality Objective FTIR1 – Continuous Check of Ambient Methane

Frequency: Continuous

Description: When the FTIR records data, it should always be capable of detecting methane in the ambient air above concentrations of 1.7 ppm. This is the natural concentration of methane in the ambient air.

Measurement Quality Objective: The data will be considered valid if the real-time measured value of methane gas is greater than or equal to 1.7 ppm. The FTIR includes internal status flags that record whether the quantified methane concentration is above this level. If the system fails this QA/QC check, a data flag is generated.

Acceptance: The FTIR will measure ambient methane at levels above 1.7 ppm.

Corrective Action: If the MQO is not met the contractor will be notified via email that the system is not operating correctly and corrective action will be taken.

Measurement Quality Objective FTIR2 – Signal Strength Check

Frequency: Continuous

Description: Data quality for extractive FTIR is directly related to the amount of light signal coming into the light detector. This MQO checks the real-time data to ensure the signal is high enough to produce valid data.

Measurement Quality Objective: Light signal coming into the light detector will be measured and recorded at the end of each data measurement.

Acceptance Criteria: The measurement will be considered valid if the light signal is greater than 10% of the full-scale value.

Corrective Action: If the light signal is below 10% of the full-scale value, an email will be generated and sent to the Contractor Program Manager who will evaluate the cause of the low signal.

Measurement Quality Objective FTIR3 - Quantification Check

Frequency: Monthly

Description: A known concentration of alkane gas will be inserted into the FTIR. The value generated by the analyzer will be compared to the known value of the calibration gas.

Measurement Quality Objective: The measurement quality objective is to compare the real-time results of the FTIR software to a validation check using a calibration gas.

Acceptance Criteria: The measurement will be considered passing if the quantified result is within 25% of the expected value.

Corrective Action: If the system fails the gas quantification check, the electronic records saved during the test will be sent to the equipment manufacturer or their representative to troubleshoot the issue.

Measurement Quality Objective FTIR4 - Detection Limit Test

Frequency: Monthly

Description: Using the method outlined in the EPA'S ETV Test Protocol for open-path air monitoring systems, the lower detection limit (LDL) will be measured for the FTIR air monitoring system.

Measurement Quality Objective: The MQO is to determine the detection limits utilizing the method outlined in the EPA'S ETV Test Protocol. Specifically, detection limits are calculated by removing the target gas from the optical path of the monitor and measuring the detection limit. The MQO be considered to have been met if the calculated detection limits are less than or equal to 75 ppb for alkanes. The specific procedure used to measure the detection limits is as follows:

With no gas present in the light beam, a series of 26 single-beam spectra are taken using the appropriate averaging time (5 min). The single-beam spectra are used to create absorption spectra, using each single beam spectrum as the background for the next spectrum. The absorption spectra are created by using the first and second single-beam spectra, the second and third, the third and fourth, etc. The resulting 25 absorption spectra are analyzed for the target gas. The LDL is defined as two times the standard deviation of the calculated concentrations.

Acceptance Criteria: This MQO will be considered to have been met if the calculated detection limits for alkanes are less than or equal to 75 ppb.

Corrective Action: If the system fails the detection limit check, the electronic records saved during the test will be sent to the equipment manufacturer or their representative to troubleshoot the issue.

Measurement Quality Objective FTIR5 - Three Point Linearity Check

Frequency: Quarterly

Description: Determining the concentration linearity of the monitor requires challenging the monitor with a target gas at several concentration levels while the instrument operational parameters remain constant. At each concentration, the monitor response will be recorded and compared to the concentration of gas inserted into the beam path.

Measurement Quality Objective: The measurement quality objective is to compare the real-time measured values of the FTIR software to three calibration gases with known concentrations of gas. The measure will be used to validate the linearity of the FTIR response to varying concentrations of the gas. The linearity of the FTIR will be tracked by comparing the response to prior quarterly linearity checks.

Acceptance Criteria: The MQO will be met if the measured linearity does not differ in a statistically significant manner from prior linearity measurements.

Corrective Action: If the system fails the detection limit check, the electronic records saved during the test will be sent to the equipment manufacturer or their representative to troubleshoot the issue.

Measurement Quality Objective FTIR6 - Precision Check

Frequency: Quarterly

Description: The precision of the monitor is a quantification of its ability to make repeatable measurements when challenged with the same gas sample inserted in the beam using a sample cell.

Measurement Quality Objective: The objective is to determine the precision of the FTIR air monitoring system and compare the measured result to historical measurements. If the results differ in a statistically significant manner, corrective actions will be initiated. The procedure for determining the precision of the FTIR is as follows:

Alkane gas will be introduced into the multi-pass cell and 25 single-beam spectra of the target gas will be obtained. The collected spectra will be analyzed for the target gas. The relative standard deviation of this set of measurements is the precision at the target gas concentration and given by the following formula:

$$RSD = \left| \frac{\sigma}{\bar{T}} \right| \times 100$$

Where:

RSD is the Relative Standard Deviation

σ is the Standard Deviation of the measurements

\bar{T} is the average value of the measurements

Acceptance Criteria: The MQO will be met if the measured precision does not differ in a statistically significant manner from prior accuracy measurements.

Corrective Action: If the system fails the precision check, the electronic records saved during the test will be sent to the equipment manufacturer or their representative to troubleshoot the issue.

Measurement Quality Objective FTIR7 - Accuracy Check

Frequency: Quarterly

Description: The accuracy of the monitors will be evaluated for target gases by inserting a calibration gas into the beam path with a known concentration of a target gas and comparing calibration gas concentration to the concentration measured by the FTIR monitor.

Measurement Quality Objective: The objective is to determine the accuracy of the FTIR air monitoring system and compare the measured result to historical measurements. If the results differ in a statistically significant manner, corrective actions will be initiated. The procedure for measuring the accuracy of the FTIR is as follows:

The relative accuracy (A) of the monitor with respect to the reference gas is assessed using the following formula:

$$A = \frac{|\bar{R} - \bar{T}|}{\bar{R}} \times 100$$

Where:

A is the accuracy of each measurement

\bar{R} is the average value of the reference gas

\bar{T} Is the average value of the measurements

Acceptance Criteria: The MQO will be met if the measured accuracy does not differ in a statistically significant manner from prior accuracy measurements.

Corrective Action: If the system fails the accuracy check, the electronic records saved during the test will be sent to the equipment manufacturer or their representative to troubleshoot the issue.

Measurement Quality Objectives UV Air Monitoring System

Measurement Quality Objective UV1 – Signal Strength Check

Frequency: Continuous

Description: Data quality for the Open-path UV is directly related to the amount of light signal coming into the light detector. This MQO checks the real-time data to ensure the signal is high enough to produce valid data.

Measurement Quality Objective: Light signal coming into the light detector will be measured and recorded at the end of each data measurement.

Acceptance Criteria: The measurement will be considered valid if the light signal is greater than 10% of the full-scale value.

Corrective Action: If the light signal is below 10% of the full-scale value, an email will be generated and sent to the contractor who will evaluate the cause of the low signal. If the low signal is due to weather related events, no further action will be taken. If the low signal is not weather related, a technician will be dispatched to perform maintenance on the system including cleaning the optical components of the system and perform a system realignment.

Measurement Quality Objective UV2 - Quantification Check

Frequency: Monthly

Description: A QA/QC cell with a known concentration of Benzene and SO₂ gas will be inserted into the UV air monitor. The value generated by the analyzer will be compared to the known value of the calibration gas.

Measurement Quality Objective: The measurement quality objective is to compare the real-time results of the UV software to a validation check using a calibration gas.

Acceptance Criteria: The measurement will be considered passing if the quantified result is within 25% of the expected value.

Corrective Action: If the system fails the gas quantification check, the electronic records saved during the test will be sent to the equipment manufacturer or their representative to troubleshoot the issue.

Measurement Quality Objective UV3 - Detection Limit Test

Frequency: Monthly

Description: Using the method outlined in the EPA'S ETV Test Protocol for open-path air monitoring systems, the lower detection limit (LDL) will be measured for the Open-path UV air monitoring system.

Measurement Quality Objective: Detection limits are determined using the method outlined in the EPA'S ETV Test Protocol. The detection limits are calculated by removing the target gas from the optical path of the monitor and measuring the detection limit. The MQO will be considered to have been met if the calculated detection limits are less than or equal to the detection limits for UV gases listed in Table 3.1. The specific procedures used to measure the detection limits are as follows:

With no gas present in the light beam, a series of 26 single-beam spectra are taken using the appropriate averaging time (5 min). The single-beam spectra are used to create absorption spectra, using each single beam spectrum as the background for the next spectrum. The absorption spectra are created by using the first and second single-beam spectra, the second and third, the third and fourth, etc. The resulting 25 absorption spectra are analyzed for the target gas. The LDL is defined as two times the standard deviation of the calculated concentrations.

Acceptance Criteria: This MQO will be considered to have been met if the calculated detection limits are less than or equal to the detection limits for UV gases listed in Table 3.1.

Corrective Action: If the system fails the detection limit check, the electronic records saved during the test will be sent to the equipment manufacturer or their representative to troubleshoot the issue.

Measurement Quality Objective UV4 - Three Point Linearity Check

Frequency: Quarterly

Description: Determining the concentration linearity of the monitor requires challenging the monitor with a target gas at several concentration levels while the instrument operational parameters remain constant. At each concentration, the monitor response will be recorded and compared to the concentration of gas inserted into the beam path.

Measurement Quality Objective: The measurement quality objective is to compare the real-time measured values of the UV software to three calibration gases with known concentrations of gas. The measure will be used to validate the linearity of the UVs response to varying concentrations of the gas. The linearity of the UVs will be tracked by comparing the response to prior quarterly linearity checks.

Acceptance Criteria: The MQO will be met if the measured linearity does not differ in a statistically significant manner from prior linearity measurements.

Corrective Action: If the system fails the detection limit check, the electronic records saved during the test will be sent to the equipment manufacturer or their representative to troubleshoot the issue.

Measurement Quality Indicator UV5 - Precision Check

Frequency: Quarterly

Description: The precision of the monitor is a quantification of its ability to make repeatable measurements when challenged with the same gas sample inserted in the beam using a sample cell.

Measurement Quality Objective: The objective is to determine the precision of the UV air monitoring system and compare the measured result to historical measurements. If the results differ in a statistically significant manner, corrective actions will be initiated. The procedure for determining the precision of the UV systems is as follows:

Benzene and SO₂ gas will be introduced into the beam path and 25 single-beam spectra of the target gas will be obtained. The collected spectra will be analyzed for the target gas. The relative standard deviation of this set of measurements is the precision at the target gas concentration and given by the following formula:

$$RSD = \left| \frac{\sigma}{\bar{T}} \right| \times 100$$

Where:

RSD is the Relative Standard Deviation

σ is the Standard Deviation of the measurements
 \bar{T} Is the average value of the measurements

Acceptance Criteria: The MQO will be met if the measured precision does not differ in a statistically significant manner from prior accuracy measurements.

Corrective Action: If the system fails the precision check, the electronic records saved during the test will be sent to the equipment manufacturer or their representative to troubleshoot the issue.

Measurement Quality Indicator UV6 - Accuracy Check

Frequency: Quarterly

Description: The accuracy of the monitors will be evaluated for target gases by inserting a gas cell into the beam path with a known concentration of a target gas and comparing cell gas concentration to the concentration measured by the open path monitor.

Measurement Quality Objective: The objective is to determine the accuracy of the UV air monitoring system and compare the measured result to historical measurements. If the results differ in a statistically significant manner, corrective actions will be initiated. The procedure for measuring the accuracy of the UV monitor is as follows:

The relative accuracy (A) of the monitor with respect to the reference gas is assessed using the following formula:

$$A = \frac{|\bar{R} - \bar{T}|}{\bar{R}} \times 100$$

Where:

A is the accuracy of each measurement

\bar{R} is the average value of the reference gas

\bar{T} Is the average value of the measurements

Acceptance Criteria: The MQO will be met if the measured accuracy does not differ in a statistically significant manner from prior accuracy measurements.

Corrective Action: If the system fails the accuracy check, the electronic records saved during the test will be sent to the equipment manufacturer or their representative to troubleshoot the issue.

Measurement Quality Objectives – Organic Gas Detectors

Measurement Quality Objective OGD1 – Continuous Check Internal Error Flags

Frequency: Continuous

Description: When the Organic Gas Detector records data, it includes internal status flags that record whether the data point is considered to be valid.

Measurement Quality Objective: Status flags will be evaluated to assist in assessing whether the OGD air monitoring equipment is operating within manufacturer specifications.

Acceptance Criteria: If the status flags read “normal” no additional action is necessary. If the status flags output an error code, the contractor will be notified the system is not working correctly.

Corrective Action: Upon notification that the system has generated an error flag, the contractor will begin the process of the troubleshooting the system to determine the cause of the error flag and correct the problem.

Measurement Quality Objective OGD2 – Gas Challenge

Frequency: Quarterly

Description: This MQO is to check the response of the OGDs by introducing a calibration gas and noting the instrument response.

Measurement Quality Objective: The measurement quality objective is to validate the operation of the OGDs by challenging them with a known quantity of methane gas and checking the system response.

Acceptance Criteria: The MQO will be considered to have been met if the quantified result is within 25% of the expected value.

Corrective Action: If the system does not meet the acceptance criteria, the manufacturer or their representative will be contacted to troubleshoot the issue.

Section 5 - Instrument Maintenance

Specific tasks for periodic testing, inspection, and maintenance are required for the air sampling and monitoring equipment to provide sufficient quality control to remain within the manufacturer's operating specifications and ensure that the project quality goals are met. Initial testing of each piece of equipment is conducted to ensure equipment operation is within the manufacturer's specifications. Operational checks are repeated during installation before initial calibration and use as field measurements. Each monitor has manufacturer-recommended maintenance schedules that are found in the operating manuals provided at the monitoring stations.

Open-path UV Instrument Maintenance Schedule

Activity	Monthly	Quarterly	Annually
Visually inspect the system.	✓		
Confirm the alignment to verify there has not been significant physical movement. Note: this is automatically monitored as well.	✓		
Download data from detector hard drive and delete old files to free space, if needed.	✓		
Ensure there are no obstructions between the detector and the light source.	✓		
Verify system settings.	✓		
Clean optics on detector and retro-reflector.	✓		
Realign system after service.	✓		
Check system performance indicators.	✓		
Change out the UV source.		✓	
Annual Service Check			✓

Schedule of Maintenance Activities for the FTIR

Activity	Monthly	Annually
Visually inspect the system.	✓	
Download data from detector hard drive and if needed delete old files to free space.	✓	
Check system performance indicators.	✓	
Annual Service Check		✓

Schedule of Maintenance Activities for the TDLAS

Activity	Monthly	Annually
Visually inspect the system.	✓	
Inspect optics on detector, clean if necessary.	✓	
Check the alignment to verify there has not been significant physical movement.	✓	
Download data from detector hard drive and delete old files to free space, if needed.	✓	
Ensure there are no obstructions between the detector and the retroreflector (such as equipment, vegetation, vehicles).	✓	
Check system performance indicators.	✓	
Review and test light and signal levels.	✓	
Verify system settings.	✓	
Annual Service Check		✓

Schedule of Maintenance Activities for the Organic Gas Detector

Activity	Monthly	Annually
Visually inspect the system.	✓	
Download data from detector hard drive and if needed delete old files to free space.	✓	
Check system performance indicators.	✓	
Annual Service Check		✓

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Section 6 - Data Management

Real-time Data Management

Data generated by the fence-line monitoring equipment undergoes review throughout the measurement and reporting process. This includes automated QA/QC checks that occur before data is reported on the real-time website as well as data quality checks for monitoring data that is reconciled on a monthly basis. Data review will be overseen by the Contractor Data Processing Manager. Automated data checks are listed in Table 6.1.

Table 6.1 – Real-time Data Quality Checks

Real-Time Check	Check	Action
Low Signal Alarm	Signal threshold test	If signal is below threshold value: 1) Real-time website reports "Low Signal" to analyzer. Automated email is sent to Program Manager, Contractor Program Manager, Data Processing Manager, and Field Technician.
Instrument Error Code	Instrument Error Code	Real-time website reports "off-line" message. Email sent to Program Manager, Contractor Program Manager, Data Processing Manager, and Field Technician. Website message board updated to inform community that analyzer troubleshooting underway. Website updated when system is back on line.
Instrument Workstation Off-line	Instrument Communication Check	Real-time website reports "off-line" message. Email sent to Program Manager, Contractor Program Manager, Data Processing Manager, and Field Technician. Website message board updated to inform community that computer workstation troubleshooting underway. Website updated when system is back on line.
Internet Connection Lost	Backup Connection enabled	Email sent to Field Technician, Contractor Program Manager, Data Processing Manager, and Program Manager. Community is not notified because backup connection will be enabled.
High Detection	Valid Data Detection Above Threshold	Real-time website indicates detection above alarm threshold by color change for gas. Notification sent to Shell Program Manager, Contractor Program Manager, Data Processing Manager, and Field Technician. Contractor will examine raw data to validate detection. Shell will initiate investigation into source. Message Board on website will be updated with information as available.

Real - Time Instrument Performance Checks

The entire fence-line monitoring system is continually monitored for system performance. This includes the instruments, workstations, and Internet communication hardware. If at any time an element of the system fails to meet performance criteria, a message is generated to key personnel at Shell and the Contractor who will begin activities to correct the problem. If an issue cannot be immediately corrected, the real-time website will be updated with a notification explaining the problem and the corrective action activities. Table 6.2 lists elements and the performance thresholds.

Table 6-2 Real-time Instrument Performance Checks

Problem	Notification	Action
Analyzer has low signal	Notification sent to Contactor and Shell	Website updated with low signal message for specific analyzer
Analyzer off-line	Notification sent to Contactor and Shell	Website updated with analyzer off-line message. Technician dispatched to correct issue.
Workstation fails	Notification sent to Contactor and Shell	Website updated with analyzer off-line message. Technician dispatched to correct issue.
Internet communication failure	Notification sent to Contactor and Shell	Backup Internet connection activated

Post Processed Data Management

Data from the fence-line system will be reviewed and validated on a monthly basis with the results stored in a separate portion of the monitoring database from the raw data. Data review and validation include but are not limited to the following:

- Non-field data such as calibration data.
- Spurious data associated with power or mechanical issues.
- Data with a light signal below predetermined thresholds.

Data review will be overseen by the Data Processing Manager. Data that has been flagged as non-valid will be retained along with a notation for the reason it was flagged. Table 6.3 summarizes the process by which monitoring data is reviewed and post processed.

Table 6.3 – Monthly Data Validation Checks

Post Process Data Check	Check	Action
Non-field Data Check	Maintenance logs and QA/QC logs will be checked to see when systems were not in normal operating mode.	Quality Assurance Manager will flag any data that meets these criteria. Data will be excluded from QA/QC report.
Spurious Data	Instrument error codes will be checked and flagged if instrument error codes are recorded.	Quality Assurance Manager will flag any data that meets these criteria. Data will be excluded from QA/QC report.
Low Signal	Data will be reviewed for low signal. If low signal is recorded, data will be flagged and reason for low signal will be recorded (weather, system misalignment etc.)	Quality Assurance Manager will flag any data that meets these criteria. Data will be excluded from QA/QC report.
Gas Detection Validation	Spectroscopist will review data detections.	Quality Assurance Manager includes any verified detections in QA/QC report.

Corrective Action Plans

Shell will initiate a Corrective Action Plan if any portion of the fence-line system fails to meet any data quality objectives, real-time performance indicators, or on-stream efficiency. The Corrective

Action Process will include members of the fence-line management team and appropriate equipment vendors to assess the problem and to initiate a long-term fix. In addition, lessons learned will be identified and implemented to minimize the chance for similar problems in the future.

Annual Data Reporting to the BAAQMD

Shell will submit an annual report to the BAAQMD that summarizes overall performance of the fence-line monitoring system. The report will include the following performance indicators:

- On-stream efficiency
- Annual averages of gas concentrations
- Summary of Data Completeness
- List of data quality issues and corrective action plans
- Summary of ongoing improvements to the system.

Section 7 - Website Management

The real-time Website is operated and maintained by the contractor 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.

Message Board Updates

A message board on the real-time website is used to inform the public whenever an event such as gas detections above a preset level occurs, the Internet connection is lost, or an instrument fails to operate within normal parameters. If one of these or similar events occur, the message board will be updated by the contractor as soon as practical.

Data 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.

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

Once QA/QC of the final data is completed within 60 days after the end of each calendar quarter, the refinery will provide one hour average concentration data in tabular format through a comma separated value data file to the BAAQMD. The BAAQMD may make the one hour average data available to the public through a BAAQMD website or through public records request. The refinery will make data available to BAAQMD upon request prior to the report submittal.

Learning Center

Individuals will be able to access additional information pertaining to the fence-line program. This will include information about each target gas, a site map showing locations of fence-line equipment, Office of Environmental Health Hazard Assessment (OEHHA) health standards for target gases (if applicable), and links to the BAAQMD and CARB.

Contact Section

Individuals will be able to send emails directly to designated personnel at Shell or the contractor operating the fence-line system.