Fenceline Air Monitoring System Quality Assurance Project Plan (Rev. 4)

Torrance Refining Company LLC

South Coast Air Quality Management District Rule 1180 Fenceline Air Monitoring System

Date:
August 5, 2024

Prepared by:

Spectrum
ENVIRONMENTAL SOLUTIONS

Revision History

Revision	Origination Date	Prepared by	Approved by	Comments / Summary of Changes
Revision 0	July 27, 2018	Glenn England	Scott Weaver	Issue for review - South Coast AQMD
Revision 1	September 10, 2019	Glenn England	Valerie Tse	Issue for review – DRAFT for South Coast AQMD review
Revision 1 (D)	December 1, 2019	Glenn England	Valerie Tse	Issue for review – revised DRAFT for South Coast AQMD review and public comment
Revision 2	October 13, 2020	Brian Cochran /Glenn England	Valerie Tse	Issue for approval (South Coast AQMD)
Revision 3	March 25, 2021	Brian Cochran	Valerie Tse	Issue for approval (South Coast AQMD). Revised in response to April 13, 2021 AQMD memo titled Review of Torrance Refinery Fenceline Monitoring Program Quality Assurance Project Plan"
Revision 4	August 5, 2024	Casey Dryer	Brian Cochran	Issue for approval (South Coast AQMD). Revised in response to adoption of Amended Rule 1180 (January 5, 2024) and Amended Rule 1180 Fenceline Air Monitoring Plan Guidelines

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Acronyms and Abbreviations

Acronym	Definition
%	percent
°	degrees
°C	degrees centigrade
$\mu g/m^3$	micrograms per cubic meter
CAR	corrective action report
CLS	classic least squares
cm	centimeter
cm^{-1}	inverse centimeters (wavelength)
CV	coefficient of variation
DC	direct current
DQA	data quality assessment
DQI	data quality indicator
DQO	data quality objective
EDMS	electronic data management system
EDXRF	Energy dispersive x-ray fluorescence
EPA	U.S. Environmental Protection Agency
ESP	electrostatic precipitator
EXRF	energy-dispersive X-ray fluorescence
FAQ	frequently-asked-questions
FCCU	fluid catalytic cracking unit
FTIR	Fourier transform infrared
GB	gigabytes
GHz	gigahertz
hPa	hectopascals
Hz	Hertz
K	Kelvins
km	kilometer
LAN	local area network
LED	light-emitting diode
mbar	millibar
m/s	meters per second
mm/hr	millimeters per hour
MQO	measurement quality objective
NAMS	national air monitoring stations
ng/m^3	nanograms per cubic meter
NIST	U.S. National Institute of Standards and Technology
nm	nanometer
O&M	operation and maintenance

Acronym	**Definition**
OPA	open-path analyzer location
OPR	open-path retroreflector location
PAR	Proposed Amended Rule
PC	personal computer
PEA	performance evaluation audit
PM	particulate matter
PMT	photomultiplier tube
ppb	parts per billion
ppm	parts per million
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
South Coast AQMD	South Coast Air Quality Management District
SCI	Sailbri Cooper, Inc.
SLAMS	state and local air monitoring stations
SES	Spectrum Environmental Solutions
SOP	standard operating procedure
TBD	to be determined
TORC	Torrance Refining Company, LLC
TSA	technical systems audit
USB	universal serial bus
UVDOAS	ultraviolet differential optical absorption spectroscopy
VAC	volts alternating current
VDC	volts direct current
VOCs	volatile organic compounds
W	Watts
XRF	X-ray fluorescence

1 Project Management

1.1 Title and Approval Sheet

Document Title:	Quality Assurance Project Plan for Torrance Refinery Rule 1180 Fenceline Air Monitoring System
Revision/Date:	**Revision 4 (Issue for Approval) / August 5, 2024**
System Owner:	Name (print):____ Environmental Manager Torrance Refining Company *3700 W. 190th Street, Torrance, California 90504* ____ / _________________ Signature/Date
Program Quality Assurance Manager:	Name (print):____ Spectrum Environmental Solutions *2340 W. Braker Lane Austin, Texas 78731* ____ / _________________ Signature/Date
System Manager/Operator:	Name (print):____ Spectrum Environmental Solutions *2340 Braker Lane, Suite A, Austin, TX 78758* ____ / _________________ Signature/Date
Rule 1180 Program Manager:	Name (print):____ Rule 1180 Program Manager South Coast Air Quality Management District *21865 Copley Drive, Diamond Bar, CA 91765* ____ / _________________ Signature/Date
Rule 1180 Quality Assurance Manager:	Name (print):____ Rule 1180 Quality Assurance Manager South Coast Air Quality Management District *21865 Copley Drive, Diamond Bar, CA 91765* ____ / _________________ Signature/Date

This approval sheet may be signed in counterparts for full approval. Signatures of the approving officials above indicate both their approval of this Quality Assurance Project Plan and the commitment of their respective organizations to follow the procedures herein.

1.2 Distribution List

The distribution list (Table 1-1) identifies all individuals that should receive a copy of this Quality Assurance Project Plan (QAPP) in electronic format including any subsequent revisions. This includes all individuals listed in Section 1.1 and all supervisory and line staff and contractors directly involved in any aspect of this monitoring project. Document storage and control is addressed in Section 1.9 of this QAPP, while training of new staff and re-training of existing staff is addressed in Section 1.8 of this QAPP.

Table 1-1. Distribution List (names and contact information may change over time)

Name, Role and Email Address	Organization
Craig Sakamoto System Owner craig.sakamoto@pbfenergy.com	Torrance Refining Company
Thomas Cheng Rule 1180 Program Manager thomas.cheng@pbfenergy.com	Torrance Refining Company
Andrea Polidori Assistant Deputy Executive Officer apolidori@aqmd.gov	South Coast Air Quality Management District
Brandon Feenstra Rule 1180 Quality Assurance Manager bfeenstra@aqmd.gov	South Coast Air Quality Management District
Olga Pikelnaya Manager, OSR/Rule 1180 opikelnaya@aqmd.gov	South Coast Air Quality Management District
Steve Hall Program QA Manager	Spectrum Environmental Solutions
Brian Cochran System Manager/Operator	Spectrum Environmental Solutions
Dan Currin Data/QC Manager	Spectrum Environmental Solutions
Ian Rust Website/Data System Manager	Spectrum Environmental Solutions
Angel Valdenegro Technical Specialist/Site Operator	Spectrum Environmental Solutions
Casey Dreyer Data Reviewer	Spectrum Environmental Solutions
Marty Hale Lead Internal Auditor	Spectrum Environmental Solutions

1.3 Project Organization and Roles

This section identifies the roles and responsibilities of the key individuals involved in the operation of the fenceline air monitoring system (Table 1-2) and lines of authority and communications between these individuals and authorities. The organizational chart (Figure 1-1) provides lines of authority and communications for all organizations involved in operation and maintenance of the fenceline air monitoring system (including contractors and subcontractors) to accomplish the QA objectives specified in this QAPP.

The monitoring equipment in this system are designed to run continuously, but site/monitor shutdowns may be necessary on occasion. **Any member of the project team has the authority to stop work or shutdown a site/monitor if there is a safety concern** (e.g., smoking equipment, exposed electrical wiring, unsafe work practices, etc.). If a site/monitor is shut down due to a safety concern, the Rule 1180 Program Manager and the System Manager/Operator must be notified as soon as possible. The monitor/site must not be restarted until the safety issue has been fully addressed and the Rule 1180 Program Manager and the System Manager have given their written approval to restart.

The need to shut down a monitor/site for non-safety related issues also exists (e.g., equipment maintenance, nearby electrical work in the refinery, etc.). Such shutdowns should be approved in advance by the Rule 1180 Program Manager and the System Manager/Operator beforehand, and these same personnel should be notified when the site/monitor is restarted.

The installation of additional monitors or the discontinuation of monitors is not expected but must be approved by the Rule 1180 Program Manager and the System Manager/Operator in writing. Additionally, the replacement of any monitors must be approved by the Rule 1180 Program Manager and the System Manager/Operator.

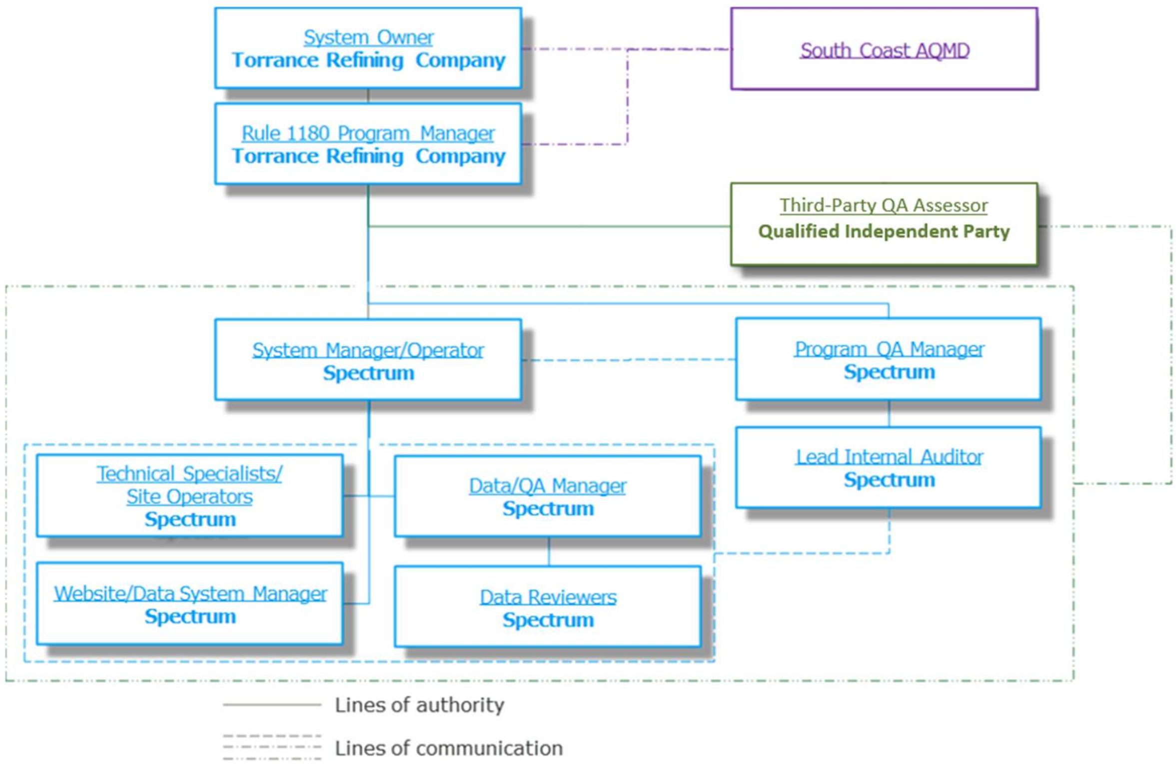

Figure 1-1. QA Organization Chart

Table 1-2. Key individuals and responsibilities

Organization	Roles	Responsibilities
Torrance Refining Company	System Owner	Overall system performance Financial resources to operate and maintain the System Appoint System Manager and Program QA Manager Review/approve QAPP
Torrance Refining Company	Rule 1180 Program Manager	Overall system operation, maintenance and data management Review/approve quarterly reports
Spectrum Environmental Solutions	System Manager/Operator	System operation and maintenance Oversee technical specialists and instrument suppliers Coordinate staff resources

Organization	Roles	Responsibilities
Spectrum Environmental Solutions	Program Quality Assurance Manager	Prepare/revise/approve QAPP Conformance with QAPP QAPP updates & revisions Coordinate internal periodic QA checks and audits Review/approve quarterly reports
Spectrum Environmental Solutions	Data/Quality Control Manager	Oversee data collection & processing Oversee daily data anomaly checks & investigations Oversee data review & validation Review/approve quarterly reports
Spectrum Environmental Solutions	Website/Data System Manager	Website administration Upload reports Ensure timely response to feedback Issue notifications
Spectrum Environmental Solutions	Technical Specialists/Site Operators	Remote and on-site system operation Preventative maintenance Unscheduled maintenance (including minor repairs) System maintenance notifications Prepare first draft quarterly reports
Spectrum Environmental Solutions	Data Reviewers	Monitor real-time data collection & processing Perform daily data anomaly checks & investigations Perform manual data review & validation
Spectrum Environmental Solutions	Lead Internal Auditor	Internal auditing tasks Internal performance evaluations Internal periodic technical audits Internal reporting system audits
South Coast AQMD	Rule 1180 Quality Assurance Manager	Procure Initial Third-Party QA assessor
An approved Qualified Independent Party	Independent Auditor	Independent audit to Identify any deficiencies in the Fenceline Air Monitoring System and quality assurance procedures and produce an Independent Audit report

Torrance Refining Company, LLC (Torrance Refinery) is the **System Owner** with overall responsibility for all aspects of fenceline air monitoring system. The System Owner provides the financial resources necessary to operate and maintain the fenceline air monitoring system in accordance with this QAPP. The System Owner appoints the organizations that will be responsible for system operation, maintenance, data management and reporting. The System Owner also reviews and approves the QAPP.

The system is managed by a **Rule 1180 Program Manager** appointed by Torrance Refinery. The Rule 1180 Program Manager acts as the central point of contact for Torrance Refinery, the South Coast Air Quality Management District (South Coast AQMD) and the Program Quality Assurance Manager. The Rule 1180 Program Manager is responsible for overseeing the system's operation, maintenance, reporting, and data management.

The system is operated by a **System Manager/Operator**, who has overall responsibility over the operation and maintenance of the fenceline air monitoring system. The System Manager/Operator oversees technical specialists, engineers, scientists, and technicians responsible for operation, maintenance, data collection, data quality, reporting, and website operations. The System Manager/Operator will coordinate staff coverage and serve as a technical resource for site measurements.

The **Program Quality Assurance Manager** is responsible for assuring the quality of data on behalf of the Rule 1180 Program Manager. The Program Quality Assurance Manager reports to the Rule 1180 Program Manager and may communicate directly with the System Owner, Rule 1180 Program Manager, and the Third-Party QA Assessor, independently of the System Manager/Operator, escalating as appropriate to assure that any issues identified by the Program Quality Assurance Manager are promptly addressed. The Program Quality Assurance Manager provides QA oversight for the system and oversees and reports on QA activities to the Rule 1180 Program Manager. The Program Quality Assurance Manager assures that daily data review and data management activities are performed in accordance with the QAPP, works with the Rule 1180 Program Manager to ensure that any data issues are promptly addressed, and that data provided to the public are of high quality. The Program Quality Assurance Manager oversees performance evaluation audits (PEAs) and technical systems audits (TSAs) conducted by the Lead Internal Auditor to ensure the integrity of the internal quality assurance program. The Program Quality Assurance Manager is responsible for developing QAPP updates and revisions when necessary. The Program Quality Assurance Manager is responsible for assuring timely response to and closure of corrective action reports.

Technical Specialists/Site Operators conduct system operation checks and perform instrument maintenance. The technical specialists ensure that all measurements are collected in accordance with all applicable SOPs, standard methods, and regulations. Technical specialists perform the required quality checks on instruments and document all work in site logs. Technical specialists may conduct these activities on-site or remotely, as applicable to the specific activities. Technical Specialists/Site Operators may initiate and participate in responses to corrective action reports. Additionally, Technical Specialist/Site Operators are responsible for the collection of any physical samples, if necessary (e.g., backup sampling).

The **Instrument Suppliers** provide technical support for the instruments deployed in the field.

The **Data/Quality Control Manager** is responsible for ensuring that daily data reviews are conducted, oversees data collection and review of data anomalies (e.g., fail auto-screening), and ensures that data validation follows the schedule and procedures described in the QAPP. The Data/Quality Control Manager is responsible for preparing quarterly reports, providing message board updates for O&M activities and report availability and for delivering the validated data to the System Manager/Operator. The Data/Quality Control Manager may initiate and participate in responses to corrective action reports.

Daily data review and data validation are conducted by experienced air monitoring system analysts. The **Data Reviewers** communicate with the Data/Quality Control Manager when there are issues and may also interact with the Technical Specialists when they observe potential O&M issues that need to be addressed.

The **Website/Data System Manager** is responsible for properly displaying data on the website, managing inquiries from the public, and ensuring that validated quarterly reports are available for download on a quarterly basis. Automated alerts will notify the Website/Data System Manager when the real-time data are not available on the website. The Website/Data System Manager is responsible for assessing and fixing data communication and other information technology–related issues concerning the website and data system. The Website/Data System Manager may initiate and participate in responses to corrective action reports.

The **Lead Internal Auditor** is not involved in the management or routine operations of this monitoring program, and functions independently from the fenceline air monitoring system operations & maintenance organizational structure. The Lead Internal Auditor is responsible for coordinating internal auditing tasks, which may include PEAs, TSAs and periodic audits. This internal auditing function is intended to supplement and not replace any third-party auditing requirements. The Lead Internal Auditor reports to the Program QA Manager and may initiate and participate in responses to corrective action reports. The Lead Internal Auditor maintains designated audit equipment in a separate location from the operations center and has access to the Program Quality Assurance Manager for assistance in promoting quality objectives.

The **Qualified Independent Party**, as required by Rule 1180, is responsible for assessing whether the fenceline air monitoring system is being operated and maintained in accordance with the *Torrance Refinery Rule 1180 Fenceline Air Monitoring Plan*[1] and QAPP. The Qualified Independent Party coordinates and performs external QA activities independent from the operations and maintenance and internal quality assurance organizations.

Activities include developing and performing periodic TSAs and PEAs. Prepares external audit reports for the Rule 1180 Program Manager and may initiate corrective action reports. The Qualified Independent Party reports to the Rule 1180 Program Manager and may communicate directly with all members of the operations and maintenance team, internal QA organization, Rule 1180 Program Manager and System Owner as appropriate to assure timely response and closure of corrective action reports.

1.4 Problem Definition/Background

This QAPP applies to a fenceline air monitoring system installed at the Torrance Refinery to comply with South Coast Air Quality Management District (AQMD) Rule 1180 *Fenceline and Community Air Monitoring for Petroleum Refineries and Related Facilities*[2] (the "Rule"), adopted December 1, 2017 and amended January 5, 2024. References to "Rule 1180" in this document are referring to the amended rule, and

[1] *Torrance Refinery Fenceline Air Monitoring Plan*, Revision 3, prepared by Spectrum Environmental Solutions (pending South Coast AQMD review as of XX, 2024).

[2] *Rule 1180.Fenceline and Community Air Monitoring for Petroleum Refineries and Related Facilities*, in Regulation XI Source Specific Standards, South Coast AQMD Rule Book, South Coast Air Quality Management District, Diamond Bar, California. Adopted December 1, 2017, Amended January 5, 2024. See https://www.aqmd.gov/docs/default-source/rule-book/reg-xi/r1180.pdf

references to the South Coast AQMD Refinery Fenceline Air Monitoring Plan Guidelines are similarly referring to the amended guidelines adopted January 2024. This QAPP is intended to satisfy the requirements of Rule 1180 and its associated *Refinery Fenceline Air Monitoring Guidelines*.[3] As suggested in the South Coast AQMD Rule 1180 guidelines, this QAPP generally conforms with content requirements specified in EPA guidelines.[4]

Rule 1180 requires monitoring for target air compounds along the refinery fenceline using open-path optical and point measurement technologies and meteorological monitoring instruments. The Rule requires public access to the data in real time via a public website and notification system.

This QAPP defines criteria and actions that the project team will take to ensure that the data collected meet all regulatory requirements and the data quality objectives (DQOs) defined in the QAPP. The document review cycle for this QAPP and its associated SOPs will be triggered by any significant change in system equipment or operations. Failing that, the QAPP will be reviewed annually and the SOPs will be reviewed every three years.

1.5 System Description and Approach

The fenceline air monitoring system that is implemented to satisfy the requirements of Rule 1180 collects continuous monitoring data for the target substances utilizing open-path monitors and fixed-point monitors. This monitoring system, which is intended as a permanent installation with an estimated lifespan of at least twenty years, provides continuous real-time data for target substances at or near the Torrance Refinery perimeter fenceline.

The system configuration includes six open-path analyzer locations (OPA), identified as OPA-1 through OPA-6 in Figure 1-2 and listed in Table 1-4. Each of these six locations has one monostatic open-path Fourier transform infrared (FTIR) analyzer and one monostatic open-path ultraviolet differential optical absorption (UVDOAS) analyzer. All locations serve two paths[5] on an alternating 5-minute basis by use of a computer-controlled motorized pan-and-tilt mount. For each of the six open-path analyzer locations there are two paths identified as “a” and “b”, with an open-path retroreflector (OPR) for each analyzer located at the path end opposite the analyzer (e.g., path from OPA-1 to OPR-1a, path OPA-1 to OPR-1b). Additionally, continuous fixed-point monitors for measuring black carbon and hydrogen sulfide are placed at six locations around the facility boundary. Four particulate matter analyzers (capable of measuring $PM_{2.5}$ and PM_{10}) and four speciated metals analyzers will be placed along the fenceline in order to address amendments made to Rule 1180 in January 2024.

See Figure 1-2 for a layout of all existing and proposed open-path, fixed-point, and meteorological monitors.

[3] *Rule 1180 Refinery Fenceline Air Monitoring Plan Guidelines*, South Coast Air Quality Management District, Diamond Bar, California. December 2017, Amended January 2024. See https://www.aqmd.gov/docs/default-source/rule-book/support-documents/1180/rule-1180-guidelines.pdf

[4] U.S.EPA, *Guidance for quality Assurance Project Plans*, QA-G5, 2002. EPA/240/R-02/009. See https://www.epa.gov/sites/production/files/2015-06/documents/g5-final.pdf (accessed August 2019)

[5] See Figure 1-2 in this QAPP and Section 5 of the *Torrance Refinery Rule 1180 Fenceline Air Monitoring Plan* **Error! Bookmark not defined.** for path lengths.

The fenceline air monitoring locations were selected by considering potential for community exposure, potential emission sources within the refinery, and prevalent wind directions. It is expected that the chosen monitoring locations will provide data representative of the overall air quality and meteorology of the area. The four metals monitoring locations were selected to provide comprehensive fenceline coverage for nearby communities and with consideration of the Fluid Catalytic Cracking Unit (FCCU) located centrally within the refinery. More information regarding monitoring location siting may be found in the Fenceline Air Monitoring Plan (FAMP).

This QAPP also addresses meteorological monitoring as specified in the Rule 1180 Guidelines. Meteorological monitoring is necessary to characterize wind and weather patterns for understanding movement and dispersion of the measured target substances. Rule 1180 Guidelines require monitoring for the following meteorological parameters: ambient temperature, horizontal wind speed, horizontal wind direction, barometric pressure, and relative humidity. The parameters to be monitored including target substances and meteorological variables are listed in Table 1-3. The major components and features of the fenceline air monitoring system are summarized in Table 1-4. Additional equipment specifications can be found in Appendix A.

Figure 1-2. Layout of open-path FTIR, open-path UVDOAS and fixed-point monitors

Table 1-3. Target substances and monitored meteorological parameters

Category	Parameters
Criteria air pollutants	Sulfur dioxide Nitrogen oxides Particulate Matter ($PM_{2.5}$, PM_{10})
Volatile organic compounds (VOCs)	Total VOCs (non-methane hydrocarbons)[6] Formaldehyde Acetaldehyde Acrolein 1,3-Butadiene Naphthalene Styrene BTEX compounds (benzene, toluene, ethylbenzene, xylenes)
Metals	Cadmium Manganese Nickel
Other compounds	Hydrogen sulfide Carbonyl sulfide Ammonia Black carbon Hydrogen cyanide Hydrogen fluoride
Meteorological parameters	Horizontal wind speed and direction Temperature Barometric pressure Relative humidity

[6] For purposes of Rule 1180 monitoring, South Coast AQMD staff has specified that "*non-methane hydrocarbons*" are defined for this program as total hydrocarbons measured by FTIR that absorb in the spectral region near 3000 cm^{-1}. This results in a measurement which approximately represents the sum of most alkanes and alkenes (with a carbon number of three and greater). Because all individual alkanes and alkenes cannot be reliably distinguished from one another by FTIR, Torrance Refinery expresses this measurement result as an equivalent concentration of propane. The concentrations measured using this method will include a group of hydrocarbons that is different from regulatory definitions for "*total gaseous non-methane hydrocarbons*" and "*volatile organic compounds*" and may include certain non-reactive compounds which are exempt under U.S. EPA and/or South Coast AQMD rules.

Table 1-4. Rule 1180 fenceline air monitoring system equipment

Component	Make/Model	Quantity
Open-Path Measurement System		
Monostatic open-path FTIR system	Spectrum WaveRunIR	6
Open-path FTIR retroreflector	Spectrum Au-Array or equivalent	12
Monostatic open-path UVDOAS system	Spectrum OP-UVDOAS	6
Open-path UVDOAS retroreflector	Spectrum Ag-Array or equivalent	12
Auto positioner/Pan and Tilt - FTIR	Quickset MPT-90	6
Auto positioner/Pan and Tilt – UVDOAS	Quickset MPT-90	6
Fixed-Point Measurement System		
Black carbon monitor	Met One BC 1060	6
Hydrogen sulfide monitor	Teledyne API T101	6
Particulate matter monitor	Teledyne API T640 or equivalent	4
Speciated metals monitor	SailBri Cooper, Inc. Xact 625i or equivalent	4
Meteorological Tower System		
10-meter tower assembly	Met One 970895	1
Wind speed	Met One 101C/2672	1
Wind direction	Met One 020C/10296	1
Relative humidity/temperature	Met One 085-35/5980	1
Barometric pressure	Met One 092	1

1.5.1 Open-Path Monitors

The fenceline air monitoring system uses a combination of open-path monitors and fixed-point monitors. The system includes both open-path FTIR analyzers and open-path UVDOAS analyzers. Open-path monitors operate by projecting a beam of ultraviolet or infrared light through open air to retroreflectors, which reflects the light back to the monitor where spectral absorption characteristics are measured. The unique spectral absorption characteristics of each gas are used to calculate and record the concentrations of each gas present in the beam. The measurement represents an average concentration over the length of the beam. The Torrance Refinery open-path monitors consist of twelve analyzers at six locations serving twenty-four paths (twelve parallel paths) on all sides of the refinery with path lengths between approximately 230 and 590 meters.

The light is transmitted to a retroreflector and back to a detector co-located with the transmitter. An auto-positioner (pan and tilt) rotates the analyzer to alternate between two different retroreflectors for two paths at five-minute intervals. The analyzer software provides five-minute (real-time) and 1-hour (rolling) average gas concentration measurements for each path as listed in Table 1-5. Because each analyzer alternates between two paths for five minutes each, the data for each path are updated at 10-minute intervals.

The detection limit of open-path systems is a dynamic quantity that will change as atmospheric conditions change. The classic least squares (CLS) value is used to determine the detection limits of each compound for each measurement. The CLS value also is referred to as a "goodness-of-fit" parameter since it assesses the agreement between the target analyte's reference spectrum and the shape of the current spectrum. After each measurement period, upon quantification of the absorbance spectrum, a primary concentration value for each analyte is calculated. Additionally, a residual (or CLS) spectrum is produced for each analyte. This residual spectrum produces a separate set of residual concentrations, one for each analyte. The residual spectrum can be thought of as a spectrum made by taking the root mean square of the difference between the absorbance spectrum and a synthetic spectrum created by using the concentration data and the spectral reference set that resides in the analysis method. Unlike the primary concentration values, the residual concentrations are always positive. The CLS value is equal to the residual concentration multiplied by a nominal value of 3. The CLS multiplication factor varies depending upon the individual analyte and may be adjusted to balance between competing objectives of achieving low detection limits and minimizing the reporting of false positive values.

The standard deviation value, which is calculated based on the detection limit calculation procedure described in US EPA Method TO-16, Section 9.6 *The Determination of the Detection Limit*[7], is used to assess program detection limits and CLS multiplication factors. In this procedure, the standard deviation value is calculated for a given target analyte using most recent fifteen five-minute spectra for which that target analyte is not present. This standard deviation value is then multiplied by a value of 3 which is the approximate Student's *t*-value for a single-tailed 99.5th percentile t statistic and a standard deviation estimate with 14 degrees of freedom. Whereas the detection limit methodology in TO-16 requires that the most recent fifteen spectra be contiguous (i.e., no time is allowed to elapse between them), the monitoring strategy used for this measurement program does not allow this. Therefore, fewer than fifteen spectra (e.g., nine) are considered to evaluate detection limits over shorter, but more representative, time periods (e.g., 1.5 hours).

If the measured concentrations of all target compounds in a spectrum are less than their respective compound-specific CLS detection limit, then the spectrum is considered to have been taken in the absence of any absorbing species of interest and the spectrum is suitable for use as an atmospheric background for subsequent measurements. Additional information on the detection limit derivation process for open-path analyzers can be found in the SOP, *TORC Data Processing, Compiling, and Management (SES SOP-TORC-07)*.

[7] *Long-Path Open-Path Fourier Transform Infrared Monitoring of Atmospheric Gases*, Compendium Method TO-16, U.S. Environmental Protection Agency, Cincinnati, Ohio, 1999. See https://www3.epa.gov/ttn/amtic/files/ambient/airtox/to-16r.pdf.

The open-path monitors include a reference gas cell that can be placed in the beam path during quality assurance activities. This enables periodic quality assurance checks using reference gas mixtures containing known concentrations of a reference gas (or gases). This procedure is referred to as an instrument challenge and is discussed in Section 2.5.1 of this QAPP. Information on the frequency of QA checks on open-path instruments is also discussed there.

Additional equipment specifications are provided in Appendix A of this QAPP.

Table 1-5. Approximate detection levels for open-path monitors

Parameter	Manufacturer	Model	Reporting units	Approximate lower detection level (ppb)	Approximate upper detection level (ppm)
Hydrogen fluoride	Spectrum	WaveRunIR	ppb	2	10,000
Total VOCs				30	10,000
Nitrogen dioxide				20	10,000
Formaldehyde				1.5	10,000
Acetaldehyde				10	10,000
Acrolein				5	10,000
1,3 Butadiene				2	10,000
Carbonyl sulfide				1.5	10,000
Ammonia				2.5	10,000
Hydrogen cyanide				20	10,000
Sulfur dioxide	Spectrum	OP-UVDOAS	ppb	1	100
Benzene				0.8	100
Toluene				2	100
Ethyl benzene				5	100
m-Xylene				1.5	100
p-Xylene				1.5	100
o-Xylene				10	100
Styrene				1	100
Naphthalene				1	100

1.5.2 Fixed-Point Monitors

Black carbon, hydrogen sulfide, particulate matter ($PM_{2.5}$ and PM_{10}), and metals (cadmium, manganese, and nickel) are monitored using fixed-point instruments, which analyze samples collected from a single location each.

Met One BC 1060 black carbon monitors measure black carbon concentrations at six locations around the fenceline. The BC 1060 analyzer uses two-wavelengths that measure the amount of black carbon in ambient air via attenuation of light signals across a filter tape. Ambient air is drawn through a size-selective inlet and through a glass fiber tape onto which ambient particulate matter is deposited. The tape is then advanced to a light detector, which measures optical transmission of light at 880 nanometers (nm) and 370 nm wavelengths through the tape filter, thereby providing an average measurement of ambient black carbon for the selected sampling time.

The lower detection limit for the black carbon monitor decreases with sampling time. Thus, a single measurement collected over a one-hour period would have a lower detection level than a measurement collected over five minutes. The instruments are configured to collect and record data in five-minute averages as required by Rule 1180. The data are used to calculate rolling hourly averages updated every five minutes.

Hydrogen sulfide is monitored at six locations around the fenceline using Teledyne/Advanced Pollution Instrumentation ("Teledyne") T101 hydrogen sulfide analyzers ("T101 analyzer"). In the T101 analyzer, sulfur dioxide is removed from the sample gas in a scrubber. Hydrogen sulfide in the sample gas then is converted into sulfur dioxide in a molybdenum converter operating at 315 °C, designed to minimize conversion of reduced sulfur species other than hydrogen sulfide. Sulfur dioxide is measured through excitation by ultraviolet light, where sulfur dioxide molecules absorb ultraviolet light and become excited at one wavelength, and decay to a lower energy state emitting ultraviolet light at a different wavelength. The emitted light is captured on a photomultiplier tube through a bandpass filter tuned to wavelengths emitted by excited sulfur dioxide molecules and is converted into a reading of hydrogen sulfide concentration.

The hydrogen sulfide analyzer collects and records data in five-minute averages. The data are used to calculate 1-hour rolling averages, updated every five minutes.

Particulate matter is monitored at four locations on the fenceline using Teledyne T640 PM Mass Monitors or equivalent. These monitors are optical aerosol spectrometers that convert optical measurements to mass measurements by determining sampled particle size via scattered light at the single particle level. Ambient aerosol is drawn into the T640, and the aspirated particles are dried and moved to an optical particle sensor where scattered light intensity is measured to determine particle size diameter. Each particle generates a scattered light impulse at an 85° to 95° angle where amplitude and signal length are measured. The amplitude of the scattered light impulse is directly related to the particle size diameter. The monitors simultaneously measure particles of size 2.5 microns or less ($PM_{2.5}$) and particles of size 10 microns or less (PM_{10}). Particulate matter measurements are recorded every five minutes and are used to calculate rolling 24-hour average measurements updated every five minutes.

Cadmium, manganese, and nickel are measured at four locations around the fenceline using SailBri Cooper, Inc. (SCI) Xact 625i Ambient Continuous Multi-Metals Monitors or equivalent. The technology of these monitors has been validated by the EPA Environmental Technology Verification (ETV) Program, as described in the South Coast AQMD PAR 110 & PR 1180.1 Final Staff Report.[8,9] These analyzers function by using reel-to-reel filter tape sampling and non-destructive energy dispersive X-ray fluorescence (EDXRF) analysis. The air is sampled and drawn through the filter tap, and the resulting PM deposit is advanced into the analysis area where energy-dispersive X-ray fluorescence (EDXRF) is used to analyze selected metals while the next sample is connected. Metal concentrations are measured every hour and are used to calculate rolling 8-hour averages (manganese only) updated every hour.

Table 1-6 lists approximate pollutant detection limits and ranges for fixed-point monitors. See Appendix A of the QAPP for fixed-point monitor equipment specifications.

Table 1-6. Performance specifications for fixed-point monitors

Parameter	Manufacturer	Model	Reporting Units	Lower detection level	Upper detection level
Black carbon	Met One	BC-1060	µg/m^3	0.1	100
Hydrogen sulfide	Teledyne/ Advanced Pollution Instrumentation	T101	ppb	0.4	10,000
Particulate matter $PM_{2.5}$	Teledyne/Advanced Pollution Instrumentation or equivalent	T640	µg/m^3	0.1	10,000
Particulate matter PM_{10}				0.1	10,000
Cadmium	SailBri Cooper, Inc. or equivalent	Xact 625i	ng/m^3	2.5	60,000
Manganese				0.14	60,000
Nickel				0.096	60,000

1.5.3 Meteorological Monitoring

The meteorological monitoring tower uses high quality sensors to collect and record data continuously and in real time. The data are used to calculate 1-hour rolling averages updated every five minutes. These meteorological instruments meet EPA specifications[10] for accuracy, range and resolution (Table 1-7).

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[8] https://sci-monitoring.com/wp-content/uploads/2023/06/ETV-Full-Report.pdf
[9] https://www.aqmd.gov/docs/default-source/Agendas/Governing-Board/2024/2024-Jan5-014.pdf
[10] *Quality Assurance Handbook for Air Pollution Measurement Systems*, Volume IV: Meteorological Measurements, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina, March 2008, EPA-454/B-08-002. See https://www3.epa.gov/ttn/amtic/files/ambient/met/Volume_IV_Meteorological_Measurements.pdf (accessed July 19, 2018)

Table 1-7. Performance specifications for the meteorological tower components

Parameter	Sensor Make and model	Reporting units	Accuracy[11]	Range	Resolution
Horizontal wind speed	Met One 010C 3-cup anemometer	Meters per second (m/s)	± 0.1	0.4 - 55.9	0.1
Horizontal wind direction	Met One 020C airfoil vane	Degrees (°)	± 3	0 to 360	0.1
Ambient temperature	Met One 083E thermistor	Degrees Celsius (°C)	± 0.15	-30 to 50	0.1
Barometric Pressure	Met One 092 solid-state pressure transducer	Hectopascals (hPa)	± 0.35 (at 20 °C) ±1.0 over full range ±0.5 over any 200 hPa range	500 to 1,100	0.1
Relative humidity	Met One 083E thin film polymer capacitor	Percent (%)	± 2	0 to 100	0.1

1.5.4 Ancillary Equipment

Ancillary equipment includes sample inlets, sample transport lines, calibration and QA check equipment, computers, data loggers, communication devices, electricity supply and conditioning equipment, lighting, etc.

Equipment included in the air monitoring system is listed in Table 1-4.

1.6 Quality Objectives and Criteria

The primary objective of Rule 1180 refinery fenceline monitoring is to provide air quality information to the public about levels of target air pollutants and groups of compounds (see Table 1-3 of this QAPP), at or near the property boundaries of petroleum refineries in the South Coast Basin. DQOs for the Torrance Refinery fenceline air monitoring system are established to assure monitoring data can be reported with a known degree of confidence. The DQOs presented in this QAPP are established considering EPA

[11] Accuracy, range and resolution values listed in this table are the manufacturer's published performance specifications.

guidelines[12,13] adapted as appropriate for the informational purposes of this Rule 1180 monitoring system. Data quality indicators (DQIs) are quantitative and qualitative characteristics associated with the collected data (i.e., calculated statistics). Measurement quality objectives (MQOs) are the acceptance or performance criteria for individual DQIs. The DQIs and MQOs for this monitoring system are presented in Section 1.6.2 - Project Quality Objectives.

1.6.1 Data Quality Objectives Process

The DQO process consists of seven steps which establish the link between the specific end use of the data, the data collection process, and the data quality requirements. These steps are detailed below, along with the results of each step.

1.6.1.1 Problem Statement

The fenceline monitoring program established in the Plan and defined in this QAPP must satisfy the requirements of Rule 1180 and its associated *Refinery Fenceline Air Monitoring Plan Guidelines*,[14] which requires monitoring for target air pollutants along the refinery fenceline and providing public access to the data in real time. See also Section 1.4 of this QAPP.

1.6.1.2 Program Goals

Rule 1180 defines the program goals:

"The purpose of this rule is to require real-time fenceline air monitoring systems and to establish a fee schedule to fund refinery-related community air monitoring systems that provide air quality information to the public about levels of various criteria air pollutants, volatile organic compounds, metals, and other air pollutants, at or near the property boundaries of Petroleum Refineries and in nearby communities."

The Torrance Refinery fenceline air monitoring system provides information to the public about concentrations of target air pollutants and groups of compounds (see Table 1-3) specified in Rule 1180 along the refinery fenceline. Monitoring data are collected with instrumentation that provides continuous concentration measurements in real-time (five-minute or one-hour averages) and averaged over rolling one hour, 8-hour, or 24-hour periods. Real-time and averaged data, and supporting information to contextualize the measurement data, are published on a publicly-accessible website. Additionally, notifications are distributed via email and/or text message to subscribers when pollutants exceed pre-determined thresholds. Finally, monitoring data that have undergone extensive quality assurance checks are published in downloadable format and summarized in quarterly reports on the website.

[12] *Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD)*, U.S. Environmental Protection Agency, May 1987. EPA-450/4-87-007. See https://www.epa.gov/sites/production/files/2015-07/documents/monguide.pdf (accessed August 2019).

[13] *U.S. EPA Guidance for the Data Quality Objectives Process*, U.S. Environmental Protection Agency, February 2006. EPA QA/G-4. See https://www.epa.gov/sites/production/files/2015-06/documents/g4-final.pdf (accessed November 2019).

[14] *Rule 1180 Refinery Fenceline Air Monitoring Plan Guidelines*, South Coast Air Quality Management District, Diamond Bar, California. December 2017. See http://www.aqmd.gov/docs/default-source/rule-book/support-documents/1180/rule-1180-guidelines.pdf (accessed August 2019).

1.6.1.3 Information Inputs

Section 1.5 of this QAPP describes the monitoring apparatus and techniques that are used to obtain ambient pollutant concentration data to address the goals of the monitoring program. Further, Section 2.9 outlines the website and community interface that, along with a public notification system, inform the public of the measurement data.

1.6.1.4 Project Boundaries

Section 1.5 describes the spatial extent of the fenceline monitoring program, measurement temporal characteristics and the monitored target substances and meteorological parameters.

1.6.1.5 Analytical Approach

Sections 1.5 and 2.4 of this QAPP describe the monitoring systems and the analytical approaches used for each measurement. The analytical approaches were specified by South Coast AQMD in the Guidelines and subsequent discussions with their staff during Monitoring Plan and QAPP development.

1.6.1.6 Performance Criteria

Performance or acceptance criteria specific to each monitoring system (i.e., open path, fixed point or meteorological) are provided in the form of specific data quality indicators (DQIs) and measurement quality objectives (MQOs) in Section 1.6.2 below.

The MQOs for open-path and fixed-point monitors are established to: 1) provide measurement data that represent conditions at the fenceline with known confidence; and 2) allow measured data comparison with established action thresholds that trigger public notifications.

MQOs for meteorological systems are established to provide context for measured concentrations (i.e., whether the point of measurement is upwind or downwind of the refinery) and identify periods of adverse atmospheric conditions that may impede open-path measurements.

Additional project-level performance criteria include:

- Records of quality control and quality assurance procedures performed during data collection will be retained. Specific documents are listed in Section 1.8 (Documents and Records);
- Reference gases shall be working standards certified by comparison to a National Institute of Science and Technology Gaseous Standard Reference Material[15], where these are commercially available;
- The minimum data completeness and other data quality objectives are established to assess the adequacy of data for the intended use, which for Rule 1180 is to inform the public concerning selected air pollutant concentrations at the Torrance Refinery fenceline (not intended for emergency notification). The capabilities of the measurement system to achieve the data quality objectives so established also must be considered. The minimum valid data completeness objective is 90% per calendar quarter for all fenceline air quality monitoring

[15] NIST Traceable Reference Material Program for Gas Standards. See https://www.nist.gov/programs-projects/nist-traceable-reference-material-program-gas-standards (accessed November 2019)

data including the advanced technology open-path monitors, fixed-point monitors and meteorological monitors. If actual or forecasted quarterly data completeness falls below 90%, the system is assessed for improvements and actions are taken as appropriate commensurate with scheduled maintenance activities, resource availability and/or practices.

- This minimum data completeness objective is more strict than stringent federal and California minimum data completeness requirements for criteria pollutant ambient air compliance monitoring systems (i.e., the national air monitoring stations (NAMS) and state and local air monitoring stations (SLAMS)), for which a minimum of 75% data completeness is required per standards established in the Code of Federal Regulations, Title 40, Part 50 and echoed in California Air Resources Board QAPP requirements.[16,17]

Note, open-path monitor interferences and signal degradation from uncontrollable adverse atmospheric conditions—such as fog, rain, ozone, particulate matter and visibility—adversely affect data collection. Periods when data collection is impacted by adverse atmospheric conditions are properly flagged and accounted for in the determination of the data completeness as defined in Section 2.5.7.4 of this QAPP.

Completeness and other DQOs are established to assess the adequacy of data for the intended use, which in this case is to inform the public concerning selected air pollutant concentrations at the Torrance Refinery fenceline as described in the Torrance Refinery Rule 1180 Fenceline Air Monitoring Plan. The system is neither intended nor required to serve as an emergency notification system in the very rare event that pollutant concentrations reach levels considered sufficient to potentially cause immediate human health effects among sensitive populations. The minimum data completeness objective establishes the minimum amount of data required to meet Rule 1180 data end use purposes. The monitoring system capabilities are relevant only to the extent they affect the ability to achieve the DQOs established based on the intended data end use. Torrance Refinery will re-evaluate DQOs and other related metrics as new information regarding the Torrance Refinery Rule 1180 fenceline air monitoring system is collected regarding system performance.

1.6.1.7 Plan for Obtaining Data

Sections 2.1 through 2.8 of this QAPP outline the approach for generating concentration data that are consistent with the DQOs of this monitoring program and to meet the overall acceptance criteria specified above and in Section 1.6.2 below.

1.6.2 Project Quality Objectives

Having established project DQOs, the quality of the data must be evaluated and controlled to ensure they are maintained within established acceptance criteria. Controlling and assessing data quality requires the development of project-specific MQOs. These project MQOs provide a framework for ensuring that data are of a known and documented quality. The MQOs are defined in terms of DQIs.

[16] Quality Management Plans and Quality Assurance Project Plans, California Air Resources Board. See https://ww2.arb.ca.gov/our-work/programs/quality-assurance/qm-document-repository/quality-management-plans-and-quality (accessed February 2020).

[17] 40 CFR Part 50, National Primary and Secondary Ambient Air Quality Standards. Minimum data completeness criteria are provided in Appendices I through S for various criteria air pollutants. See https://gov.ecfr.io/cgi-bin/text-idx?SID=6e34302e2721ca6883b918429605bc23&mc=true&node=pt40.2.50&rgn=div5 (accessed March 2020).

The DQIs which define the fenceline monitoring system data quality are based on definitions provided in US EPA Guidance for Quality Assurance Project Plans[18]:

- Precision – a measure of agreement among repeated measurements of the same property under identical or substantially similar conditions;
- Bias – the systematic or persistent distortion of a measurement process that causes errors in one direction;
- Accuracy – a measure of overall agreement of a measurement to a known value; it includes a combination of random error (precision) and systematic error (bias);
- Representativeness – a qualitative term that expresses the degree to which data accurately and precisely represent a characteristic of a population;
- Comparability – a qualitative term that expresses the measure of confidence that one data set has when compared to another;
- Sensitivity – a measure of a method or instrument's ability to discriminate between measurement responses representing different levels of the variable of interest; and
- Completeness – a measure of the amount of valid data obtained from a measurement system.

Details on how these DQIs are defined and assessed for the fenceline monitoring system are provided in Tables 1-8 and 1-9 below, and in Sections 2.5 and 2.7 of this QAPP.

Representativeness was addressed during the design of the existing air monitoring network and can be evaluated in terms of the spatial coverage and temporal resolution. For example, the system described in this plan includes open measurement paths that will actively monitor pollutant concentrations along approximately 86% of the refinery perimeter fenceline, with a few minor exception that are not covered due to obstructions or path interferences. These measurement paths border residential, commercial, and industrial communities on all sides of the refinery and provide comprehensive coverage on the predominantly downwind sides. The fixed-point black carbon and hydrogen sulfide monitors are stationed at six locations around the refinery – each of the six open-path shelters with the exception of OPA-1, and a separate walk-up site located on the western edge of the refinery near OPR-1a. The four particulate matter and metals monitors are located at four of the open-path shelters, which were selected to provide adequate coverage for nearby communities, and with consideration of the refinery's Fluid Catalytic Cracking Unit (FCCU) location.

With regard to temporal resolution, all of the measurement equipment utilized in this study sample continuously and generate high time resolution data (i.e., 5-minute discrete or average measurements). As such, the design will assure that the data generated by the fenceline air monitoring system will appropriately characterize pollutant concentrations along the refinery fenceline. An assessment of the representativeness of this project's monitoring data also will take place as a part of the processes described in Section 4.3 of this QAPP, *Reconciliation with Data Quality Objectives*.

[18] U.S.EPA, *Guidance for quality Assurance Project Plans*, QA-G5, 2002. EPA/240/R-02/009. See https://www.epa.gov/sites/production/files/2015-06/documents/g5-final.pdf (accessed August 2019)

Comparability is assessed in multiple ways, for example, by evaluating concentrations measured by the fenceline monitoring system against other measurements of the same parameters. Additional information on this topic is included in Section 4.1 of this QAPP, Data Review, Verification, and Validation.

The remaining DQIs are addressed in MQOs for open-path and fixed-point monitors (Table 1-8) and meteorology monitors (Table 1-9). Completeness is evaluated against the calendar quarter data set of daily averages (periods during which adverse atmospheric conditions, acts of God, vandalism, terrorism, loss of station power or other events over which neither the refinery nor their monitoring contractor has control over are accounted for in data loss calculations as specified in Section 2.5 of this QAPP). US EPA guidelines on quality assurance for meteorological measurements[19][10] do not specify precision MQOs for meteorological measurements. Formulas for calculating DQIs are presented in Section 2.5 of this QAPP.

Table 1-8. DQIs and MQOs for refinery fenceline air monitoring systems

DQIs	MQOs for open-path systems	MQOs for fixed point systems	MQOs for meteorological systems
Completeness	Minimum 90% quarterly	Minimum 90% quarterly	Minimum 90% quarterly
Accuracy	See Tables 2-2 - 2-3	See Tables 2-4 – 2-7	See Table 2-8
Precision	See Tables 2-2 - 2-3	See Tables 2-4 – 2-7	See Table 2-8
Sensitivity (detection limits)	See Table 1-5	See Table 1-6	--

Table 1-9. DQIs and MQOs for the meteorological tower system[20]

Measurement	Method	Reporting Units	Operating Range	System Accuracy	Sensitivity (resolution)	Completeness (minimum)
Ambient Temperature	Thermistor	°C	-30 to 50	± 0.15	0.1	90%
Relative Humidity	Psychrometer/ Hygrometer	%	0 to 100	± 2	0.1	90%
Barometric Pressure	Aneroid Barometer	hPa	500 to 1,100	±0.35 (at 20 °C)	0.01	90%

[19] *Quality Assurance Handbook for Air Pollution Measurement Systems*, Volume IV: Meteorological Measurements, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina, March 2008, EPA-454/B-08-002. See https://www3.epa.gov/ttn/amtic/files/ambient/met/Volume_IV_Meteorological_Measurements.pdf (accessed July 19, 2018)

[20] Accuracy, range and resolution values listed in this table are the manufacturer's published performance specifications of the corresponding sensors.

Measurement	Method	Reporting Units	Operating Range	System Accuracy	Sensitivity (resolution)	Completeness (minimum)
				±1.0 over full range ±0.5 over any 200 hPa range		
Wind Speed	Cup or sonic anemometer	m/s	0.4 to 50.0	± 0.1	0.003 (0.1 mph)	90%
Wind Direction	Vane or sonic anemometer	Degrees (°)	0 to 360	± 5, includes orientation error	0.1	90%

1.7 Training and Certifications

Adequate education and training are key components to any successful monitoring system that strives to produce data of known quality meeting DQOs. Activities conducted under this QAPP are performed by individuals with proper training and experience. All personnel assigned to operation, maintenance, quality assurance, and data handling will be sufficiently trained in the underlying technical and scientific principles behind the air monitoring equipment being used. Staff assigned to operate and maintain the system will be trained on operation and maintenance of the system prior to and during the start-up phase. The System Manager/Operator will determine specific training requirements, including periodic refresher training for existing staff and initial training of new staff, for operation and maintenance of the system. Training will be provided by the System Manager/Operator or designated representatives, and a record of training will be maintained by the System Manager/Operator.

Staff new to the refinery fenceline air monitoring program will undergo the above-mentioned training program before beginning work associated with the program. Additionally, periodic refresher training of all staff will be performed at least once every 2 years to ensure all staff maintain currency with procedures established in the Plan and QAPP, and are aware of changes to the monitoring system, Rule 1180 program or the QAPP.

1.8 Documents and Records

The System Manager/Operator is responsible for distributing the most recently approved QAPP (and other documents used throughout the project operation) to all personnel identified in the QAPP distribution list via email. Emails are also considered records.

Controlled versions of all project documents, including the QAPP and copies of significant emails, are maintained in electronic format by the Program Quality Assurance Manager in an electronic data management system (EDMS). The most recently approved or partially approved QAPP is also posted on the public website, labeled to indicate approval status. Independent audit reports, specific cause analysis reports, and corrective action plans will also be posted on the public website. The QAPP and project documents should be reviewed, updated and re-approved as the fenceline air monitoring system requirements, design or equipment change. Failing that, the QAPP will be reviewed annually and the SOPs will be reviewed every three years. These documents can be made available to South Coast AQMD staff upon request. In accordance with Rule 1180, the records for at least the most two recent calendar years are kept onsite at the refinery.

The dataset created for this monitoring program will consist of the following components for open-path, point monitors and meteorological systems stored for at least five years in the project database and project files:

- For open-path monitors:
  - The 5-minute and 1-hour averaged concentration measurements for each path;
  - Detection limits for the 5-minute and 1-hour averaged concentration measurements generated for each path;
  - Individual absorption spectra including raw and processed spectra; spectral references, light source spectra, instrumental noise spectra, and dark spectra from each path;
- 5-minute average wind speed, wind direction, ambient temperature, barometric pressure, and relative humidity measurements at the meteorological tower, and the calculated hourly rolling average of the 5-minute meteorological data;
- 5-minute average concentration data generated from each hydrogen sulfide monitor and the calculated 1-hour rolling average concentration;
- 5-minute average concentration data generated from each black carbon monitor and the calculated 1-hour rolling average concentration;
- 5-minute average concentration data generated from each particulate matter monitor and the calculated 24-hour rolling average concentrations; and
- 1-hour average concentration data generated from each metals monitor and the calculated rolling 8-hour rolling average concentrations (manganese only).

The following critical documents and sources of information will support these data:

- Station logbooks and operator notes (in electronic form);
- Absorption spectra and raw data files from the open-path FTIR and UVDOAS monitors;
- Calibration records for all measurement systems, consisting of quality assurance checks with reference gases introduced into cells in the open-path monitor beams, fixed-point monitor calibrations and meteorological sensor calibrations;
- Maintenance records for all measurement systems;
- Data validation and editing instructions;
- QA audits of field operations and system performance;
- Third-party QA audit, inspection, assessment records;
- Specific cause analysis records;

- Standard operating procedures (SOPs), including:
  - SOP for Operation and Maintenance of the SES WaveRunIR™-OP FTIR
  - SOP for Operation and Maintenance of the SES OP DetectUV™-DOAS
  - SOP for Testing Instrument Accuracy of Open Path Analyzers
  - SOP for Operation and Maintenance of Meteorological Monitoring Sensors
  - SOP for Operation and Maintenance of the Met One BC 1060
  - SOP for Operation and Maintenance of the Teledyne T101 H2S Analyzer
  - SOP for Operation and Maintenance of the Teledyne T640 Particulate Matter Monitor
  - SOP for Operation and Maintenance of the Sailbri Cooper Xact 625i Metals Monitor
  - SOP for TORC Data Processing, Compiling, and Management
  - SOP for TORC Data Validation
- Corrective action reports.

Quarterly data summary reports and downloadable historical data available on the public website are prepared as a part of this air monitoring program. These reports include a comparison of monitored target pollutant concentrations against their respective concentration thresholds, assessments of data completeness, a description of any significant instrument issues encountered, and a summary of quality control efforts. Additional details on these quarterly reports are provided in Section 2.9, Data Management and Section 3.3, Reports to Management of this QAPP.

2 Data Generation and Acquisition

2.1 Sampling Process Design

Fenceline air monitoring data are collected using open-path instruments to measure and record pollutant concentrations over a path interval of nominally 500 meters (corresponding to a folded optical path length of 1000 meters for the monostatic systems) along or near the Torrance Refinery fenceline. There are six fixed-point monitor locations on or near the facility fenceline to monitor levels of black carbon and hydrogen sulfide, and there are four particulate matter and four metals fixed-point monitor locations. The selection of these monitoring sites is discussed in the *Torrance Refinery Rule 1180 Fenceline Air Monitoring Plan*Error! Bookmark not defined.. Additional information on the design of this monitoring network is provided in Section 1.5 of this QAPP, and additional details on data management are provided in Section 2.9.

2.2 Sampling Methods

This section describes the field work associated with this program, including the sampling methods and equipment that are used. All measurements are performed on a continuous basis; no physical samples are collected for offsite analysis. Standard operating procedures and methods for all the measurement equipment used in this study can be found in the respective equipment operation manuals. The sampling methods listed in this section were selected to comply with the requirements of Rule 1180. No changes to these sampling methods are expected. However, if any changes in sampling methods are made, these changes must be authorized and approved in writing by the Rule 1180 Program Manager and System Manager/Operator, documented in the site log, and this QAPP must be updated to reflect these changes.

2.2.1 Open-Path Monitoring Systems

This QAPP will serve as the primary reference for the open-path FTIR and open-path UVDOAS monitoring systems for the Torrance Refinery. All pertinent O&M and QA/QC procedures are cited as references and summarized in this QAPP.

The open-path analyzers are described in Section 1.5.1 of this QAPP. The open-path FTIR analyzer is a Spectrum *WaveRunIR*™, and the open-path UVDOAS analyzer is a Spectrum *OP-UVDOAS* analyzer. Both are mono-static multi-gas open-path analyzers. The analyzer systems operate by sending a beam of infrared or ultraviolet light through open air from a light source to a retroreflector cube array that redirects the light beam back to the analyzer.

The System Manager Operator team remotely performs daily system checks, data validations, and travels to the site as needed to perform both routine and emergency maintenance. The Technical Specialists/Site Operators provides on-site checks and necessary routine maintenance (system alignment optimization, bulb replacement, etc.) or repairs. A cellular modem interface to the analyzer computer(s) and to the alarm system allows the System Manager/Operator team to remotely retrieve data and system logs, conduct system performance checks, and perform certain types of system recoveries and adjustments.

The open-path monitors record target gas concentrations along pathway segments along or near the perimeter fenceline. Each measurement is collected over a 5-minute period. All the monitors cover two adjacent pathways via use of a computer-controlled motorized auto-positioner (pan and tilt) that rotates the instrument between the two paths at programmed 5-minute intervals.

Monitoring data are collected using on-site computers which parse the data and perform preliminary automated QC of the data. The data are then sent to a cloud server through a cellular connection every five minutes. Once delivered to the cloud server, validation calculations and distribution occur. Monitoring data are presented on the public website as five-minute measurement results and rolling 1-hour averages.

2.2.2 Fixed-Point Monitor Data

The fixed-point monitors for black carbon, hydrogen sulfide, particulate matter, and metals are described in Section 1.5.2 of this QAPP. The continuous data from black carbon, hydrogen sulfide, and particulate matter monitors are collected in five-minute averages, updated every five minutes. Metals monitor data are collected every hour and updated every hour. The data are sent to a cloud server through a cellular connection.

Black carbon and hydrogen sulfide concentrations are presented as 1-hour rolling averages of the 5-minute data, updated every 5 minutes. Particulate matter data will be presented as 24-hour rolling averages of the 5-minute data, updated every 5 minutes. Metals data will be presented as the hourly block averages only, with the exception of manganese, which will also be presented as 8-hour rolling averages of the 1-hour average, updated every hour. The averaging period for each compound was selected for consistency with the averaging periods of their respective health standard- or information-based notification thresholds indicated in Rule 1180.

2.2.3 Meteorological Data Collection

Meteorological instruments installed on a 10-meter tower at one location within the refinery are described in Section 1.5.3 of this QAPP. The meteorological instruments are configured to collect and record five-minute average data updated every five-minutes. The data are then sent to a cloud server through a cellular connection every five minutes. The meteorological data are presented on the public website as five-minute averages and rolling 1-hour averages.

2.2.4 Backup Monitoring

Rule 1180 requires alternate or temporary monitoring systems when the continuous monitoring systems are offline for extended periods (e.g., for maintenance or repair). The alternative monitoring systems will not be used to determine individual gaseous target compounds and/or surrogates when the open-path systems are down due to atmospheric conditions, but only in the event of extended periods for unscheduled maintenance or outages.

The backup monitoring plan is described in Section 6.6 of the *Torrance Refinery Rule 1180 Fenceline Air Monitoring Plan*[Error! Bookmark not defined.]. The approach to backup monitoring may be adjusted over time, for example, as techniques and technologies evolve.

2.3 Monitoring Data Documentation, Custody, and Control

The real-time open-path monitors and fixed-point monitors used to collect data for the fenceline air monitoring system do not involve physical sample shipping or custody transfer. However, the real-time monitoring data produced by the monitors are controlled using chain-of-custody information that verifies that monitoring data have not been changed or altered during data handling and transmission processes. Field operation records include site visit logs, continuous monitor calibration/validation documents, and maintenance logbooks. Many of these records are in electronic form, primarily as spreadsheets or text files. All field operation records are returned at least monthly to the Data/QA Manager for inclusion in the project files. The automatic data polling systems are password protected and only selected System Manager/Operator team members have access.

Original monitoring data records (including the original spectral data from open-path monitors) are stored as read-only files, and changes are made only to duplicates of the original files. Changes to data records, when required, will generally occur during data validation activities. Each data record will include one or more fields for data qualifiers (Table 2-1) entered during data review and validation. If a change is required, the original record is flagged appropriately. For example, if a data-point has to be invalidated it is marked as “invalid – correction applied” (or similarly marked) and will not be included in recalculation of time-averaged results. A duplicate record with corrected data is created for the same date and time and flagged “duplicate – validated” and included in recalculation of time-averaged results. The time and date of each change to a data record, if any, is noted along with the names of the persons making and approving each change.

Table 2-1. Data qualifiers for fenceline air monitoring data

Flag	Type	Explanation
BDL	Data Qualifier	Measurement results is below the minimum detection limit (MDL). The compound was not detected at a concentration that could be reliably quantitated. This may mean the compound is present but had interferences present, was below the detection capability of the instrument, or not present at all.
J	Data Qualifier	Result below limit of quantitation, but above minimum detection level.
Q	Data Qualifier	Questionable data
V	Data Qualifier	Validated data. Data accepted by data validators. The validators have reviewed the data and determined that it is valid.
MNT	Null Data Qualifier	Indicates the instrument or monitoring site is undergoing maintenance and data collected is not valid data.

Flag	Type	Explanation
MAL	Null Data Qualifier	A (instrument) malfunction that voids the data has occurred. The operator has determined that the datum is not valid and should be ignored; or the instrument has generated an error code and is not producing valid measurement data.
QAQC	Null Data Qualifier	Instrument off-line for routine quality assurance/quality control activities (e.g., calibration checks, calibrations, audits, etc.)
INS	Null Data Qualifier	Insufficient Data. Less than 75% data completeness for the averaging period
L	Null Data Qualifier	Low signal (open path analyzers).
ATM	Null Data Qualifier	Data invalid - interference due to atmospheric conditions.
NVAL	Null Data Qualifier	Invalid/Null Data. Datum rejected by data validators. The validators have reviewed the datum and determined that it is not valid.
M	Null Data Qualifier	Generic "Missing" for data, especially averages, for which the cause of the anomaly has yet to be assigned. Usually indicates that data was never collected. This may also be triggered by delays or breakdowns in data communications.

2.4 Analytical Methods

The analytical methods for each monitor type are described briefly below. The analytical methods listed in this section were selected to comply with the requirements of Rule 1180. No changes to the analytical methods for black carbon, hydrogen sulfide, particulate matter, or metals are expected, and no changes may be implemented unless authorized and approved in writing by the Rule 1180 Program Manager and the System Manager/Operator. However, the analytical methods for the open-path analyzers may be modified as needed to respond to changing atmospheric conditions and to improve analytical performance and optimize data quality. Examples of analytical method changes include adding new compounds (i.e., interferents) to the method, modifying CLS factors, and changing quantitation regions. These changes in the open-path analytical methods will generally be applied by the Site Operators. These changes do not require management approval; however, any changes in the analytical method must be documented in the site log. Refer to Sections 1.6, 2.5 and 2.7 for details on instrument performance criteria and refer to Section 3.1.5 which outlines corrective action reports and procedures.

2.4.1 Open-Path Monitor Analytical Methods

The spectral analysis methods employed for monitoring target gas concentrations using the open-path FTIR and open-path UVDOAS analyzers are based on applying a least-squares regression analysis for comparing calibrated reference spectra and measured absorption spectra as described in EPA Compendium Method TO-16[21]. Tables 1-5 and 1-6 of the QAPP present the Rule 1180 gaseous target compounds that will be monitored by these analyzers and their respective detection limits. The *Torrance Refinery Rule 1180 Fenceline Air Monitoring Plan*[Error! Bookmark not defined.] lists the health standard- or information-based notification levels used in this program for each compound as determined by Rule 1180.

2.4.2 Black Carbon Monitor Analytical Methods

Black carbon concentrations are calculated based on the relationship between measured optical attenuation through the filter tape as black carbon accumulates and ambient black carbon levels based on historical measurement data collected by thermo-optical methods. Based on laser light absorption onto quartz filters measured via the thermo-optical techniques, an empirical relationship is developed that describes the mass attenuation cross section (in units of m^2/g) and its wavelength dependence. The relationship between the attenuation of laser light through quartz filters onto which ambient particulate samples containing soot had been collected and the concentration of “graphitic carbon” of the same samples has been established in previous literature, and this correlation has been found to be linear over a wide concentration range.[22,23]

The black carbon analyzer measures the ambient concentration of black carbon by detecting the change in optical transmission as black carbon-containing particulate matter accumulates onto a filter. Transmission of light coming from light emitting diodes is measured across filter tape onto which sampled aerosol containing black carbon is being accumulated. Reference transmission across a clean portion of the filter tape is simultaneously measured.[24] As black carbon accumulates onto the filter tape light transmission across the portion of the tape onto which black carbon is accumulating relative to the reference transmission will decrease. The transmission data are converted into black carbon concentration by normalizing by volumetric flow rate, time interval of measurement and cross-sectional area of the filter spot.

The Met One BC 1060 black carbon analyzer uses two industry-standard wavelengths, 880 nm and 370nm, to determine the concentration of black carbon and ultraviolet light-absorbing particulate matter.

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[21] *Long-Path Open-Path Fourier Transform Infrared Monitoring of Atmospheric Gases*, Compendium Method TO-16, U.S. Environmental Protection Agency, Cincinnati, Ohio, 1999. See https://www3.epa.gov/ttn/amtic/files/ambient/airtox/to-16r.pdf (accessed July 19, 2018).

[22] Rosen, H., Hansen, A. D., Gundel, L., and Novakov, T., “Identification of the optically absorbing component in urban aerosols.” *Appl. Opt.,* **17**:3859-3861, 1978.

[23] Gundel, L., Dod, R., Rosen, H., and Novakov, T., “The relationship between optical attenuation and black carbon concentration for ambient and source particles.” *The Science of the Total Environment*, **36**:197-202, 1984.

[24] BC 1060 Black Carbon Monitor Operation Manual Section 9, BC 1060-9800, REV A, Met One Instruments.

2.4.3 Hydrogen Sulfide Monitor Analytical Methods

Ultraviolet fluorescence fixed-point monitors are used to monitor hydrogen sulfide. The Teledyne/Advanced Pollution Instrumentation T101 ultraviolet fluorescence hydrogen sulfide analyzer is selected to monitor hydrogen sulfide concentrations at six locations around the fenceline. Hydrogen sulfide is measured on the principle that hydrogen sulfide can be converted into sulfur dioxide. The hydrogen sulfide-to-sulfur dioxide converter receives sample gas from which the sulfur dioxide has been removed by a scrubber, which removes sulfur dioxide from the sample gas. The hydrogen sulfide converter contains a molybdenum catalyst and operates at 315 °C, which is designed to minimize conversion of reduced sulfur species other than hydrogen sulfide. Sulfur dioxide is measured through excitation by ultraviolet light from a low-pressure zinc-vapor lamp.

Sulfur dioxide molecules absorb ultraviolet light and become excited at a wavelength of approximately 214 nm, then decay to a lower energy state emitting ultraviolet light at wavelength of 330 nm. Excitation light is supplied by a low-pressure zinc-vapor lamp, and light from the lamp is focused using an ultraviolet light source lens and passes through a bandpass filter configured to allow light with a wavelength of 214 nm, the excitation frequency of sulfur dioxide.

Light emitted from the decay of excited sulfur dioxide molecules is captured on a photomultiplier tube (PMT) through a bandpass filter tuned to a wavelength of 330 nm corresponding to light emitted by excited sulfur dioxide molecules. This filter strips away light outside of the fluorescence spectrum of decaying excited sulfur dioxide including reflected ultraviolet light from the source lamp and other stray light. To further assure that the PMT only detects light given off by decaying sulfur dioxide the pathway of the excitation ultraviolet light and field of view of the PMT are perpendicular to each other and the inside surfaces of the sample chamber are coated with a layer of black Teflon® that absorbs stray light.

2.4.4 Particulate Matter Monitor Analytical Methods

Four Teledyne T640 (or equivalent) particulate matter monitors will be used to monitor concentrations of $PM_{2.5}$ and PM_{10} along the refinery fenceline. The Teledyne T640 utilizes the principles of optical particle counting and scattered light spectrometry to differentiate between particle sizes and measure concentrations of particulate matter in ambient air.

As air is drawn into the analyzer, particles in the sample pass through an aerosol sample conditioner, then move into the optical particle sensor where scattered light intensity is measured to determine particle size diameter. The particles move into a T-aperture through optically differentiated measurement volume that is illuminated with an LED polychromatic light source. Each particle generates a scattered light impulse that is detected at an 85 to 95° angle where amplitude and signal are measured. The resulting scattered light intensity is measured by photodetectors within the chamber to determine particle size diameter and concentration.

2.4.5 Metals Monitor Analytical Methods

Four Sailbri Cooper Xact 625i (or equivalent) particulate metals monitors will be used to monitor concentrations of cadmium, manganese, and nickel. These monitors utilize the principle of X-ray fluorescence (XRF), where source X-rays cause removal of an electron from an inner electronic shell of a metal atom in a sample. The vacancy is then filled by an electron from an outer shell. This process emits an X-ray with a longer wavelength than that of the original excitation and is characteristic of the metal in question. The Sailbri Cooper Xact 625i uses nondestructive energy-dispersive XRF (EDXRF), wherein the detector and electronics resolve emitted X-rays based on their energy.

Air is drawn through a size-selective inlet and the resulting sample PM10 is deposited onto a small spot on automated, moveable filter tape. When the tape advances, the collected sample spot is placed in the X-ray excitation and analysis section of the instrument.

2.5 Quality Control

This section describes various QC checks for the monitoring system. These QC checks include sample gas flow checks and calibration checks (i.e., calibration verification without instrument adjustment). Calibrations (i.e., adjustments) are also a part of quality control and are discussed separately in Section 2.7 - Equipment Calibration. SOPs with detailed QC check procedures have been developed for each instrument and are referenced in the appropriate sections.

A table with a list of QC checks, minimum required frequencies, warning criteria, and acceptance criteria is presented for each instrument. If QC check results do not meet the stated acceptance criteria, corrective action needs to be taken, recalibration may be required, and any potential impact on data quality should be assessed and addressed during the data validation process (see Section 4.2). If QC checks are in the 'warning' range, corrective action (including recalibration) may be required to keep QC results from further straying and possibly not meeting acceptance criteria during future QC checks. The stated QC check frequencies are the *minimum* frequencies and they assume routine operation without any significant instrument issues. However, QC checks should be performed as needed and more frequently if significant issues with instrument performance are occurring. Additionally, QC checks should be performed after any major maintenance activities or instrument replacement.

The DQIs and MQOs for this monitoring system are provided in Section 1.6.2- Project Quality Objectives. Audits (external and internal) are discussed in Section 3.1 - Audits and Response Actions.

2.5.1 Open-Path Systems QC Checks

Open-path instrument performance is assessed through various QC checks, many of which are described in EPA Method TO-16r[25] and in the *EPA Handbook for Optical Remote Sensing for Measurement and Monitoring of Emissions Flux and Particulate Matter*[26]. This document outlines general QC checks for a variety of sensing technologies, and its guidelines were used to inform this QAPP.

Table 2-2 lists QC checks, minimum frequency, warning criteria, and acceptance criteria for the FTIR monitors, and Table 2-3 covers the UVDOAS monitors. A reference gas check is performed by taking a measurement of a known gas (e.g., 1,3-butadiene for the FTIR, benzene for the UVDOAS) concentration

[25] *Long-Path Open-Path Fourier Transform Infrared Monitoring of Atmospheric Gases*, Compendium Method TO-16, U.S. Environmental Protection Agency, Cincinnati, Ohio, 1999. See https://www3.epa.gov/ttn/amtic/files/ambient/airtox/to-16r.pdf (accessed July 19, 2018).

[26] *EPA Handbook: Optical and Remote Sensing for Measurement and Monitoring of Emissions Flux of Gases and Particulate Matter*, U.S. Environmental Protection Agency, September 1, 2018. See https://www.epa.gov/sites/production/files/2016-06/documents/gd-052.pdf (accessed May 2019).

in an enclosed cell placed into the normal measurement path, over a fixed path length and at a known temperature and pressure. This serves as a quality control check in the presence of all the spectral interferences present in the normal measurement path. That measurement response is then compared with the reference spectra, and if values are within acceptable criteria, the calibration can be verified. A reference gas check requires one concentration level, since absorption and response are linear. A reference gas check with one measured gas verifies performance for all measured gases because it verifies the spectral measurements and analysis used for all gases.[27] Instrument challenges should be performed on a quarterly basis and after initial commissioning, major repair or replacement. Additional information on the reference gas check can be found in the SOP, *Testing Instrument Accuracy of Open Path Analyzers (SES SOP-TORC-03).*

Another type of QC check for the FTIR is known as an atmospheric gas check. In this check, the atmospheric concentration of a gas measured by the open path system is compared against an expected or known concentration value. The atmospheric check is conducted by comparing the measured concentration of nitrous oxide (N_2O) against its global average concentration of approximately 330 ppb[28]. This check is possible as nitrous oxide is an atmospheric gas with a relatively uniform spatial and temporal distribution. This check is conducted automatically after each measurement, and sample results not meeting the acceptance criteria are automatically flagged for further review. A final decision on data usability for these flagged samples is made during the quarterly data validation process.

The detection limit of open-path systems is a dynamic quantity that will change significantly depending upon co-pollutants, atmospheric interferents, and atmospheric conditions. Detection limits are automatically screened against historical (normal) levels and against the approximate minimum detection levels specified in this QAPP, and outliers are automatically flagged for further review. Additional information on the atmospheric gas check and the detection level check can be found in the SOPs, *TORC Data Processing, Compiling and Management (SES SOP-TORC-07), and TORC Data Validation (SES SOP-TORC-08).*

Table 2-2. QC checks for FTIR monitors

QC Check	Minimum Frequency	Warning criteria	Acceptance criteria
Reference gas check	Quarterly After major repair or instrument replacement	Accuracy: ≤ 25% of reference gas value, calculated using Equation 4 presented in Section 2.5.7 Precision: ± 20%, calculated using Equation 2 presented in Section 2.5.7	Accuracy: ≤ 30% of reference gas value, calculated using Equation 4 presented in Section 2.5.7 Precision: ± 25%, calculated using Equation 2 presented in Section 2.5.7

[27] *EPA Handbook: Optical and Remote Sensing for Measurement and Monitoring of Emissions Flux of Gases and Particulate Matter*, U.S. Environmental Protection Agency, September 1, 2018. See https://www.epa.gov/sites/production/files/2016-06/documents/gd-052.pdf (accessed May 2019).
[28] See https://www.n2olevels.org/ (accessed September 9, 2019).

QC Check	Minimum Frequency	Warning criteria	Acceptance criteria
Atmospheric gas (N_2O) check	Continuously (each measurement) and Quarterly	Accuracy: ≤ 25% of expected value, calculated using Equation 4 presented in Section 2.5.7	Accuracy: ≤ 30% of expected value, calculated using Equation 4 presented in Section 2.5.7
Detection level (sensitivity) check	Continuously (each measurement) and Quarterly	Variable criteria depending upon the target pollutant, the approximate minimum detection levels specified in this QAPP, and historical detection limit data. See *SES SOP-TORC-07* and *SES SOP-TORC-08* for additional information.	

Table 2-3. QC checks for UVDOAS monitors

QC Check	Minimum Frequency	Warning criteria	Acceptance criteria
Reference gas check	Quarterly After major repair or instrument replacement	Accuracy: ≤ 25% of reference gas value, calculated using Equation 4 presented in Section 2.5.7 Precision: ± 20%, calculated using Equation 2 presented in Section 2.5.7	Accuracy: ≤ 30% of reference gas value, calculated using Equation 4 presented in Section 2.5.7 Precision: ± 25%, calculated using Equation 2 presented in Section 2.5.7
Detection level (sensitivity)	Continuously (each measurement) and Quarterly	Variable criteria depending upon the target pollutant, the approximate minimum detection levels specified in this QAPP, historical detection limit data, and atmospheric conditions. See *SES SOP-TORC-07* and *SES SOP-TORC-08* for additional information.	

2.5.2 Black Carbon Monitor QC Checks

Table 2-4 lists QC checks, minimum frequency, warning criteria, and acceptance criteria for the black carbon monitors. Flow, temperature, and barometric pressure checks are conducted by comparing the instrument's readings against an independent, certified measurement device (e.g., a BGI TetraCal or equivalent). The optical span and precision test is conducted using a neutral density filter that introduces a known and consistent amount of optical attenuation into the measurement system. Detailed QC check procedures for the black carbon monitors can be found in the SOP, *Operation and Maintenance of the Met One BC 1060 (SES SOP-TORC-05).*

Table 2-4. QC checks for black carbon monitors

QC Check	Minimum Frequency	Warning criteria	Acceptance criteria
Flow Check	Monthly	≤ ± 4% (% difference)	≤ ± 5% (% difference)
Temperature Check	Monthly	≤ ± 0.8° C	≤ ± 1.0° C
Barometric Pressure Check	Monthly	≤ ± 7 mbar	≤ ± 10 mbar
Optical Span Check	Quarterly	≤ ± 7.5% of the values indicated on the label of the neutral density filter	≤ ± 10% of the values indicated on the label of the neutral density filter
Optical Span Precision Check	Quarterly	≤ 7.5%	≤ 10%

2.5.3 Hydrogen Sulfide Monitor QC Checks

Table 2-5 lists QC checks, minimum frequency, warning criteria, and acceptance criteria for the hydrogen sulfide monitors. The zero check and calibration check entail introducing a known concentration (e.g., 0, 30 or 200 ppb) of H_2S and comparing the instrument's measured response against that known concentration value. The precision check is conducted by collecting replicate H_2S measurements and assessing the variability in those measurements.

The SO_2 scrubber utilizes a consumable compound to absorb SO_2 from the sample. To help ensure that the SO_2 scrubber is operating correctly, an SO_2 scrubber check will be performed at least every six months. This involves introducing SO_2 gas though the instrument's SO_2 scrubber and comparing the resulting concentration response against the expected concentration (i.e., 0 ppb).

The converter efficiency check is conducted by comparing the instrument's calibration response for H_2S against its calibration response for SO_2. Detailed QC check procedures for the hydrogen sulfide monitors can be found in the SOP, *Operation and Maintenance of the Teledyne T101 H_2S Analyzer Analyzers (SES SOP-TORC-06).*

Table 2-5. QC checks for hydrogen sulfide monitors

QC Check	Minimum Frequency	Warning Criteria	Acceptance Criteria
Zero Check (0 ppb)	Monthly	> ± 1.0 ppb	< ± 1.5 ppb
Calibration Check (30 & 200 ppb)	Monthly	> ± 10%	< ± 15.1 %
Precision Check	Monthly	> 10%	< 15.1%

QC Check	Minimum Frequency	Warning Criteria	Acceptance Criteria
Scrubber Check	Every 6 months (during multipoint calibration procedure)	> 1.5 ppb	< 2.0 ppb
Converter Efficiency Check	Every 6 months (during multipoint calibration procedure)	< 90%	> 85%

2.5.4 Particulate Matter Monitor QC Checks

Table 2-6 lists QC checks, minimum frequency, warning criteria, and acceptance criteria for the particulate matter monitors. Temperature, pressure, and sample flow checks are conducted by comparing the instrument's readings against an independent, certified measurement device (e.g., a BGI TetraCal or equivalent). These QC checks, and their associated calibrations (when applicable, see Section 2.7.3), must be performed in a specific order.

Detailed QC check procedures for the black carbon monitors can be found in the SOP, *Operation and Maintenance of the Teledyne T640 Particulate Matter Monitor (SES SOP-TORC-10)* and the Teledyne T640 PM Mass Monitor Manual.

Table 2-6. QC checks for particulate matter monitors

QC Check	Minimum Frequency	Warning Criteria	Acceptance Criteria
Ambient Temperature Sensor Check	Quarterly	± 2.4°C	± 2°C
Ambient Pressure Sensor Check	Quarterly	± 12 mmHg	± 10 mmHg
Sample Flow Rate Check T640 Sample Flow: 5.0 LPM	Quarterly	± 6% of standard compared to current reading on T640	± 5% of standard compared to current reading on T640
PMT Check with SpanDust™	Quarterly or as needed (e.g., high dust load or Perform Span Dust Check Alert)	SpanDust™ value ± 0.6	SpanDust™ value ± 0.5
Pump Performance Check	Quarterly	NA	Pump PWM < 80% Valve PWM < 85%
Leak Check (with "zero" filter)	Quarterly or as needed	0.2 – 0.3 μg/m^3	0.0 – 0.2 μg/m^3

2.5.5 Metals Monitor QC Checks

Table 2-7 lists QC checks, minimum frequency, warning criteria, and acceptance criteria for the metals monitors. Daily automated QA checks are performed by the metals monitors to monitor the stability and performance of critical XRF processes.

Detailed QC check procedures for the metals monitors can be found in the SOP, *Operation and Maintenance of the Sailbri Cooper Xact 625i Metals Monitor (SES SOP-TORC-11)* and the Sailbri Cooper Xact 625i Metals Monitor Manual.

Table 2-7. QC checks for metals monitors

QC Check	Minimum Frequency	Warning Criteria	Acceptance Criteria
QA Upscale Tracking (Energy calibration checks and QA upscale automatic functions performed daily. QA upscale values outside of acceptance criteria will display alarm flag)	Quarterly	± 12% CES set point	± 10% CES set point
QA Blank Check	Quarterly	NA	NA
Leak Check	Quarterly or as needed (any time a connection break occurs in the flow system)	< 180 mmHg	< 150 mmHg/min
Flow Check (3 readings per flow rate)	Quarterly	< 2% average percent difference	< 1% average percent difference
Temperature Check	Quarterly	± 12% reference	± 10% reference
Pressure Check	Quarterly	± 12% reference	± 10% reference
XRF Calibration Check	Quarterly or as needed (e.g., if QA upscale metal concentrations continuously deviate outside specified limits)	± 12% reference	± 10% mass difference

2.5.6 Meteorological Sensor QC Checks

Table 2-8 lists QC checks, minimum frequency, warning criteria, and acceptance criteria meteorological sensors. These checks are conducted by comparing each sensor's response against nearby sensor(s). The QC check procedures for the meteorological sensors can be found in the SOP, *Operation and Maintenance of Meteorological Monitoring Sensors (SES SOP-TORC-04).*

Table 2-8. QC checks for meteorological sensors

QC Checks	Minimum Frequency	Warning Criteria	Acceptance Criteria
Ambient temperature check	Every 12 months	± 0.8 ˚C	± 1.0 ˚C
Relative humidity check	Every 12 months	± 7% relative humidity	± 10% relative humidity
Barometric pressure check	Every 12 months	± 7 mb	± 10 mbar
Wind speed check	Every 12 months	± 0.8 m/s	± 1.0 m/s
Wind direction check	Every 12 months	± 3.5 degrees	± 5 degrees

2.5.7 Statistics for the Assessment of QC Checks

Calculations of measurement uncertainty are carried out following procedures like those used for ambient air monitoring networks[29], provided in the following subsections.

2.5.7.1 Percent Difference

All measurement quality checks start with a comparison of an audit concentration or value (flow rate) to the concentration/value measured by the analyzer using the percent difference calculation shown in Equation 1. For each single point check the percent difference, d_i, is calculated as follows:

$$d_i = \frac{meas - audi}{audit} \times 100 \qquad \text{Equation 1}$$

Where, *meas* is the concentration indicated by the monitoring organization's instrument and *audit* is the audit concentration of the standard used in the QC check being measured.

2.5.7.2 Precision Estimate

The precision estimate is used to assess the one-point QC checks for each instrument. The precision estimator is the coefficient of variation (*CV*) and is calculated using equation 2:

$$CV, \% = \frac{\sigma_{meas}}{\overline{C_{meas}}} \times 100 \qquad \text{Equation 2}$$

Where $\overline{C_{meas}}$ is the average measured gas concentration and σ_{meas} is the standard deviation of the measurements, defined as:

$$\sigma_{meas} = \sqrt{\frac{\sum(C_{meas} - \overline{C_{meas}})^2}{n-1}} \qquad \text{Equation 3}$$

Where C_{meas} is a single measured concentration and *n* refers to the number of measurements conducted.

29 Quality Assurance Requirements for Monitors used in Evaluations of National Ambient Air Quality Standards, Appendix A, Part 58, Title 41 *U.S. Code of Federal Regulations*.

2.5.7.3 Accuracy Estimate

Accuracy, A, is defined as:

$$A,\% = \frac{|\overline{C_{audit}} - \overline{C_{meas}}|}{\overline{C_{audit}}} \times 100 \qquad \text{Equation 4}$$

Where C_{audit} refers to the average value of the reference gas and $\overline{C_{meas}}$ refers to the average value of all measurements.

2.5.7.4 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system. Completeness objectives are listed in Table 1-8 for open-path and fixed-point monitors and Table 1-9 for meteorological monitors.

Due to the nature of open-path measurement devices, adverse atmospheric conditions such as fog, high humidity, rain, high ozone, particulate matter, haze, and other conditions can affect an open-path FTIR or UVDOAS monitor's ability to provide reliable data. Since these conditions are uncontrollable, it is not possible to mitigate their effects.

Scheduled and unscheduled maintenance also results in loss of data. Scheduled or preventative maintenance is predictable and accounted for in setting data completeness objectives. Unscheduled maintenance is determined by the robustness of the monitoring equipment designs, component selections and preventative maintenance procedures.

Data completeness is calculated for each target pollutant and path or fixed point. Rolling hourly, rolling 8-hour, rolling 24-hour, daily block, and quarterly completeness for open-path and fixed-point systems are defined as follows:

$$\%\ \text{complete}_{\text{hourly,rolling}} = 100 \text{ x } \frac{\text{n}_{\text{valid}}}{\text{n}_{hour} - \text{n}_{\text{excluded}}} \qquad \text{Equation 5}$$

Where n_{hour} refers to the number of five-minute measurements within each whole hour (n_{hour} is equal to 12 for fixed-point and meteorological monitors and is equal to 6 for each open-path monitor path), n_{valid} refers to the number of valid 5-minute measurements taken within each whole hour, and $n_{excluded}$ refers to the number of 5-minute measurements invalidated due to adverse atmospheric conditions or scheduled maintenance.

$$\%\ \text{complete}_{8-\text{hr,rolling}} = 100 \text{ x } \frac{\text{m}_{\text{valid}}}{8 - \text{m}_{\text{excluded}}} \qquad \text{Equation 6}$$

Where m_{valid} refers to the number of valid 1-hour measurements taken within each 8-hour period, and $m_{excluded}$ refers to the number of 1-hour measurements invalidated due to adverse atmospheric conditions or scheduled maintenance.

$$\%\ \text{complete}_{24-\text{h ,rolling}} = 100 \text{ x } \frac{\text{p}_{\text{valid}}}{288 - \ _{\text{excluded}}} \qquad \text{Equation 7}$$

Where p_{valid} refers to the number of valid 5-minute measurements taken within each 24-hour period, and $p_{excluded}$ refers to the number of 5-minute measurements invalidated due to adverse atmospheric conditions or scheduled maintenance.

$$\% \text{ complete}_{\text{daily,block}} = 100 \text{ x } \frac{h_{\text{valid}}}{24 - h_{\text{excluded}}} \qquad \text{Equation 8}$$

Where h_{valid} refers to the number of contiguous whole hours in a calendar day with complete or valid data (i.e., whole hours that have met or exceeded the target completeness percentage for fixed-point and meteorological monitors and whole hours with valid 1-hour averaged measurements for open-path monitors) and $h_{excluded}$ refers to the number of whole hours during which all data are invalidated due to adverse atmospheric conditions or scheduled maintenance.

$$\% \text{ complete}_{\text{quarterly}} = 100 \text{ x } \frac{d_{\text{valid}}}{d_{\text{quarter}} - d_{\text{excluded}}} \qquad \text{Equation 9}$$

Where d_{valid} refers to the number of whole days in a calendar quarter with complete data (i.e., whole days that have met or exceeded the target completeness percentage), $d_{quarter}$ refers to the number of contiguous whole days in that calendar quarter and $d_{excluded}$ refers to the number of whole days during which all data are invalidated due to adverse atmospheric conditions or scheduled maintenance.

2.6 Equipment Inspection, Testing, and Maintenance

Equipment inspection, testing and routine maintenance activities help make sure instruments are operating as intended and generating monitoring data that meet the project's DQOs. Some testing activities can be conducted remotely (e.g., monitoring instrument diagnostic parameters), but most inspection and maintenance (e.g., filter tape replacement) require a hands-on site visit. Additionally, some testing activities are fully automated and happen continuously, while others happen at periodic intervals and require manual action or intervention.

A table with a list of inspection, testing, and maintenance activities is presented for each instrument. This table also presents the required *minimum* frequency for each activity. As with the minimum frequencies provided in the preceding section on QC Checks, the frequencies listed in this section assume routine operations without any significant instrument issues. However, inspection, testing and maintenance checks should be performed as needed and more frequently if significant issues with instrument performance are occurring. Additionally, these activities should be performed after any major maintenance activities or instrument replacement. All equipment installed in the System must pass factory acceptance testing (FAT) and site acceptance testing (SAT) prior to operation. This process is discussed in the *Torrance Refinery Rule 1180 Fenceline Air Monitoring Plan* ***Error! Bookmark not defined.*** and the SAT and FAT procedures for each instrument are saved in the electronic data management system. If a newly purchased instrument does not pass in-house acceptance testing upon receipt, the instrument should be returned to the vendor while still under warranty.

If an instrument fails a particular test, or an inspection activity reveals a significant issue, corrective action needs to be taken, an "as-found" QC check (before instrument repair/troubleshooting is conducted) may be required, and any potential impact on data quality should be assessed and addressed during the data validation process (see Section 4.2). Detailed descriptions of how inspection, testing and maintenance activities are performed can be found in the instrument operation manuals and the SOPs referenced in this section. Additionally, information on how re-inspections should be performed and how to assess the effectiveness of corrective actions can also be found in the instrument manuals and SOPs referenced in this section.

The Site Operator and System Manager are responsible for ensuring that critical spare parts are included with the field instruments to reduce potential downtime for repairs. The inventory will primarily contain parts that are subject to frequent failure, have limited useful lifetimes, and/or cannot be obtained in a timely manner.

2.6.1 Open-Path FTIR Monitor Inspection, Testing, and Maintenance

Some testing activities are conducted continuously and automatically by the software controlling the FTIR monitor, including signal strength (intensity) tests, line shifting tests, and concentration error tests. Other tests (e.g., instrument resolution tests, detector linearity tests, noise equivalent absorbance [NEA] tests) only need to be conducted after major maintenance or instrument replacement, or as needed to support troubleshooting. Procedures for these tests are provided in the documents, Factory Acceptance Test Procedure for the Torrance Refining Company Open Path FTIR and Site Acceptance Test Procedure for the Torrance Refining Company Open Path FTIR.

Routine, non-automated inspection, testing and maintenance activities for the FTIR are summarized in Table 2-9. These routine activities are performed according to the manufacturer's recommendations and following the SOP, Operation and Maintenance of the SES WaveRunIR™-OP FTIR (SES SOP-TORC-01). Signal strength should be evaluated following environmental events such as wildfires or dust storms to determine whether signal strength has degraded and retroreflector array cleaning is required.

Table 2-9. Routine inspection, testing, and maintenance activities for open-path FTIR monitors

Activity	Minimum Frequency
Cleaning the optical bearing	Every two years
Stray Light Check	Quarterly
Validation cell inspection	Quarterly
IR source inspection	Annually
HeNe laser voltage level inspection	Annually
IR detector inspection	Annually
Optimizing the Tracker Positioning	Quarterly
Retroreflector array cleaning	Quarterly
Telescope turning flat cleaning	Quarterly
Telescope optics cleaning	Every two years

2.6.2 Open-Path UVDOAS Monitor Inspection, Testing, and Maintenance

Some testing activities are conducted continuously and automatically by the software controlling the UVDOAS monitor including signal strength (intensity) tests and concentration error tests. Other tests (e.g., instrument resolution tests, noise equivalent absorbance [NEA] tests) only need to be conducted after major maintenance or instrument replacement, or as needed to support troubleshooting. Procedures for these tests are provided in the documents, *Factory Acceptance Test Procedure for the Torrance Refining Company Open Path UVDOAS* and *Site Acceptance Test Procedure for the Torrance Refining Company Open Path UVDOAS.*

Routine, non-automated inspection, testing and maintenance activities for the UVDOAS are summarized in Table 2-10. These routine activities are performed according to the manufacturer's recommendations and following the SOP, *Operation and Maintenance of the SES OP DetectUV™-DOAS (SES SOP-TORC-02).* Signal strength should be evaluated following environmental events such as wildfires or dust storms to determine whether signal strength has degraded and retroreflector array cleaning is required.

Table 2-10. Routine inspection, testing, and maintenance activities for open-path UVDOAS monitors

Activity	Minimum Frequency
Cleaning retroreflector array	Quarterly
Validation cell inspection	Quarterly
Ultraviolet lamp inspection	Quarterly
Dark spectra collection/verification	Quarterly

2.6.3 Black Carbon Monitor Inspection, Testing, and Maintenance

Routine black carbon monitor inspection, testing and maintenance activities are informed by the manufacturer's recommendations and are performed following the SOP, *Operation and Maintenance of the Met One BC 1060 (SES SOP-TORC-05)*. Routine, non-automated inspection, testing and maintenance activities for the UVDOAS are summarized in Table 2-11.

Table 2-11. Routine inspection, testing, and maintenance activities for black carbon monitors

Activity	Minimum frequency
Debris Filter Changes	Annually
Cyclone Trap Cleaning	Monthly
Cyclone Main Cavity Cleaning	Monthly
TSP Inlet Inspection and Cleaning	Quarterly
Filter Tape Installation, Loading, and Filter Material Notes	As required (when tape remaining is < 5%)

Activity	Minimum frequency
Leak test	Monthly
Replace cyclone O-rings	As required

2.6.4 Hydrogen Sulfide Monitor Inspection, Testing, and Maintenance

Routine hydrogen sulfide monitor inspection, testing and maintenance activities are informed by the manufacturer's recommendations and are performed following the SOP, *Operation and Maintenance of the Teledyne T101 H2S Analyzer (SES SOP-TORC-06)*. Routine, non-automated inspection, testing and maintenance activities for the H_2S monitor are summarized in Table 2-12.

The H_2S monitor's SO_2 scrubber utilizes a consumable compound to absorb SO_2 from the sample. This scrubber material is capable of efficiently scrubbing SO_2 for up to 1000 ppm-hours. This means that if the SO_2 content of the sample gas is typically around 0.010 ppm or 10 ppb (a conservative fenceline concentration for the Torrance Refinery based on historical data), the scrubber material could function for approximately 100,000 hours (over ten years). However, to help ensure that the SO_2 scrubber is operating correctly, an SO_2 scrubber check is performed at least every six months (see Section 2.5.3). The replacement of the SO_2 scrubber reagent is generally dependent on the results of this scrubber check.

The catalyst contained in the monitor's H_2S-to-SO_2 converter is capable of efficiently converting H_2S into SO_2 for up to 6000 ppm-hours. This means that if the H_2S content of the sample gas is typically around 0.006 ppm or 6 ppb (a conservative fenceline concentration for the Torrance Refinery based on historical data), the converter material could function for approximately one million hours or over 100 years. However, to help ensure that the converter is operating correctly, an H_2S converter efficiency check is performed at least every six months (see Section 2.5.3). Additionally, the H_2S converter temperature is continuously measured and recorded. If it falls outside the expected range (315°C ± 5°C), a converter temperature warning is automatically generated and sent to the Site Operator who will investigate the issue. The replacement of the hydrogen sulfide-to-sulfur dioxide converter catalyst is generally dependent on the results of the periodic converter efficiency checks.

The H_2S monitor sample flow rate and sample pressure are continuously measured and recorded. If these parameters ever fall outside expected ranges (i.e., flow rate not between 540 and 660 cc/min or sample pressure not between 21 and 27 in. Hg), a warning message is automatically generated and sent to the Site Operator who will investigate the issue. Additionally, an independent, external flow meter is used to perform a sample flow rate test on at least a monthly basis. The replacement of the critical flow orifice and sintered filters is generally dependent on the results of these automated sample pressure/flow rate tests and the results of the periodic independent flow rate tests.

Table 2-12. Routine inspection, testing, and maintenance activities for hydrogen sulfide monitors

Activity	Minimum Frequency
Replacement the sample particulate filter	Monthly

Activity	Minimum Frequency
Replace the sulfur dioxide scrubber reagent	As needed based on results from scrubber efficiency checks (see Section 2.5.3)
Replace the hydrogen sulfide-to-sulfur dioxide converter catalyst	As needed based on measured converter temperature values and results from converter efficiency checks (see Section 2.5.3)
Change the critical flow orifice and sintered filters	As needed based on results from periodic flow rate tests and automated sample flow rate and pressure tests
Perform independent flow rate test	Monthly
Inspect external pump, internal filter, and replace if needed	Annually

2.6.5 Particulate Matter Monitor Inspection, Testing, and Maintenance

Routine particulate matter monitor inspection, testing and maintenance activities are informed by the manufacturer's recommendations and are performed following the SOP, *Operation and Maintenance of the Teledyne T640 Particulate Matter Monitor (SES SOP-TORC-10)*. Routine, non-automated inspection, testing and maintenance activities for the particulate matter monitor are summarized in Table 2-13.

Table 2-13. Routine inspection, testing, and maintenance activities for particulate matter monitors

Activity	Minimum Frequency
Clean inlet	Quarterly
Inspect and clean optical chamber	Every 6 months
Inspect and clean RH/T sensor	Every 6 months
Change disposable filter unit for 5-LPM flow and bypass flow if installed	Annually, or when Pump PWM Value approaches 80%
Inspect inlet, inner and outer sample tubes	Monthly

2.6.6 Metals Monitor Inspection, Testing, and Maintenance

Routine metals monitor inspection, testing and maintenance activities are informed by the manufacturer's recommendations and are performed following the SOP, *Operation and Maintenance of the Sailbri Cooper Xact 625i Metals Monitor (SES SOP-TORC-11)*. Routine, non-automated inspection, testing and maintenance activities for the particulate matter monitor are summarized in Table 2-14.

Table 2-14. Routine inspection, testing, and maintenance activities for meteorological sensors

Activity	Minimum Frequency
Replace filter tape	As needed
Examine tubing, enclosure, and components for particle build up, rust, or damage. Replace parts as needed	Annually

2.6.7 Meteorological Sensor Inspection, Testing, and Maintenance

Routine meteorological sensor inspection, testing and maintenance activities (Table 2-15) are informed by the manufacturer's recommendations and are performed according to the SOP, *Operation and Maintenance of Meteorological Monitoring Sensors (SES SOP-TORC-04).* Most of these sensors are designed to operate for an extended period of time with a minimum of care or maintenance, but periodic inspections are warranted to try and detect sensor issues that may not be apparent from the QC Checks described in Section 2.5.6.

Table 2-15. Routine inspection, testing, and maintenance activities for meteorological sensors

Sensor	Activities	Minimum Frequency
Met One 010C wind speed sensor	Inspect for proper operation	Quarterly
Met One 020C wind direction sensor	Inspect for proper operation	Quarterly
Met One 085 relative humidity and temperature sensor	Inspect for proper operation	Quarterly
Met One 092 barometric pressure sensor	Inspect for proper operation. Clean the sintered filter	Quarterly

2.7 Equipment Calibration

This section summarizes procedures and frequencies for calibrations. A calibration is the process of *adjusting* the response of a measurement instrument to agree with value of an applied standard within a specified accuracy. Information on calibration checks (as-found verification without instrument adjustment) are provided in Section 2.5 – Quality Control.

For the open-path systems, there are no field calibrations because the instruments are factory calibrated to spectral reference libraries. A reference gas cell and a reference gas of known concentration are used with the open-path monitors to verify the calibration.

Calibrations and validations, flow rate checks, audits, and calculations are selectively reviewed by the Program Quality Assurance Manager to ensure that:

- Quality assurance procedures are being followed;
- The performance of all equipment is within the limits specified in this document;
- All calculations are being performed properly; and
- All data are reasonable and technically consistent.

If the Program Quality Assurance Manager finds systemic or ongoing issues that may significantly impact data quality or completeness during their review, a corrective action report is created to document the issue, action taken to correct it and resolution of the problem. See Section 3.1.4 of this QAPP for further details on corrective action procedures.

2.7.1 Black Carbon Monitor Calibrations

Calibrations can be conducted on the black carbon monitor's temperature, pressure and flow rate sensors. Calibration procedures for these sensors are informed by the manufacturer's recommendations and are performed following the SOP, *Operation and Maintenance of the Met One BC 1060 (SES SOP-TORC-05).* These calibration procedures are nearly identical to the QC checks described in Section 2.5.2. However, whereas the minimum frequency for temperature, flow rate, and barometric pressure QC checks is monthly, the minimum frequency for calibrations is quarterly (i.e., every three months). This information is summarized in Table 2-16. Of course, calibrations may be required more frequently based on results of QC checks and other considerations (e.g., after equipment repair or replacement). A traceable, certified measurement device (e.g., a BGI TetraCal or equivalent) must be used for calibrations.

Table 2-16. Black carbon monitor calibration information

Calibration	Minimum Frequency
Flow Rate Calibration	Quarterly
Temperature Calibration	Quarterly
Barometric Pressure Calibration	Quarterly

2.7.2 Hydrogen Sulfide Monitor Calibrations

Calibration procedures for the hydrogen sulfide monitors are informed by the manufacturer's recommendations and are performed following the SOP, *Operation and Maintenance of the Teledyne T101 H_2S Analyzer Analyzers (SES SOP-TORC-06).* The calibration procedure is very similar to the procedure for the zero- and calibration checks described in Section 2.5.3. However, whereas the minimum frequency for those QC checks was monthly, the minimum frequency for H2S calibrations is every six months. The multipoint calibration process starts with an as-found calibration check at four different concentration levels (0, 30, 200 and 400 ppb). After the as-found calibration check, the instrument is calibrated (adjusted), and these same four concentration levels are re-run to assess whether the post-calibration results meet the stated acceptance criteria. This information is summarized in Table 2-17. Of course, calibrations may be required more frequently based on results of QC checks and other considerations (e.g., after equipment repair or replacement). Traceable, certified gas standards and mass flow controllers must be used for calibrations. Scrubber efficiency checks and converter efficiency checks (described in Section 2.5.3) are generally performed at the same time as the multipoint calibration.

Table 2-17. Hydrogen sulfide monitor multi-point calibration information

Calibration Step	Concentration Levels (ppb)	Minimum Frequency	Acceptance Criteria
As-is calibration (verification) without any adjustment	0, 30, 200, 400	Every 6 months	NA
Final calibration (after adjustment)	0, 30, 200, 400	Every 6 months	Zero point: < ± 1.0 ppb Non-zero points: < ± 10% (from expected concentration)

2.7.3 Particulate Matter Monitor Calibrations

Calibrations can be conducted on the particulate matter monitor's pressure and sample flow rates, and PMT adjustments may be made if necessary. Calibration procedures for these sensors are informed by the manufacturer's recommendations and are performed following the SOP, *Operation and Maintenance of the Teledyne T640 Particulate Matter Monitor (SES SOP-TORC-10).*

A traceable, certified measurement device (e.g., a BGI TetraCal or equivalent) must be used for pressure and flow calibrations. The operator must follow a specific order of calibration checks/calibrations for the Teledyne T640. Information regarding calibration activities and their respective minimum frequencies is summarized in Table 2-18. Calibrations may be required more frequently based on results of QC checks and other considerations (e.g., after equipment repair or replacement).

Table 2-18. Particulate matter monitor calibration information

Calibration	Minimum Frequency
Ambient Pressure Calibration	Quarterly
Sample Flow Calibration	Quarterly
PMT Adjustment	Quarterly or as needed (e.g., high dust load, in response to failed monthly SpanDust check, when Span Dust Check alert triggers)

2.7.4 Metals Monitor Calibrations

Calibrations can be conducted on the metals monitor's flow rate using a traceable, certified measurement device (e.g., a BGI TetraCal or equivalent). The monitor performs daily automated QA checks and calibrations to monitor the stability and performance of critical XRF processes. Any calibration procedures for these sensors are informed by the manufacturer's recommendations and are performed following the

SOP, *Operation and Maintenance of the Sailbri Cooper Xact 625i Metals Monitor (SES SOP-TORC-11).* If the metals monitor fails an Xact calibration check for the target metals (see Table 2-7), CES personnel or authorized distributor should be contacted for further instruction on maintenance, repair, and/or return for recalibration.

Table 2-19. Metals monitor calibration information

Calibration	Minimum Frequency
Flow Calibration	Quarterly

2.7.5 Meteorological Equipment Calibrations

The meteorological sensors are fully calibrated by the manufacturer at the time of purchase. Sensors which do not meet QC check acceptance criteria or fail performance audits will generally be sent back to the manufacturer for repair and re-calibration. The wind direction sensor alignment will be verified and realigned as needed following the SOP, Operation and Maintenance of Meteorological Monitoring Sensors *(SES SOP-TORC-04).*

2.7.6 Fenceline Air Monitoring System Calibration and Verification Recordkeeping

All calibration data are recorded and documented following the processes described in Section 1.8, Documents and Records, and 2.9, Data Management. The Site Operators document the serial numbers of all equipment used in the calibration process and information for all gas standards (e.g., cylinder ID, certification date, expiration date, verified concentration, etc.) in the field log. The Site Operators have primary responsibly for analyzing the calibration data following the procedures and processes described and referenced in this section.

2.8 Inspection of Supplies and Consumables

Acceptance criteria for supplies and consumables vary with the operation being conducted and are generally described in the relevant SOPs. In general, the SOPs are checked to ensure the adequate criteria for supplies and consumables are met and appropriate for use for the operation. Reference gas labels are checked to ensure they are traceable to NIST standards and meet the required accuracy and concentration specifications. All parts received via shipment are opened and examined to ensure they are not damaged, the packing slips are archived, and an inspection log shall be maintained which records when the incoming shipments were received and inspected.

The spare parts and consumable items strategy is designed to achieve the data completeness criteria without an inventory of redundant complete analyzers. The System Manager/Operator orders and maintains spare parts inventory for the fenceline air monitoring systems, at the minimum quantities recommended by the respective suppliers and as necessary to achieve the data completeness objectives. The System Manager/Operator also maintains a consumable supplies inventory and update it as consumable items are used, or as new parts are ordered. The System Manager/Operator performs routine and emergency maintenance, including the replacement of spare parts, in an expedited manner.

2.9 Data Management

Pollutant concentration data are collected using on-site computers which parse the data and perform preliminary automated QC of the data. The data are then sent to a cloud server through a cellular connection, at minimum, every five minutes for further validation, archiving, and distribution. Once delivered to the cloud server, validation calculations and distribution will occur. Concentration values are presented on a public website as 5-minute and 1-hour block measurements and 1-hour, 8-hour, or 24-hour rolling averages. The averaging times for each pollutant are dependent on the notification threshold averaging period, as specified by the South Coast AQMD in Rule 1180. These values are updated for each path every ten minutes for the open-path systems, every five minutes for hydrogen sulfide, black carbon, and particulate matter fixed-point monitors, and every hour for metals fixed-point monitors. Once a measurement is collected, it is typically posted to the public website within approximately one minute. Additional information in included in the SOP, *TORC Data Processing, Compiling, and Management (SES SOP-TORC-07).*

To verify the accuracy of data reported on the website, raw data from the on-site computers will be compared to data presented on the website. This comparison will be conducted on an annual basis and cover each parameter and monitoring site/path. Any discrepancies between reported and raw data will be investigated and resolved with all findings documented. No paper records are generated by this project. All records and data are saved locally on-site PCs and are simultaneously uploaded to the cloud. Further information on data management can be found in the Standard Operating Procedure to Process and Compile Data. Electronic data and document systems access are password-protected and restricted to the level of need (e.g., some staff only need read-only access while others can flag or invalidate data).

The pathway for raw and validated data is shown in Figure 2-1 and described in detail in the following sections.

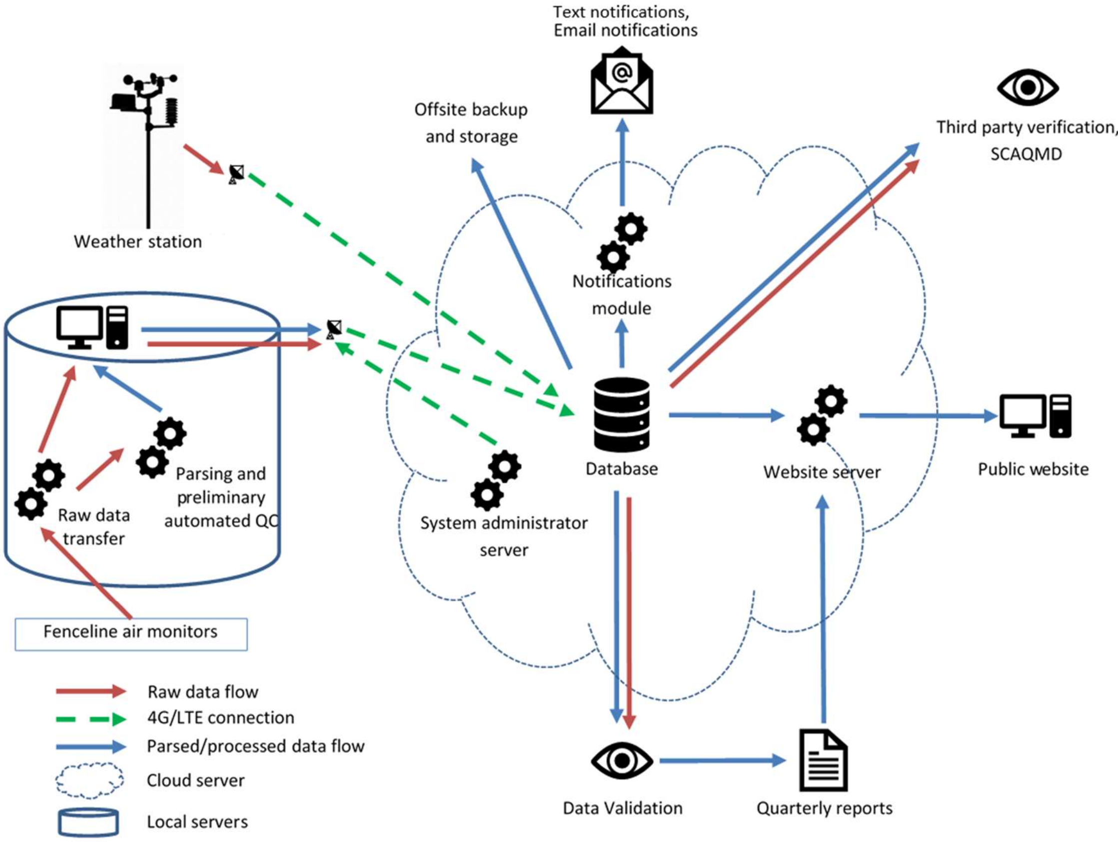

Figure 2-1. Raw and validated data flow

2.9.1 Website Management and Community Interface

A publicly accessible website displays data in real time. A detailed description of the website layout, directions for interactions, and figures is provided in the *Torrance Refinery Rule 1180 Fenceline Air Monitoring Plan*Error! Bookmark not defined., but a brief overview of its functionality is provided below.

The overall goals of the website are to:

- inform the public of pollutant concentrations with data quality flags at or near the refinery fenceline;
- inform the public of fenceline air monitoring system operations, outages, and events;
- educate the public on the health- and information-based concentration thresholds, monitoring techniques and procedures;
- provide the public access to historical pollutant concentration data and quarterly reports;
- provide links to community emergency response planning resources;

- provide access to the fenceline air monitoring plan and QAPP, independent audit reports, specific cause analyses, and corrective action plans; and
- offer an opt-in notification system for text messages and/or emails, integrated with data collected by the air monitoring system.

A message board page shows a history of notifications in chronological order. This is primarily used to notify the public of pollutant concentrations that are greater than thresholds, significant instrument outages, significant increases in pollutant concentrations above thresholds, conclusions of events, and explanations of any false alerts. Users can subscribe to receive automated notifications from the website through an email service and/or through text message.

A data page shows real-time and averaged values for conditions at the facility in an interactive map. Users can view current concentrations at any of the monitors placed around the facility fenceline and view meteorological conditions in real time. Users also can view historical data for a given time period, monitor, and parameters of their choosing.

All quarterly data reports are made available on the website for download through the Reports page. Data are verified and validated according to the steps outlined in Section 4 before quarterly data reports are published on the website, to ensure that the data are accurate, valid, and representative of ambient conditions at the refinery fenceline. Any third-party data displayed on the website or contained in quarterly reports are clearly marked as such.

Finally, a Learning Center page provides insight into monitoring operations, in the form of a FAQ page. This section also provides information on the monitors used, potentially emitted pollutants, their health effects, significant threshold levels, monitoring plan documents and their approval statuses, potential off-site sources, commonly used terms and definitions, etc. Links are provided to additional resources for users that want to learn more.

2.9.2 Public Notification System

A public notification system, available to anyone, sends automated email and/or text message alerts to announce pollutant threshold exceedances and relevant follow-up information (e.g., maximum concentration of the pollutant measured during the event, duration of the exceedance).The public may opt into or out of these fenceline notifications.

Automated public notifications are sent via email and/or text as soon as technically feasible, but no later than within 15 minutes of a 1-hour, 8-hour (manganese only), or 24-hour (particulate matter only) rolling average pollutant concentration that was measured greater than its respective threshold. Pollutant concentration notification thresholds and their respective averaging times are prescribed by Rule 1180 and presented in Section 7 of the Torrance Refinery Rule 1180 Fenceline Air Monitoring Plan. Exceedance notifications contain the following information, pursuant to Rule 1180:

- A unique notification identification number (one per exceedance event);
- Facility name;
- Location, site, date, and time of exceedance;

- Air pollutant name, concentration measured, and notification threshold; and
- A link to the OEHHA Air Chemical database website for the specific pollutant.

Follow-up notifications, which contain the same information as listed above, are sent each time the measured concentration of the pollutant increases significantly above the initial threshold, or when the pollutant is continuously measured at a level below the threshold for 30 minutes or two continuous measurements. Any fenceline notifications sent in error will be followed up with another notification explaining the cause of the false alert.

Measurements invalidated via the automatic QA/QC system, such as during known instrument outages, atmospheric interference, or when instruments are showing operational errors, do not generate automated public notifications. However, they are reviewed by the Data/Quality Control Manager and the Program Quality Assurance Manager.

3 Assessment and Oversight

3.1 Audits and Response Actions

The project team includes a Lead Internal Auditor, whose duties are solely in the area of independent assessment of the measurement effort. To promote objectivity and independence, the Lead Internal Auditor maintains independent audit equipment in a separate location from the operations center and has access to the Program Quality Assurance Manager for assistance in promoting the quality objectives of the company. A Third-Party QA Assessor also perform external audits independent from the operations and maintenance and internal quality assurance organizations. See Section 1.3 for more information on project organization.

Assessments conducted for this project fall into two categories: Technical Systems Audits (TSAs) and Performance Evaluation Audits (PEAs). Both provide vital information regarding the status of the project team operation and how well the measurement data adhere to the quality specifications of the QAPP.

All PEAs and TSAs are conducted following the guidance documents in the "EPA Quality Assurance Handbook" series, Volumes I,[30] II,[31] and IV.[32] 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.

3.1.1 Third Party Audits

Routine, independent audits performed by a qualified independent party are required by Rule 1180. The initial audit, as required by Rule 1180, will be completed by January 1, 2029, and once every three years following the initial audit. The independent auditor will identify any deficiencies in the fenceline air monitoring program and procedures and document their findings in an audit report. Audit reports will be submitted to the South Coast AQMD and posted on the public website within 90 days of the audit's completion. If deficiencies are identified, a corrective action plan will be developed within three months of the audit report and posted on the website once approved by South Coast AQMD. More information on corrective action plan development, approval, and post-approval action is provided in Section 3.1.5.

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[30] A Field Guide to Environmental Quality Assurance, Volume I, in *Quality Assurance Handbook for Air Pollution Measurement Systems*, Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C., April 1994. EPA-600/R-94/038a. See https://www3.epa.gov/ttn/amtic/files/ambient/qaqc/r94-038a.pdf (accessed December 2019).

[31] Ambient Air Quality Monitoring Program, Volume II, in *Quality Assurance Handbook for Air Pollution Measurement Systems*, Air Quality Assessment Division, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina, January 2017. EPA-454/B-17-001 . See https://www3.epa.gov/ttn/amtic/files/ambient/pm25/qa/Final%20Handbook%20Document%201_17.pdf (accessed December, 2019)

[32] Meteorological Measurements, Volume IV (Version 2.0, Final), in *Quality Assurance Handbook for Air Pollution Measurement Systems*, Air Quality Assessment Division, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina, March 2008. EPA-454/B-08-002. See https://www3.epa.gov/ttn/amtic/files/ambient/met/Volume_IV_Meteorological_Measurements.pdf (accessed December 2019).

3.1.2 Technical Systems Audits

TSAs for the field operation have several areas of focus. The primary goal of a TSA is to determine if operation and maintenance of the fenceline air monitoring system conforms with the procedures and criteria specified in this QAPP. The TSA is conducted employing a checklist as a guide to the major topics to be assessed, and the auditor is free to allot greater amounts of time to any particular area as needed. The checklist is prepared in advance of the audit and is based on information presented in the QAPP and in general, the guidance of the EPA QA Handbook series.

The field TSA includes a review of overall equipment siting and exposure, site visit logs, continuous analyzer and meteorological operating procedures, and documentation of any site maintenance activities. From this assessment, the auditor is able to determine the quality requirements for the monitoring effort from the QAPP, 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.

TSAs 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.);
- Review of logs and determinations if past problems were addressed/resolved;
- Examine all open-path, fixed-point and meteorological monitor functions and components using the maintenance checklist to confirm that the equipment is operating with manufacturer specifications; and
- Analysis methods for of target compound(s) accuracy, precision and sensitivity per requirements listed in Table 1-8 and 1-9.

3.1.3 Performance Evaluation Audits

PEAs are quantitative audits in which analytical results are generated by the monitoring system for samples that originate outside of the monitoring system/manager organization. PEAs are used to assess bias in the monitoring systems. PEAs consist of: single-blind reference gas challenges of the open-path and/or hydrogen sulfide monitors; and/or single-blind optical calibration checks of the black carbon monitors. Single-blind PEAs involve analysis of samples for which the monitoring system/manager organization knows they are PEA samples but does not know their concentrations or, in the case of the open-path monitors, their analytes. PEA samples are generated and certified on behalf of the auditor by an independent organization (e.g., NIST) and can be transferred to the monitoring system/manager organization following formal chain of custody procedures with written instructions for documentation, storage, handling, schedule, results reporting and return of auditing equipment (if any). PEAs may be performed when the auditor is present or not present at the monitoring site.

3.1.4 Periodic Data Quality Assessments

Periodic Data Quality Assessments (DQAs) are conducted to determine whether the quality of data is adequate to support decisions based on the DQOs. DQAs involve statistical analysis of environmental data to estimate the quality of data being collected (i.e., calculating DQIs presented in Section 1.6 of the QAPP). Further information on the DQAs is presented in Section 4.3 of this QAPP.

3.1.5 Corrective Action Procedure

Corrective action reports (CARs) are issued when an internal TSA or PEA, or third-party audit, reveals a quality assurance problem that impacts data quality, storage or reporting. CARs are issued by the Program QA Manager, based on internal QA audits or QA issues noted by them, raised by the lead internal auditor, technical specialists, or external third party auditors. The CAR is sent via email to the personnel responsible for the system in question and/or responsible for mitigation actions (i.e., System Manager/Operator, Website/Data System Manager or Data/QA Manager). The System Manager/Operator is notified of all CARs issued.

The CAR contains the date of the finding, a summary of the finding, a recommendation on how to resolve the issue, suggestions for steps to minimize recurrence and a proposed date for completion. Follow-up meetings may be scheduled depending on the severity of the issue, though each manager is empowered to take corrective action without discussion should it be clear that immediate action is warranted. Resolution of the QA issue is then documented in the CAR which is signed by the appropriate responsible personnel and returned to the Program QA manager.

CARs are issued by the Program QA manager to the relevant responsible personnel within seven days of any internal QA audit, or within seven days of when a QA issue is raised. The responsible personnel shall respond within four days with an acceptance of the CAR, a revised date of completion, or decline the CAR and indicate the reason(s) for not pursuing action. The responsible personnel shall communicate to the Program QA manager should there be any delays to the completion date. The CAR shall be completed with a summary of the corrective action implemented, signed and dated, and returned to the Program QA manager within seven days of completion of work.

QA issues and CARs are documented in quarterly reports to management. They are reviewed together with the System Manager/Operator and Program QA manager to determine whether there any patterns in the findings that could be indicative of a systematic quality issue.

Corrective actions arising from equipment maintenance and validation activities are conducted according to the individual equipment manuals and SOPs referenced in Section 2.6 and 2.7. These actions, and their resolution, are noted in operator field logs.

3.1.6 Audit Frequency

PEAs and TSAs may be performed by the Lead Internal Auditor (internal PEA or TSA) or a Third-Party QA Assessor (external PEA or TSA). Table 3-1 below indicates the frequency of internal and external TSAs and PEAs.

Table 3-1. Frequency of Internal and External Audits

Audit	Internal Audit Frequency	External Audit Frequency
TSA	No frequency requirement	At least once every 3 years (following initial audit, completed by January 1, 2029)
PEA	Annually	

3.2 Specific Cause Analysis

As required by Rule 1180, if a pollutant is measured above its respective notification threshold, a Specific Cause Analysis will be initiated within 24 hours of discovery. A variety of techniques may be used in order to determine the source(s) of the air pollutant, including, but not limited to: visual inspection, optical gas imaging, and leak inspection via EPA Method 21. Corrective action will be initiated as soon as reasonably possible, but no later than 24 hours after identifying the specific cause if it was determined to be from an on-site source.

If the specific cause was determined to be from an on-site source, a Specific Cause Analysis report will be submitted to the South Coast AQMD and posted on the public website within 14 days. This report will include the following information:

- The cause and duration of emissions;
- Determination of the emission source(s) and methodology utilized;
- Mitigation and/or corrective actions taken;
- If relevant, justification for corrective action(s) taking more than 14 calendar days to implement; and
- Any additional data requested by the Executive Officer.

If corrective actions are required, a reinspection will occur within 14 calendar days, and a report will be submitted to the South Coast AQMD and posted on the public website within 28 days of completing the corrective actions.

Based on the Rule 1180 staff report, the “FCCU is the only unit capable of emitting high concentrations of metals as part of spent catalyst.” If the FCCU and electrostatic precipitator (ESP) unit are operating under normal process conditions and/or the certified Opacity meter does not show any significant increase from background concentrations, no corrective actions or reinspection will be performed for metals and particulate matter that exceed the notification threshold. Fugitive dust in an around the fenceline boundary are unavoidable due to variable weather conditions in the area.

If three “events” require a specific cause analysis within the same calendar year, or indicate the cause is unknown for the same air pollutant detected on the same air monitor, Torrance Refinery will bring in a qualified independent party to initiate a Specific Cause Analysis. The qualified independent party will conduct a specific cause analysis and generate a specific cause analysis report to be submitted to the South Coast AQMD and posted on the public website within 14 days of the completion of the report. Once the cause is identified, Torrance Refinery will conduct corrective actions and reinspection. A follow-up report will be submitted and posted to the public website within 28 days of corrective actions.

3.3 Reports to Management

Reports for field performance and TSAs 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. The auditor should always provide the field technician and or the System Manager/Operator a list of preliminary findings and recommendations during a debriefing meeting held at the conclusion of the audits. If significant deficiencies are determined that impact the ability of the system to properly function, the System Manager/Operator is notified immediately. The System Manager/Operator notifies the Rule 1180 Program Manager of the situation and advises on the response actions being undertaken to restore the systems to full operational status. A formal report is provided to the project team within three weeks of completion of the audits. If there are no corrective action items, the auditor may close the audit. If further action is required, the audit is classified as open pending verification that the corrective action was completed, and the audit specification is met.

Third party audit reports will be submitted to the South Coast AQMD and made available on the public website within 90 days after the audit has been performed, and any generated Corrective Action Reports and Specific Cause Analysis Reports will also be posted to the public website. See Sections 3.1.1, 3.1.5, and 3.2 for more information on these reporting requirements.

The System Manager/Operator team develops quarterly reports summarizing systems performance and containing the final validated monitoring results for that quarter. Quarterly reports are due within 60 days after the conclusion of the quarter for which the data were collected. After the quarterly reports have been approved, they are posted on the Torrance Refinery website for public access.

4 Data Validation and Usability

4.1 Data Review, Verification, and Validation

Data review, validation and verification procedures are presented in this section. Verification of data involves evaluating the completeness, correctness, and conformance/compliance of a specific data set against the predetermined specifications (i.e., DQIs specified in this QAPP). Data validation extends evaluation of data to determine the quality of data relative to its end use (in this case, providing air quality information to the public about pollutant levels at the refinery's fenceline). Procedures for data validation are found in this SOP, *TORC Data Validation (SES SOP-TORC-08).*

Three types of data are collected for this project:

- Continuous data from the open-path systems;
- Continuous data from the fixed-point monitors; and
- Continuous data from the meteorology sensors.

Data are declared invalid whenever documented evidence exists demonstrating that a monitor was malfunctioning, or data were collected under non-representative conditions. It should be noted that the monitors are independent of one another for the purpose of documenting invalid data. For example, if the meteorological system is down, the data from an open-path or fixed-point monitor may still be acceptable and reported.

Data reviews and appropriate validations are performed for each monthly data set under the supervision of the project manager. The data management task leader verifies that the data from the individual monitors are complete for the month. The task leader then informs the System Manager/Operator when the complete data set is ready.

The activities involved in validation of the data in general include the following:

- Reviewing the site visit logs, calibration data (as appropriate), audit data, and project memoranda for indications of malfunctioning or instrument maintenance events; and
- Examining the monitor and meteorology data for spikes in the data, unusual persistence, unusually high rates of change, or measurement values that seem incongruous with normal measurement ranges and/or diurnal variations. Spectral analysis for selected large or anomalous measurements may be required; and
- Comparing measured concentrations against data from nearby air monitoring stations as well as overlapping open path monitor data for those pollutants that are measured by both the FTIR and UVDOAS analyzers on the same path.

Data are never declared invalid solely because they are unlikely to occur in nature but may be flagged as suspect and subject to further review until the cause for an apparent anomaly is determined. The results from all quality control and quality assurance checks are evaluated to determine if the DQOs for each instrument are being met. Data qualifier codes (Table 2-1 in Section 2.3 of this QAPP) are assigned to monitoring results during data validation as appropriate to indicate data limitations or explanations for data anomalies.

Evidence of overwhelming measurement bias, external influences on the representativeness of the data, or lack of reproducibility of the measurement data may be cause for the data to be judged invalid.

4.1.1 Open-Path and Fixed-Point Monitors

The open-path and fixed-point monitor measurements and system performance data are transmitted to the cloud server continuously via modem. The data are reviewed at least daily to verify that the systems are collecting data and that there are no indications of equipment malfunctions. If a problem is detected in the daily reviews, the System Manager/Operator (or their designee) is immediately notified (text or email) so that he can direct the site operator's corrective actions. This contact is documented electronically (e.g., through email or site logs)and distributed to the project team so that the situation may be accounted for in the monthly validation process and summary reports.

Open-path monitor spectral data are archived continuously. All other data are archived on System Manager/Operator network drives so that they are available to post-processing and reporting personnel. Manual spectral validations are performed on data above the action levels listed in Section 7 of the *Torrance Refinery Rule 1180 Fenceline Air Monitoring Plan*[Error! Bookmark not defined.]. Additional data validations are performed as needed/required during reporting or times where operations of the open-path systems are suspect.

A conservative approach is taken with the open-path data in that it is accepted as is except under situations where QC indicators are met. The primary QC indicators are past alarms events that have been validated as false positives or any data deemed erroneous due to known system influences or failures.

4.1.2 Meteorology Sensors

The meteorology data are retrieved and subject to manual data review. Certain screening tests, such as those recommended by EPA,[33] are performed to aid in identifying data that require further investigation.

4.2 Verification and Validation Methods

US EPA guidance on remote sensing for monitoring of ambient pollutants[34] recommends four levels of data validation: level 0, 1, 2 and 3. These levels are described below along with specific activities that are performed to ensure validity and usability of the fenceline data collected from the open-path and fixed-point monitors.

Level 0 verification includes review of raw calibration data and initial setup observation prior to collecting field data. It also includes field observation of the equipment setup and function.

Because monitoring results are displayed in real-time, the system software will incorporate a variety of automated data QC verification checks to reduce the likelihood that real-time results are affected by

[33] *On-Site Meteorological Program Guidance for Regulatory Modeling Applications*, U.S. Environmental Protection Agency, February 2000. EPA-454/R-99-5. See https://www3.epa.gov/scram001/guidance/met/mmgrma.pdf (accessed August 2019).

[34] *EPA Handbook: Optical and Remote Sensing for Measurement and Monitoring of Emissions Flux of Gases and Particulate Matter*, U.S. Environmental Protection Agency, September 1, 2018. See https://www.epa.gov/sites/production/files/2016-06/documents/gd-052.pdf (accessed May 2019).

instrument malfunction or spurious data. The following general types of automated verification checks are performed on all measurements:

- Range checks will confirm the measurement is within pre-defined minimum and maximum values;
- Sticking value checks are used to flag data for further review;
- Rate of change checks will confirm that subsequent observations change by a reasonable extent and are used to identify potentially spurious data or instrument failure for further review;
- Sensor codes or alarms generated by the instruments, if available, are used to validate observation data; and
- The return beam intensity also is used to verify data for open path instruments.

Reference gas check results for the open-path analyzers and calibration data from the fixed-point monitors and meteorological system are reviewed after each verification check has been performed to ensure they satisfy requirements set forth in this QAPP, SOPs or operation manuals for the following criteria:

- Calibrations are performed on schedule;
- Calibrations are performed in the proper sequence;
- Reference gas and calibration standards reflect conditions expected during operational measurements or manufacturer's recommendations; and
- Linearity checks or other checks were performed to ensure the measurement system was stable during calibration.

Monthly visual field inspections also are performed to visually verify performance of monitors as follows:

- The equipment is operational and optical data was being collected and stored;
- The equipment is aimed correctly, and the collected data are different from zero or full saturation; and
- There are no anomalies in the time-series of data collected by the monitors or meteorological sensors.

These inspections are logged and kept on file for audit inspections or other review.

If anomalies are found, or if results exceed action thresholds for notifications, data are flagged, and an email notification is sent to the System Manager/Operator and Program Quality Assurance Manager for further verification and validation.

Level 1 validation involves downloading data from the measurement systems/instruments and reviewing variables calculated as part of the QC process. Specific aspects that are reviewed consist of the following:

- Whether the signal intensity from the equipment has drifted or diminished relative to the most recent maintenance activity;

- The frequency with which data exceed the allowable ranges or fail the sticking value check;
- Whether the measurement results contained any data qualifiers (defined in Table 2-1 in Section 2.3 of this QAPP) or other indication of anomalous data collection; and
- Whether the range and values of minimum detection limits reported by the instruments are within expected bounds.

Level 2 review entails validating measurement data relative to ancillary measurements and historical data. Calibration logs, audit reports, meteorological measurements, facility activity logs and historical measurement data will be used to perform a manual review to determine whether data flagged as anomalous should be corrected or invalidated. The following checks will be done monthly (at a minimum):

- Trends and excursions in optical data will be reviewed against prevailing wind speed and direction and facility process information;
- During the QA Manager review, data time series charts and other data visualizations are reviewed to identify potential outliers and special attention is given to unusually low or high outliers or deviations in the minimum measured value from day to day;
- Data completeness and representativeness DQOs are assessed; and
- Five-minute average data are reviewed to flag and evaluate rapid changes in value between successive data points.

Level 3 data validation represents the highest level of data review conducted. Level 3 data validation may be performed by the Program QA Manager, by the independent Third-Party QA Assessor or both. This team will have a basic understanding of the instrument operation and will be familiar with typical results from similar measurement projects.

Level 3 data validation will determine which open-path measurement data should be invalidated if a serious response problem with the open-path technology is detected, or if calibration errors are identified. The reasons for changes to data quality resulting from the validation process, and details of corrective action taken, are documented. Data qualifier codes are reviewed to interpret combinations of multiple data qualifiers and contribute to decisions on whether data should be invalidated.

Given the real-time nature of this measurements program, it is important to have follow-up procedures and established timeframes for distinguishing between data that may indicate an instrument issue and data that may reveal a real exceedance of established notification threshold concentrations. In the event that a reported average concentration exceeds a notification threshold concentration, on-call staff at Spectrum will investigate the data management system, analyzer data files, and the analyzer data processor as quickly as possible. The follow-up actions depend on whether the hourly concentration exceedance notification was found to be valid or a false alert. Any actions taken will be communicated to all members of the project team via email and/or other electronic communication channels.

- If it’s determined the concentration exceedance notification was a false alert:
  - The first personnel to identify the false alert will notify all members of the project team with their findings via email as soon as possible;

  - The System Manager will be responsible for delivering a follow-up email to all public notification subscribers informing them of the false alert;
  - The System Manager will work with TORC to make any necessary changes to TORC's default language for responding to "false alert" notifications;
  - The Data System Manager will invalidate data in the data management system, remove invalid data from the TORC Rule 1180 website, and add information on the false alert to the Notifications Section of the TORC Rule 1180 website;
  - The Data System Manager will send a follow-up notification with an explanation as to the cause of the false alert; and
  - If the false alert is the result of an issue that has the potential to produce more false alerts or invalid readings, one or more of the following actions may be necessary:
    - The Data System Manager can stop the display of potentially impacted data on the TORC Rule 1180 Website;
    - The Data System Manager can disable the generation and delivery of additional automated notifications that may be triggered by the issue; and
    - Technical Specialists/Site Operators can shut off analyzer software via remote access until the problem is resolved.
- If it's determined the concentration exceedance notification was valid:
  - The first personnel to verify the readings will notify all members of the project team via email or other electronic communications as soon as possible;
  - The Data System Manager will ensure that information on the exceedance notification is added to the Notifications Section of the TORC Rule 1180 website;
  - The System Manager will work with TORC to determine if a follow-up email message to the public notification subscribers is warranted. If so, the System Manager will deliver this email message and the Website Manager will ensure it is added to the Notifications Section of the TORC Rule 1180 website; and
  - Spectrum's data management system will send an automated follow-up email to the public notification subscribers:
    - If the initially-measured exceedance concentration increases and exceeds specified levels; and
    - When concentrations have fallen below the respective concentration notification threshold for a minimum of 30 minutes or two consecutive measurements.

4.3 Reconciliation with Data Quality Objectives

Periodically, the Program Quality Assurance Manager and System Manager/Operator evaluate the monitoring system's progress toward meeting the goals and objectives given in Section 1.6 of this QAPP. This evaluation occurs annually at a minimum and more frequently as needed. Two areas are reviewed: the performance of the project in respect to the quality goals and objectives specified in Section 1.6 of this QAPP and the limitations (if any) on the measurement data for their intended use. Also, per the Rule

1180 Guidelines,[35] this annual evaluation also assesses the effectiveness of the monitoring plan covering experimental design, representativeness of the data, and peer review. The results of this annual evaluation are reported to the Rule 1180 Program Manager.

4.3.1 Assessment of Measurement Performance

As part of the annual review the performance of the monitoring network are assessed to determine to what extent the measurement data meet the requirements of the data user (client and/or regulatory agency). In Section 1.6 on Quality Objectives and Criteria, a discussion of the DQIs is presented in relation to precision, accuracy, completeness, representativeness, and comparability goals for the monitoring effort. Specific quantitative measures of precision, accuracy and completeness are defined for use in estimating the quality of the data set. These metrics are calculated and compared with the project goals and objectives.

4.3.2 Data Quality Assessment

If any of the data quality measures indicate performance outside the desired objective (e.g., an audit result fails to meet the stated objective or quarterly data completeness is less than the goal) the data associated with that result are not considered useless. The burden is on the System Manager/Operator to determine the extent to which a quality issue affects the related data, and ultimately how the issue impacts the fitness for use of the data. Most often a single isolated incident in which the performance objective is not met does not automatically render the data useless, but rather slightly reduces the confidence that the measurement is reliable and indicates that increased quality control measures are needed. Any such data for which there are questions of confidence are appropriately flagged in the database. The DQOs are assessed periodically throughout the monitoring year, and a complete evaluation is conducted at the completion of each calendar quarter. A quarter in which the completeness statistic for a given monitor is below the objectives is cause for concern and corrective action, but if the other quarters within a four-quarter period are within the objective, the confidence in the data set remains high.

Any potential limitations of the validated data set are identified and communicated. The project team presents all known or potential data limitations with each data submittal and apply and annotate data qualifier codes as needed so that users may determine if the data should be used for a particular discussion or decision.

Table 2-1 lists data qualifier codes that are used during data validation to qualify raw and processed data.

[35] *Rule 1180 Refinery Fenceline Air Monitoring Plan Guidelines*, South Coast Air Quality Management District, Diamond Bar, California. December 2017. See http://www.aqmd.gov/docs/default-source/rule-book/support-documents/1180/rule-1180-guidelines.pdf (accessed August 2019).

Appendix A

Fenceline Air Monitoring System Specifications

Table A-1. Open-path FTIR analyzer specifications

Parameter	Units	Specification	Comment
Analyzer type	None	FTIR	
Spectrometer Wave resolution	cm^{-1}	0.125 - 32	
Spectral range	cm^{-1}	550 – 7,800	Range is dependent on supplier
Scan frequency	scans/second	Varies – 0.5 to 2 at 0.5 cm^{-1}	Scan frequency increases as resolution decreases
Receiver configuration	None	monostatic	
Source type	None	Polaris™ long lifetime source	
Detector type	None	Mercury Cadmium Telluride (MCT)	
Detector cooling type	None	Stirling cyrocooler	
Detector temperature	K	77	
Beam splitter	None	ZnSe	
Interferometer type	None	90° dynamically aligned Michelson interferometer	
Signal to noise ratio	None	100,000:1	
Bench stabilization	None	Dynamic alignment	Algorithm reduces noise
QA gas cell type	None	Internal linear dual pass cell	Cell can be moved into beam path.
Cell Window	None	ZnSe	
Operating Temperature	°C	0 to 60 °C	
Time resolution (averaging time)	Minutes per reading	5 per path	
Power requirement	VAC	110 - 240	
Signal sampling	ADC	24-bit	Used for data acquisition
Output	None	USB	
Material of construction	None	Aluminum with stainless steel fasteners	Robust and ruggedness required

Table A-2. FTIR – ancillary equipment specifications

Parameter	Units	Specification	Comment
Alignment Mechanism/Rotating Pedestal/Auto-positioner			
Type	None	Quickset MPT-90	
Mechanism	None	Pan and Tilt Unit	Required to remotely position analyzer
Load capacity	pounds	At least 100	
Pan movement range	°	435°	
Tilt movement range	°	180°	
Operating temperature	°F	5 to 131	Without heaters (heaters not required in southern California weather conditions)
Motor yype	None	Stepper	
Communications to pan & tilt		RS232 or LAN to PC	
Communications to sensors		RS232 Analog or LAN pass-through	
Material	None	Housing: 6061-T6 aluminum, stainless steel hardware permanently sealed radial ball bearings	
Retroreflectors			
Configuration	None	Open hollow cubes	Hollow cube retro reflectors have three flat sides that are attached in an orientation so that the reflected beam exits at nearly the same angle of incidence as the incoming beam.
Mounting	None	Rail mounted	
Material (substrate)	None	Polished glass	
Coating	None	Gold coating	
Surface quality	None	80-50 scratch dig	

Table A-2. FTIR – ancillary equipment specifications

Parameter	Units	Specification	Comment
Adhesion	None	Mil F-48616; Humidity MIL F-48616 or equivalent	
Operating temperature range	°C	-40 to 60	
Reflectivity	cm^{-1}	500 to 15,000	
Array configuration	None	85 to 104 cubes	Varies by path length
Enclosure	None	Customer supplied	
Heater	None	Optional	Can help reduce condensation
Heater power consumption	W	480 maximum	Required 120 VAC, 5 amp, 60 Hz

Table A-3. FTIR – computer and software specifications

Parameter	Specification	Comment
Computer	MS Windows; Memory: 3 GB minimum; Dual Core 2.1 GHz processor; Min. 2 USB ports; Ethernet port; 802.11 b/g/n wireless LAN.	
Software		
Type	Real-time monitoring of pollutants	
Data display	Real-time display of results as well as instrument diagnostics.	
Alarms	User programmable to set alarms when concentrations are greater than thresholds	
Notifications	Ability to send notifications when pollutant concentrations greater than a specified threshold are measured	
Beam intensity	Ability to display beam intensity being measured	

Table A-3. FTIR – computer and software specifications

Parameter	Specification	Comment
Communication	Compatible with all computer systems and software for data processing	The equipment should be able to communicate alarms, operational parameters and results with a computer.
Remote control	Calibrations and augments done remotely	
Smart features	Analytical method customization; Background and interference compensation; Retroactive spectra analysis.	

Table A-4. Open-path UVDOAS analyzer specifications

Parameter	Units	Specification	Comment
Analyzer type	None	open-path UVDOAS	
Receiver configuration	None	monostatic	
Spectrometer resolution	nm	0.5	
Ultraviolet light source		150 W Xenon lamp	
Ultraviolet light source replacement	hours	Every 3000 hours	Minimum expected lifetime; can be longer as long as light intensity is sufficient and spectral features are adequate
Operational wavelength	nm	210-340	
Beam operating temperature	°C	-20 to 50	
Indoor shelter temperature limits	°C	-15 to 35	
Bench stability	None	Thermally-stabilized	
Operating humidity	%	0 to 95%	
Detector type	None	2048 pixel spectrometer	
QA gas cell	None	8-cm flow-through cell	
Electrical requirements	VAC	110 or 240, single phase, 50-60 Hz, 5 amp maximum	

Table A-4. Open-path UVDOAS analyzer specifications

Parameter	Units	Specification	Comment
Time resolution (averaging time)	minutes	5 minutes per reading	
Data acquisition rate	Milliseconds/scan	10-1000	
Data output rate		10 sec – 5 min	User configurable
Output	None	USB	
Material of construction	None	Aluminum with stainless steel fasteners	Robust and ruggedness required

Table A-5. Open-path UVDOAS – ancillary equipment specifications

Parameter	Units	Specification	Comment
Alignment Mechanism / Rotating Pedestal / Auto-positioner			
Type	None	Quickset MPT-90	
Mechanism	None	Pan and Tilt Unit	Required to remotely position analyzer
Load capacity	pounds	At least 100	
Pan movement range	°	435°	
Tilt movement range	°	180°	
Operating temperature	°F	5 to 131	Without heaters (heaters not required in southern California weather conditions)
Motor type	None	Stepper	
Communications to pan & tilt		RS232 or LAN to PC	
Communications to sensors		RS232 analog or LAN pass-through	
Material	None	Housing: 6061-T6 aluminum, stainless steel hardware permanently sealed radial ball bearings	
Retroreflectors			

Table A-5. Open-path UVDOAS – ancillary equipment specifications

Parameter	Units	Specification	Comment
Configuration	None	Open hollow cubes	Hollow cube retro reflectors have three flat sides that are attached in an orientation so that the reflected beam exits at nearly the same angle of incidence as the incoming beam.
Mounting	None	Rail mounted	
Material (substrate)	None	Polished glass	
Coating	None	Enhanced aluminum coating	
Surface quality	None	80-50 scratch dig	
Adhesion	None	Mil F-48616; Humidity MIL F-48616 or equivalent	
Operating temperature range	°C	-40 to 60	
Reflectivity	Nm	200-400	
Array configuration	None	27 to 37 cubes	Varies by path length
Enclosure	None	Customer supplied	
Heater	None	Optional	Can help reduce condensation
Heater power consumption	W	480 maximum	Required 120 VAC, 5 amp, 60 Hz.

Table A-6. Open-path UVDOAS – computer and software specifications

Parameter	Specification	Comment
Computer	MS Windows; Memory: 3GB minimum; Dual Core 2.1 GHz processor; Min. 2 USB ports; Ethernet port; 802.11 b/g/n wireless LAN.	
Software		

Table A-6. Open-path UVDOAS – computer and software specifications

Parameter	Specification	Comment
Type	Real-time monitoring of pollutants	
Data display	Real-time display of results as well as instrument diagnostics.	
Alarms	User programmable to set alarms when concentrations are greater than thresholds	
Notifications	Ability to send notifications when pollutant concentrations greater than a specified threshold are measured	
Beam intensity	Ability to display beam intensity being measured	
Communication	Compatible with all computer systems and software for data processing	The equipment should be able to communicate alarms, operational parameters and results with a computer.
Remote control	Calibrations and augments done remotely	
Smart Features	Analytical method customization; Background and interference compensation; Retroactive spectra analysis.	

Table A-7. Black carbon monitor specifications

Parameter	Units	Specification	Comment
Cartridge filter bypass	None	Required	Filter used for clean air tests, should be replaced once a year.
Electronic data output	None	Single serial output through either RS-232, USB, or Ethernet port.	1200 to 115200 baud.
Calibration kit	None	Neutral density optical filter calibration kit or equivalent	Ability to calibrate the absorptive properties of the instrument
Filter tape material	None	Reinforced glass fiber	Reduce effects of relative humidity.
Flow rate options	Liters per minute	2	

Table A-7. Black carbon monitor specifications

Parameter	Units	Specification	Comment
Internal vacuum pump	None	Internal DC powered pump	
Light source	(nm)	LED light sources at different wavelengths	Different wavelengths measure the absorption of different types of carbon (including black carbon at 880 nm).
Power supply	Watts (W)	12 V DC. Universal 100-240 VAC 50/60 Hz input.	12 VDC 8.5-amp output supply included.
Pulse damper	None	Recommended	Decrease pump pulsations to minimize interferences with sensitive measurements.
Resolution	Microgram per cubic meter ($\mu g/m^3$)	0.001	
Sample inlet tubing	None	Static Dissipative tubing	Minimize amount of tubing required.
Time base of measurements	Seconds (s)	5-minute time base	

Table A-8. Black carbon analyzers - computer and software specifications

Parameter	Specification	Comment
Computer	Minimum 1 GB, Windows	
Software		
Alarms	Operational parameters and analyzer operation issues logged	
Communication	Compatible with all computer systems and software for data processing	
Remote control	Alarm identification and troubleshooting, calibration and flow checks, ability to view real time concentrations remotely	
Data display	Physical display on equipment and remote display of consolidated data	

Table A-8. Black carbon analyzers - computer and software specifications

Parameter	Specification	Comment
Data processing	5-minute and 1-hour averaging capabilities, processing of alarms and QA check information	

Table A-9. Hydrogen sulfide ultraviolet fluorescence analyzer specifications

Parameter	Units	Specification	Comment
Manufacturer/model	--	Teledyne/API T-101	
Electronic data output	None	RS-232, Ethernet, or USB port capabilities; Capability to transmit analyzer information to software	
Flow rate options	Liters per minute	0.65 - 1	
Light source	(nm)	LED light sources in the range of sulfur dioxide absorption wavelengths	ultraviolet light in the range of wavelengths absorbed by sulfur dioxide (190 nm - 230 nm).
Power supply	Watts (W)	100-230VAC, 50/60Hz (auto-switching) – 200-300 W average	Standard US Connection.
Resolution	ppb	1	
Time base of measurements	Seconds (s)	5-minute time base	
Operating Temperature	°C	20-30	
Lag time	seconds	25	

Table A-10. Particulate matter analyzer specifications

Parameter	Units	Specification	Comment
Analyzer type	None	Broadband spectroscopy using 90° white-light scattering with Polychromatic LED	

Table A-10. Particulate matter analyzer specifications

Parameter	Units	Specification	Comment
Particle size resolution	µm	0.18 - 20	256 sizes over range, combined to 64 channels for mass calculation
PM mass measurements	None	PM_{10} and $PM_{2.5}$	
PM mass resolution measurement range	µg/m^3	0.1 – 10,000	
Mass measurement and display resolution	µg/m^3	0.1	
Precision	µg/m^3 (1-hr. Average)	± 0.5	
Lower detectable limit	µg/m^3 (1-hr. Average)	< 0.1	
Data rate	seconds – hr	10s to 48 hr (user-selectable)	
Mass concentration accuracy	None	None	Exceeds US EPA PM_{10} FEM and Class III FEM $PM_{2.5}$ performance requirements for additive and multiplicative bias compared to FRM samplers
Flow rate	lpm	5.0	
Flow accuracy	%	± 1%	Typically within ± 0.5%
Operating temperature	°C	0 – 50, non-condensing	
Ambient temperature	°C	-40 – 60	
Ambient relative humidity	%	0 – 100	
Enclosure details	None	None	Weatherproof required within 0 – 50 °C, non-condensing environmental control
Warm up time	minutes	10	
Data interface	None	T Series Analyzer interface	Touch screen display and NumaView™ operating software and remote software
Electrical requirements	VAC	100 – 240VAC 50/60Hz, power consumption < 120W @ 120VAC	
Unit dimensions	inches (HxWxD)	7 x 17 x 14	

Table A-10. Particulate matter analyzer specifications

Parameter	Units	Specification	Comment
Unit weight	lbs	19	

Table A-11. Metals analyzer specifications

Parameter	Units	Specification	Comment
Analyzer type	None	Nondestructive EDXRF (energy dispersive X-ray fluorescence)	Based on EPA Method IO 3.3: Determination of Metals in Ambient PM Using XRF
Key applicable elements	None	Cd, Mn, Ni, etc.	
Measurement range	µg/dscm	≤ 60	
Detection limits	ng/m^3	Metal and sample time dependent	see Table 1-6
Sampling analysis times	minutes	Every 5, 15, 30, 60, 120, 180, or 240	User defined
Sample flow rate	lpm	16.7	
Unit dimensions	inches (WxDxH)	19 x 20 x 30	
Unit weight	lbs	130	
Electrical requirements	VAC	120 VAC, 50/60 Hz @ 4 amp or 120 VAC, 50/60 Hz @ 20 amp (with small AC enclosure) 220 VAC, 50/60 Hz @ 2.1 amp or 220 VAC, 50/60 Hz @ 11 amps (with small AC enclosure)	
Outputs	None	RS 232 or TCP/IP, Modbus protocol CSV file Reporting of metals, operational parameters, alarms, warnings	