CLARK COUNTY DEPARTMENT OF AIR QUALITY

Monitoring Division

PROCEDURE NUMBER 800

STANDARD OPERATING PROCEDURE FOR QUALITY ASSURANCE FIELD AUDITS AND CORRECTIVE ACTION REQUESTS

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ACRONYMS AND ABBREVIATIONS

Acronyms

AC	alternating current
AQS	Air Quality System
CAR	Corrective Action Request
DAQ	Clark County Department of Air Quality
DAS	data acquisition system
DC	direct current
EPA	United States Environmental Protection Agency
FEM	federal equivalent method
FRM	federal reference method
IT	information technology
MET	meteorological
NAAQS	National Ambient Air Quality Standards
NCore	National Core Monitoring Station
NIST	National Institute of Standards and Technology
NPAP	National Performance Audit Program
PEP	Performance Evaluation Program
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
SOP	Standard Operating Procedure
TAD	technical assistance document
TSA	technical systems audit
TTP	through the probe
WD	wind direction
WS	wind speed

Abbreviations

°	compass degrees
%RH	percent relative humidity
CO	carbon monoxide
mb	millibars
mph	miles per hour
NO	nitrogen oxide
NO_2	Nitrogen dioxide
O_3	ozone
Pb	lead
PM	particulate matter
ppb	parts per billion
ppm	parts per million
psig	pounds per square inch gauge
SO_2	sulfur dioxide
TSP	total suspended particulate

1.0 PURPOSE

The purpose of this procedure is to establish a uniform process for quality assurance (QA) field audits and generating Corrective Action Requests (CARs) within the Monitoring Division of the Clark County Department of Air Quality (DAQ).

Confidence in the quality of the ambient air and meteorological (MET) data as presented to decision-makers is essential. Decisions founded on scientific validity of the monitoring and MET data affect allocations of resources, focus of enforcement activities, and promulgation of improved regulations.

2.0 SCOPE/APPLICABILITY

This procedure provides general guidance on conducting QA field audits and initiating CARs based on failed audits. The Quality Assurance Project Plan (QAPP) for Criteria Pollutants outlines the general objectives on audits and CARs. (See specifically Sections C1.2 and C2.1 of the QAPP for Criteria Pollutants for background.)

Embedded in the quality management system is an assessment of quality control (QC) activities. These activities enhance the defensibility of the data products utilized and the decisions made from the data. Quality assessments require the following internal and external independent evaluations:

- Monitoring equipment performance;
- Monitoring data review;
- Technical systems audit (TSA);
- Corrective action requirements; and
- Report and data submission.

3.0 SUMMARY OF METHOD

DAQ conducts internal field audits based on the United States Environmental Protection Agency (EPA) requirements and the DAQ QAPPs. Field audits can be performed on gaseous, particulate, and MET instrumentation. Audits may also include documentation, data, systems, and processes. External audits are typically conducted by EPA or EPA contractors.

In the event of any failed audit a CAR is generated. While the primary purpose of a CAR is to respond to failed audits, a CAR may be generated by staff or management at any time a corrective action is warranted.

4.0 DEFINITIONS

Audit – A systematic and independent examination to determine whether quality system activities and related results comply with planned operations and whether these operations are implemented effectively and are suitable to achieve objectives.

Corrective Actions – Any measures taken to rectify conditions adverse to quality, and, where possible, to preclude their recurrence.

Performance Evaluation – A type of audit in which the quantitative data generated in a measurement system are obtained independently and compared with routinely obtained data to evaluate the proficiency of an analyst, measurement instrument, or laboratory.

QA – An integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the client.

QC – The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify the attributes and performance meet the stated quality requirements established by the customer; the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits to provide protection against "out of control" conditions and ensure the results are of acceptable quality.

Standard Operating Procedure (SOP) – A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps; an officially approved method for performing certain routine or repetitive tasks.

5.0 ROLES AND RESPONSIBILITIES

The CAR process was initially developed to address failed audits. Its use has been expanded to address corrective action for any system, operation, or equipment, as deemed necessary, and can be initiated by anyone in the division. The CAR template (see CAR Template on the DAQ network drive) outlines the order of action and responsibilities after initiation.

It is the QA Sr. Technician's responsibility to conduct field audits to verify operation of monitoring instruments through the QA Audit Procedures. It is the responsibility of the QA Supervisor to oversee the process, and it is the responsibility of the QC Supervisor to inspect and verify that the work performed followed all acceptable procedures and resulted in a lasting solution. It is up to the QA Sr. Technician to approve or deny closure of the CAR.

Field audit personnel must maintain a level of separation between QA performance activity and routine QC activity. Under normal circumstances, no operator shall utilize the same National Institute of Standards and Technology (NIST) traceable instrument for both assessment and control; if, however, only one NIST-traceable instrument is available, then no one person shall perform both the control and the assessment evaluation.

6.0 PROCEDURE

DAQ conducts internal performance audits of the gaseous and particulate matter (PM) network's air monitoring instrumentation, and evaluates MET sensors, gravimetric laboratory balance weights, and environmental control. Auditing frequency and applicable requirements are outlined in 40 CFR, Part 58, Appendix A.

With regard to sensor instrumentation, assessments begin with acceptance testing by both the vendor (providing certification) and by DAQ. Documented external and internal testing results are made available for QA review. Some internal acceptance testing methodologies are similar or identical to field control activities. NIST-traceable audit instrumentation is employed where possible when acceptance testing.

External performance audits are independently contracted by the EPA, Region IX. These National Performance Audit Program (NPAP) evaluations include quarterly Performance Evaluation Program (PEP) challenges to the federal reference method (FRM) and federal equivalent method (FEM) PM networks; through the probe (TTP) evaluations of selected gaseous stations; and lead (Pb) laboratory audits.

TSAs are programmatic reviews of the entire quality system, including:

- Evaluation of the organization's data collection, analysis, processing procedures, and documentation;
- Evaluation of personnel duties, training regimen, and equipment utilized in air monitoring activities; and
- Evaluation of staff adherence to procedures and management adherence to the Quality Management Plan.

Externally the EPA, Region IX, completes a TSA every three years following the procedural plan listed in "Guidance on Technical Audits and Related Assessments for Environmental Data Operations EPA QA/G-7 Final," which is the reference and guide for establishing and keeping the quality management system of monitoring activity.

6.1 Health and Safety Warnings

Hazards from physical activities involved in this procedure (lifting, carrying, etc.) can be minimized by following proper steps for these types of activities.

When working on MET equipment, personnel should be aware of a falling hazard, usually from the nearby roof of the tower's supporting structure. Staff must be cognizant of the physical danger from pinching or crushing of hand digits while the tower is in movement.

Personnel must observe standard safety precautions whenever electrical equipment is operated, and use normal precautions when working on the inside of the analyzer with the power connected. Multiple monitoring instruments are powered by 120 volts alternating current (AC), and the analyzers are supplied with a 3-wire grounding line cord. Under no circumstances should the analyzer be operated without an electrical ground.

Certain analyzer adjustments are required when the analyzer is in operation. Caution must be taken when working on an analyzer when energized. Some components may have minimal electrical hazards due to the low voltage direct current (DC) of some of the internal parts, but

120 volts AC is active inside the unit. As with all electrical work, precautions should be taken to avoid unnecessary exposure to electrical shocks. An electrical shock hazard is also possible while utilizing power tools.

Calibration gases used in the procedures should be vented out the shelter and away from any operations. The air coming out of the heated hydrocarbon scrubber is 575° Fahrenheit (300° Centigrade), and the coil and the case can be very hot. When pouring out the charcoal or Purafil®, properly dispose of the materials. Whenever possible, perform this procedure outside to minimize airborne dust in the station, and use a dust mask if desired.

On many gas delivery applications, pressure applied is 30 pounds per square inch gauge (psig). Only specially modified units require that the delivery pressure be set higher. Refrain from setting the delivery pressure higher than 55 psig, which can cause damage to the unit and injury to the operator. Please refer to the manufacturer's equipment manuals for additional safety precautions.

This list is not all inclusive of the risk involved in this procedure. Common sense, safety training, and supervisory communication are advised for any concerns about safety.

6.2 Cautions

The analyzer's signal can be affected through wire degradation that prevents a clean signal from reaching the data logger system. A damaged analyzer can also cause erratic readings within the system. Care should be taken in the handling and installation of the equipment.

One must be careful with audit equipment placement so that it remains balanced, stable, and accessible. Improper placement may cause equipment to drop or fall a significant distance. Ensure tubing, cables, wires, and circuit boards are in good condition and properly connected/seated within and between equipment. Care should be taken when handling MET towers/sensors. Lowering and raising MET towers/sensors can result excessive cable slack and pinch points between tower subassemblies.

Rapid weather changes may create stability problems between audit and monitoring equipment. Ensure audit equipment has stabilized and is equilibrated, particularly in unstable weather conditions, prior to use.

Damaged equipment, bad wiring, and compromised tubing can cause poor equipment performance. Inspection and replacement of suspect equipment is recommended. Open or shorted wiring, faulty connections, contaminated filters, contaminated scrubbers, defective seals, or compromised tubing can impact monitoring and audit equipment performance. Interferences such as hydrocarbons, water vapors, electrical noise, and temperature swings can also affect monitoring and audit equipment.

Damaged or ineffective bagging or blocking materials will impact the wind speed/wind direction (WS/WD) evaluation of MET equipment. Nearby water sprinkler systems may impact the relative humidity sensor and related data. Rapidly changing weather systems can cause ambient

pressure fluctuations, and ambient temperature may rise or fall rapidly during certain seasons and times of day.

6.3 Equipment, Supplies, and Other Requirements

1. Laptop or desktop to communicate with data logger system and connect with webpages.

2. Software for communicating to the data logger and for completing audits.

3. Copy or access to the associated spreadsheet or word documents for the work involved.

4. Access to manufacturer's manuals, SOPs, guides, technical assistance documents (TADs), and EPA regulations.

5. Ability to enter data to both station and instrument logs.

6. Calibrated (NIST-traceable) standards and certified challenge gases with gauges and valves.

7. Polyethylene or paper bag and four small plasticized foam end pieces for the wind sensor.

8. Handheld compass or WD siting scope.

6.4 QA Audit Frequency

1. Every gaseous monitoring instrument (nitrogen oxide/nitrogen dioxide (NO/NO_2), carbon monoxide (CO), sulfur dioxide (SO_2), and ozone (O_3)) is audited at least once a year.

2. Continuous PM monitors are audited at least twice a year but not within consecutive quarters.

3. Manual PM samplers are audited at least quarterly.

4. The Pb total suspended particulate (TSP) sampler and the speciation samplers are audited quarterly.

5. The National Core Monitoring Station (NCore) MET array is audited semiannually, and all other MET arrays are audited annually.

6. Audits are conducted as needed, e.g., upon QC request, after an exceedance, after a QA failure, or as part of a corrective action. Refer to the Maintenance Calibration Certification Operations and Firmware Schedules for audit schedule and frequencies.

6.5 Audit Steps

1. Upon entrance to the site, the Auditor shall make a data acquisition system (DAS) operator log entry and indicate the general purpose of the visit. Refer to the Station Operations and Log Entries Guide. The purpose of the visit may include gaseous, particulate, or MET audits.

2. If during or after the instrument or system audit the instrument or system is found to be malfunctioning or inoperable, the Auditor shall make note in the DAS operator log and shall not commence with the audit.

3. Audit equipment shall be introduced to the site with minimal disruption of the site layout and analyzer connections. The audit equipment shall be allowed to achieve equilibration and stability. Reactive gas systems shall be purged with dry zero air.

4. Pollutant ranges displayed are: 0 to 50 parts per million (ppm) for CO, and 0 to 0.5 ppm for O_3 and NO/NO_2. Special category NCore ranges are 0 to 5 ppm for trace CO, 0 to 200 parts per billion (ppb) for trace SO_2, and 0 to 250 ppb for NO/NO_Y.

5. Audit levels are provided by audit equipment that has undergone certification and/or verification. Criteria pollutant gases are commercially obtained according to EPA Protocol. Zero air is provided by a certified or verified zero air source.

6.6 QA Audit Evaluation

1. Worksheets are used for entering site equipment information and recorded data values. Auditor compares the DAS concentrations against the audit equipment concentrations. Data logger channels shall be put in Q mode for manual gaseous audits. Refer to the Data Logger Guide.

2. Continuous PM audits are conducted with the applicable data logger channels in Q mode. Refer to the Data Logger Guide. The instrument flow, ambient temperature, and barometric pressure are checked against a certified standard, and results are documented on the worksheets and logs.

6.7 QA Audit Termination

1. When criteria pollutant gas flow is terminated, clean, dry zero air shall be applied to the audit equipment and site analyzer to purge residual or artifact pollutants.

2. The site analyzer shall then be reattached to the filter assembly/solenoid. The data logger shall be restored to K mode. Refer to Data Logger Guide.

3. Activities shall be entered into site and instrument logs. Refer to the Station Operations and Log Entries Guide.

4. The Auditor shall power off and remove the audit equipment, and the site-specific sampling configurations shall be restored.

5. Upon departure, the Auditor shall reset any alarms and secure the site.

6.8 Internal Meteorological Audits

DAQ utilizes sonic anemometers for WS in miles per hour (mph); WD in compass degrees (°); ambient temperature sensors indicating degrees Fahrenheit; ambient barometric pressure sensors indicating millibars (mb); and relative humidity sensors indicating percent relative humidity (%RH). These sensor outputs are processed through the automated data collection system.

With operational support from a station operator, the Auditor shall require lowering of the MET tower or cross arm so that evaluation can occur. Any MET sensor attached to the cross arm must be made accessible. Close proximity to any MET sensor is a requisite for providing the best evaluation findings. Wind sensor alignment is verified with the MET tower raised.

For meteorological instrumentation auditing:

- The Auditor will get assistance (preferably from site technicians) to raise and lower the tower, to provide data logger value recordation while testing the sensors, and to help with the movement or identification of sensors. Meteorological sensor audits are conducted with the applicable data logger channels in Q mode. Refer to the Data Logger Guide.
- NIST-traceable standards shall have a current certification, and a copy of the certification shall be on the DAQ network drive.
- Verification of MET accuracy at NCore is required. Refer to Maintenance Calibration Certification Operations and Firmware Schedules. Table 0-4 “NCore Calibration and Accuracy Criteria” can be found within the EPA, Quality Assurance Handbook for Air Pollution Measurement Systems, Volume 4: Meteorological Measurements.

6.8.1 Computer Hardware and Software

A laptop computer or other electronic device that is able to interface with the data logger is required. Monitoring division management shall, consistent with DAQ equipment refresh requirements, provide and maintain computers as required.

6.8.2 Data Acquisition, Data Reduction, and Calculations

The DAS shall translate sensor voltages or outputs into engineering units for display on webpages.

Note that some audit equipment values are expressed in different units from those of the DAS. Unit conversions may be required, and all such calculations should be evident within the QA spreadsheets.

The QA spreadsheets should follow the naming convention on the DAQ network drive.

6.8.3 Troubleshooting

Double-checking connections of all types will save time in identifying potential system errors. When required, consult with other Monitoring Technicians or the Monitoring Supervisor for additional assistance with troubleshooting.

Specific manuals relative to the audit equipment are found on the DAQ network drive; refer to them for assistance in troubleshooting issues. Most manuals have direct phone numbers to technical personnel at the manufacturers who can also assist in troubleshooting.

If problems arise consult:

- The proper equipment manual;
- Other Monitoring Technicians;
- Monitoring Supervisor; and/or
- Equipment vendor

6.8.4 QA Reports

1. Results of internal audits shall be placed on the DAQ network drive for review by DAQ personnel. The QA Sr. Technician shall publish audit reports on the DAQ network drive.

2. A Monitoring Site Inspection form shall be completed by QA staff when site visits are conducted, and completed copies of the form shall be distributed to the site operators and to the QC and QA Supervisors.

3. Instrument audits shall be specific to station, shall identify a specific instrument, and shall be categorized as PASS/FAIL. Instrument PASS/FAIL shall be documented in the instrument and site logbooks. Refer to the Station Operations and Log Entries Guide.

4. FAIL designation shall require the initiation of a CAR.

5. QA audit data shall be submitted to the EPA Air Quality System (AQS) database. Whether PASS or FAIL, all information required by AQS is submitted. QA data shall be processed and appear on the annual data certification report. The data certification report is completed by QA, signed by the Air Pollution Control Officer (Director of DAQ), and submitted to EPA.

6. PEP and TTP data is entered into AQS by an independent contractor, as specified by EPA Region IX.

7. The EPA Region IX designated contractor gives DAQ the preliminary findings of the TTP on site at the time of completion. When DAQ receives the final results from the contractor through e-mail, these findings are posted on the DAQ network drive. Official TTP results are entered into AQS by the designated contractor.

6.8.5 Data Acquisition, Data Reduction, and Calculations

1. The annual AMP600 report provides review of all verified and validated data submitted during the past year. The annual data certification letter attests to the validity and completion of data and also notes any data anomalies.

2. Gaseous instrument calibration values are stored in the DAS, and records of the calibrations shall be noted in the specified instrument log.

3. The DAS stores ambient data, calibration data, and metadata. QA is able to challenge both instrument performance and system performance through the DAS.

4. QC calibration for each gaseous analyzer provides a linear regression with slope and intercept. Formulas are stored, and conversion from raw voltage to engineering units is made on the DAS server. Conversion, whether electronic or manual, shall be: (analyzer millivolts – intercept) / slope = engineering units.

5. Because continuous PM data is scaled at the data logger, readings may be taken directly off the appropriate logger channel without conversion. QA utilizes a laptop computer with Ethernet connection to the data logger or information technology (IT) network to collect test data.

6.8.6 Corrective Action Requests (CARs)

1. CARs are issued by QA staff to provide immediate feedback to the operators, supervisors, and manager if a performance or safety audit discloses a problem that would adversely impact quality or staff safety and requires a prompt, reasoned, and effectual response. The response selected must be acknowledged by the Manager and be a closed-loop correcting process. Solution methods may be incremental or iterative but appropriate to the expressed system need. A performance evaluation FAIL shall always qualify as an actionable event and require preparation of a CAR.

2. Any member of DAQ staff that has a network-wide quality system or safety concern may initiate a CAR using the CAR form (see CAR Template on the DAQ network drive). The CAR is to contain the date, location, summary of the issue, and timeline for completion. Information may also include a summary of the cause(s) resulting in the finding, minimization/prevention recommendations, and mitigation

recommendation. All of the information required on the CAR template must be provided, and the chain of communication, as outlined on the CAR template, must be followed.

3. If the Manager accepts an initiated CAR, the responsible Monitoring Supervisor must ensure that corrective action is implemented within the timeline indicated on the CAR.

4. Any personnel tasked with an aspect of corrective action shall be notified by e-mail. Once that assigned task is completed, the responsible Monitoring Supervisor shall be notified by e-mail.

5. Complementary corrective action activities shall be entered into the electronic station log and/or an individual electronic instrument log. Refer to the Station Operations and Log Entries Guide. These logs are available on the DAQ network drive.

6. Upon receipt, QA staff shall review the CAR with respect to appropriateness of the corrective action and suitability of actions or recommendations in preventing or minimizing a recurrence of the condition or issue that initiated the CAR. In the event a CAR submitted as completed does not satisfy these criteria, it will be disapproved as outlined on the CAR template.

7.0 RECORDS MANAGEMENT

All electronic records stored on the DAQ network drive are considered to be the official record of activity.

Electronic copies of instrument acceptance testing records should be placed on the DAQ network drive. Upon approval, acceptance testing documents may be modified to accommodate needed changes.

The results of the acceptance testing will be available on the DAQ network drive for QA review. This location allows for review by the Sr. Monitoring Technicians, Supervisors, and the Manager.

DAQ IT is tasked with recordation policy and methods of assignment, personnel access to recorded data, and improvement/change in furthering data security and storage.

8.0 QUALITY ASSURANCE/QUALITY CONTROL

The QA Supervisor has determined that following the procedures for QA field audits and CARS fall within EPA guidelines and rules for these analyzers.

Detailed specifications can be found in *USEPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Ambient Air Monitoring Program, EPA-454/B-13-003, May 2013.*

The QA Sr. Technician has the ability to review all procedures and equipment operations set forth in this SOP.

9.0 REFERENCES

USEPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Ambient Air Monitoring Program, EPA-454/B-13-003, May 2013, located at http://www.epa.gov/ttn/amtic/files/ambient/pm25/qa/QA-Handbook-Vol-II.pdf.

United States EPA, Quality Assurance Handbook for Air Pollution Measurement Systems, Volume 4: Meteorological Measurements, Revision No: 2.0, Date 01/20/08, internet URL as www.epa.gov/

U.S. EPA Title 40, Chapter 1, Subchapter C, Part 58, Subpart B, Appendix A at the same URL contains some material referenced in EPA Vol. 4.

Data Logger Guide

DAQ's Quality Assurance Project Plan for Meteorology and NCore Air Quality Monitoring.

DAQ's Quality Assurance Project Plan for Criteria Pollutants.