ATTACHMENT 15

QUALITY ASSURANCE AND CALIBRATION PROCEDURES PLAN FOR CO and O_2 CONTINUOUS EMISSION MONITORS

Attachment 15
Quality Assurance and Calibration Procedures Plan for
CO and O_2 Continuous Emission Monitors

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Note: The actual data sheets used may vary in format from those in Appendices B, C, D, and E but will have all the essential information required in these examples.

LIST OF ACRONYMS AND ABBREVIATIONS

AAO	Air Approval Order
acfm	actual cubic feet per minute
APC	air pollution control
CAA	Clean Air Act
CBO	Control Board Operator
CD	calibration drift
CE	calibration error
CEMS	continuous emission monitoring system
CEM	continuous emission monitor
DAQ	Utah Division of Air Quality
dscf	dry standard cubic feet
EA	Aragonite Environmental Affairs
EER	Excess Emissions Report
FRP	fiberglass reinforced plastic
ID	induced draft
MACS	Maihak automatic calibration system
mA	milli ampere
NIST	National Institute of Standards and Technology
NOx	oxides of nitrogen
PCBs	polychlorinated biphenyls
P&ID	process and instrumentation drawing
ppm	parts per million
PST	performance specification test
QAP	quality assurance plan
RA	relative accuracy
RAA	relative accuracy audit
RATA	relative accuracy test audit
RCRA	Resource Conservation and Recovery Act
scfm	standard cubic feet per minute
TSCA	Toxic Substances Control Act
UAC	Utah Air Conservation Rules
UDSHW	Utah Division of Solid and Hazardous Waste

1. PROJECT DESCRIPTION

Clean Harbors Aragonite, LLC operates a hazardous and industrial waste incineration facility located at Aragonite, in Tooele County, Utah. The purpose of this document is to outline the procedures used by Aragonite to comply with RCRA and TSCA requirements specifically for the Carbon Monoxide and Oxygen Continuous Emission Monitors as required under 40 CFR 266. This document is only part of the overall Quality Assurance Plan, required by Utah Division of Air Quality for the entire Continuous Emission Monitoring System (CEMS) at Aragonite. The entire CEMS also includes CO_2 and NO_x monitors and an annubar to measure stack gas flow.

This Quality Assurance Plan (QAP) has been developed as Attachment 15 of the State Permit UTD981552177. This plan describes the quality assurance and quality control procedures, including instrument calibration, which will be used to insure that the CEMS data are valid.

The CEMS at Aragonite consist of two complete (redundant) CEM systems. When one of the CEMS is being calibrated, the other CEMS is on-line to insure that the waste feed cutoffs for CO and O_2 are being maintained.

1.1 Location Description

The CEMS analyzers are located in the stack room situated near the base of the stack. Stack gas samples are transported to the instruments via heated, Teflon sampling lines.

2. RESPONSIBILITIES

2.1 Normal Operation and Maintenance

One of the two CEMS will be on-line continuously when the plant is processing waste. Data collection from the CEMS is managed by the plant control system. Daily calibration is initiated by instrumentation technicians or other qualified personnel, in cooperation with the control board operator.

In conjunction with the daily calibration checks, a general inspection of the CEMS is performed. Preventive maintenance is conducted in accordance with Section 9 of this plan. Daily inspections of CEMS are conducted by the Maintenance Department.

2.2 Audits and Data Evaluation

The calibration drift and other calculations are performed by the instrumentation technicians on a daily basis. The Instrumentation Supervisor or other qualified designee shall review the results of the daily calibration and inspection forms. The calibration forms are maintained in the maintenance department or the document vault on site for permanent storage.

2.3 Quarterly and Annual Audits

Aragonite insures that the required quarterly and annual audits are conducted. The actual audit is performed by trained Aragonite personnel or qualified contractors.

2.4 Training

Each department manager is responsible for training employees in their specific job responsibilities. Records of employee training are maintained in the Training Department. Training on this QAP will be given to all instrument technicians and involved supervisors. Refresher training will be given whenever changes are made to the QAP.

3. INSTRUMENT FUNCTION

3.1 Incineration System Description

The incinerator facility consists of a horizontal slagging rotary kiln with a vertical afterburner chamber, a gas conditioning and air pollution control train composed of a spray dryer, baghouse, saturator, wet scrubber, induced draft fan, and a stack.

Waste bulk solids are fed into a feed hopper at the kiln front wall and then enter the kiln through the solids feed chute. Containerized wastes are fed to the kiln through the container feed elevator and feed chamber inlet gate. Waste liquids, sludges, and fuels are fed to the kiln through burners or lances at the kiln front wall.

The afterburner chamber has two burners to maintain the minimum required temperatures and provides sufficient volume to hold waste gases for the required residence time.

Gases exit the afterburner chamber into the hot duct. A relief vent is located at the highest elevation of this duct which activates to vent the system under certain plant upset conditions. Under vented conditions there is a net inflow through all unsealed openings. The system is maintained under negative pressure.

3.2 Air Pollution Control System

The Air Pollution Control System (APCS) quenches the exhaust gases to lower temperatures, removes particulate material, and scrubs acid gases from the gas stream.

3.2.1 Spray Dryer

Combustion gases from the afterburner chamber enter the spray dryer. A neutralized scrubbing solution from the downstream scrubbers and make-up water are sprayed into the hot gases, cooling them and evaporating all of the incoming water so that dissolved solids are left as dry crystalline solids.

3.2.2 Baghouse

The gas then flows to the baghouse, where solids are filtered out. As solids build up on the fabric surfaces, the pressure drop across the baghouse increases. The bags are periodically pulsed with compressed air on the discharge side to remove solids, which then fall into the baghouse hoppers.

3.2.3 Saturator and Wet Scrubber

Gas from the baghouse at about 350-520°F travels to the saturator, where a water solution is sprayed into the hot gas to reduce its temperature to less than 225°F and generating a saturated gas stream. An excess of water is used, and the excess is drained to the wet scrubber neutralization tank and recirculated. The saturated gas flows into the wet scrubber which is a two-staged packed bed design.

The majority of the HCl and $C1_2$ is removed in the saturator and the first stage of the scrubber, and the majority of the SO_2 is removed in the second stage of the wet scrubber, although a portion of each gas is removed in both scrubbers.

The temperature of the gas stream is further reduced to about 140 to 150°F in the scrubber which causes the majority of the water in the gas stream to condense and results in a much smaller volume of gas.

3.2.4 Induced Draft Fan and Stack

The induced draft (ID) fan creates the draft (partial vacuum) in the incineration train which causes the gases to flow through the system.

The gases are discharged to the atmosphere via a 150 foot high fiberglass reinforced plastic (FRP) stack. The stack is five feet in diameter. Stack instruments include an annubar to measure gas velocity, CO and CO_2 instruments to measure combustion efficiency, O_2 analyzers, and NOx analyzers. This QAP only addresses CO and O_2 monitors.

3.3 Stack Gas Continuous Emission Monitoring System (CEMS)

The facility has two independent CEM systems. Each consists of the same types of gas monitors. The #1 CEM system has a separate low and high range CO monitor. The #2 CEM system has a single dual range CO monitor.

The Continuous Emissions Monitoring System (CEMS) is an extractive system used to measure the stack gas components of carbon monoxide (CO) and oxygen (O_2). The equipment for this system includes a sampling probe with a heated sample line to extract the stack gas, a primary and standby sample conditioning system that cools and dries the gas, and the analyzers which display the value of each measured gas. Diagrams of the systems are shown in drawings D-800-PI-215 and D-800-PI-216 in Attachment 10.

In the #1 CEM cabinet, located on the east wall of the CEM room there are two CO instruments, one working in the low-range (0-200 ppm) and the other working in the high range (0-2000 ppm). Switching between ranges is performed by the plant control system. The programming automatically toggles between the low and high range values when the top of the low range is reached.

In the #2 CEM cabinet, located on the west wall of the CEM room, the CO range switching is accomplished internally by the dual range monitoring circuitry. This instrument automatically and instantaneously switches to the high range whenever the low range reading reaches 200 ppm. When the analyzer switches ranges, a contact from the analyzer provides an indication to the plant control system that the range has changed.

3.3.1 Sampling Probes and Gas Conditioning

The purpose of these systems is to continuously deliver a representative sample of exhaust gas to the individual gas monitors. The sample gas must be essentially free of moisture and particulates and be at a relatively low temperature (near ambient).

The sample probes for each CEM system have in-line filters. Probes in the stack are located as specified in drawing D-034-PI-212 in Attachment 10. A protective tube is included to prevent cooling of the probe below the dew point of the sample gas.

These probes are used to draw sample gas from the stack. The vacuum to extract the samples is created by vacuum pumps located in the CEMS cabinets. The gas is routed from the stack to the CEM cabinet via a heated sample line.

The sample line consists of sample and calibration tubes and a heating element in an insulated jacket. One tube is used for sample collection. This tube originates at the stack probe and travels to the CEM cabinet. For calibration purposes, a second tube carries certified calibration gasses to the stack probe. A check valve is incorporated to prevent the gas stream from entering the test gas line. The temperature of the sample line is regulated by a temperature controller.

3.3.2 Gas Conditioning System

Upon entering each sample cabinet, the sample gas passes through a pre-cooler which reduces the sample temperature to near ambient. This cooling condenses water vapor and the liquid is separated in a condensate separator and pumped to a drain. The drain pump is controlled by level switches in the condensate separator which provides a contact closure to the local control panel. When the level in the separator rises to the "high" level, the condensate pump starts and runs until the level decreases to the "low" level. The "high-high" level switch provides an alarm and also stops the sample pump.

The gas sample exits the condensate separator and enters the first path of the refrigerant sample dryer. The dew point of the gas sample is lowered substantially and more water vapor condenses and is removed via a condensate separator.

The gas sample exits the first sample dryer and enters the suction side of the sample pump. The pump elevates the pressure to push the gas sample through the second path of the refrigerant sample dryer which lowers the dew point of the sample to between 32 and 38°F. Vapor is condensed and separated with a condensate separator/pump arrangement.

The gas sample exits the sample dryer and passes through a condensate detector and a sample flow meter. The condensate detector is incorporated to sense any moisture in the sample. If this condition should occur, an alarm light is energized, the sample pump is stopped and the sample gas solenoid valves are closed to prevent any moisture from being sent to the analyzers. The sample flow meter provides a signal to the plant control system to stop all waste feed when the CEM sample flow drops below the set point.

The sample gas is distributed to the analyzers through solenoid valves. After the sample gas passes through the analyzers it is vented to atmosphere.

A remote test gas control panel is attached to each CEM cabinet, and is designed to supply calibration gas to all analyzers in both cabinets. A three position switch is used to switch the high and low range CO span gas to the probe. Since the remote test gas is routed back through the sample line, any gas that is selected is sent to all of the analyzers.

Currently, all calibrations are conducted manually. Provisions have been made for the use of an automatic calibration system, in the event that such a modification is approved and the necessary equipment is purchased. In that case, solenoids are installed which allow both zero and span gas for each instrument to be sent to the sample probe. These solenoids are connected to the same line used with the manual calibration solenoids. These solenoids allow for sequencing the calibration gasses used for all the instruments without interference.

3.3.3 Gas Monitor Units

Servomex 4900 The Servomex 4900 is used for monitoring O_2 in the stack gases. The gas measurement principle uses the paramagnetic properties of oxygen for measurement. Information for the two oxygen analyzers in use at Aragonite is given below:

Parameter	Manufacturer	Model No.	Measurement Range
Oxygen #1	Servomex	4900	0 - 25 %
Oxygen #2	Servomex	4900	0 - 25 %

Maihak UNOR 6N The Maihak UNOR 6N is used at Aragonite for monitoring CO emissions. The principle of measurement of these monitors is nondispersive infrared photometry. Information for the CO analyzers used at Aragonite is given below:

Parameter	Manufacturer	Model No.	Measurement Range
CO lo #1	Westinghouse Maihak	UNOR 6N	0 - 200 ppm
CO hi #1	Westinghouse Maihak	UNOR 6N	0 - 2000 ppm
CO dual #2	Maihak	UNOR 6N	0-200 / 0-2000 ppm

The serial numbers for the analyzers currently in service will be tracked in a separate document. This document will be transmitted to the appropriate agencies when the serial number changes.

3.3.4 Plant Control System

Data from the #1 and #2 CEM systems are retrieved through the plant control system. A computer interface is provided as part of the control system, and a software package archives the CEMS data.

The plant control system allows for operator interface, alarming, and automatic control. The alarms are set up to provide an indication to the operator of the current status of the on-line (selected) CEMS. Calculated values for diluents and automatic waste feed cutoffs are based on the data from the selected CEMS. The value calculated in the plant control system represents CO corrected to 7% oxygen.

3.3.5 Data Archiving System

The data archiving system also performs other calculations. A CO one hour rolling average is calculated and transmitted to the plant control system to provide for an automatic waste feed cutoff at high levels. The CO emissions incorporate the stack flow and stack temperature in an hourly accumulation.

Data is archived using a data compression algorithm to efficiently utilize storage space.

3.4 Plant Emission Limitations and Standards

The limitations on stack CO emissions at the Aragonite facility are specified in Condition 5.B.4. of this permit.

4. DATA QUALITY OBJECTIVES

The purpose of the CEMS is to continuously analyze the levels of CO and O_2 in the stack gas to confirm continuous compliance with the permitted emission limits. The minimum data quality objectives for the CEMS are the performance specifications of the State Permit and 40 CFR 266, Appendix IX, as incorporated in the State Permit.

To achieve these objectives, quality assurance and quality control procedures are used. Quality control consists of all the procedures and activities implemented to control or improve the quality of the data derived from the CEMS. These activities include calibration drift adjustments and audits to determine instrument accuracy and linearity. Quality assurance consists of the review and evaluation of the data and procedures to ensure that the quality control program is working effectively and that the quality objectives are being met.

4.1 Summary of Data Quality Criteria

The sections below enumerate the specific performance specification criteria found in the relevant permits and regulations. The detailed performance specification requirements are found in 40 CFR 266, Appendix IX.

4.1.1 Instrument Zero and Span

The CEMS data measurement range must include zero and a high level or span value. The high level values are selected depending on the magnitude of the emissions of each constituent. The ranges of the constituents monitored by the CEMS were given in Section 3.3.3. The CEMS must allow a determination of calibration drift at the zero and high level values.

4.1.2 Calibration Drift

As defined in the regulations, calibration drift is the difference between the CEMS readings and the established reference value (certified calibration gas) after a stated period of operation during which no unscheduled maintenance, repair, or adjustment took place. The concentration ranges of the calibration gasses must be between 0 - 20 percent of span for the zero point and between 50 - 90 percent of span for the high level point. Appendix A presents the acceptable concentration ranges for the calibration gases used for the CEMS.

The calibration drift (CD) calculation is used to verify that the CEMS meets the CD quality criteria for determining the emission rates of CO and O_2. The CD must be calculated each day.

4.1.3 Relative Accuracy

Relative accuracy (RA) is a comparison of the emission rate determined by the total CEMS to the same value determined by a Reference Method. The purpose of the RA test is to verify the ability of the total CEMS to provide accurate and representative data. RA audits are conducted at system startup and thereafter during the annual performance specification test period.

4.1.4 Response Time

Response time is the time interval between the start of a step change in the system input (changing concentration of calibration gas) and the time when the instrument displays 95 percent of the final value. Response time testing will be conducted annually during the performance specification test period. The performance specifications for CO and O_2 CEMS are given in 40 CFR 266, Appendix IX, and also appear in Table 5.1

4.1.5 Calibration Error

Calibration Error (CE) is the difference between the concentration indicated by the CEMS and that of the audit gas (EPA protocol audit gas). The purpose of this test is to verify the accuracy and linearity of the individual CO and O_2 monitors over the entire measurement range. The CE audit is conducted on a quarterly basis. This test differs from the daily calibrations in that different audit gases are used (EPA protocol vs. certified NIST) and the testing is done at three data points, rather than two. The performance specifications for CO and O_2 calibration error testing are given in 40 CFR 266, Appendix IX, and Table 5.1.

4.1.6 Measurement and Recording Frequency

The sample to be analyzed must pass through the measurement section of each monitor without interruption. The measurement and recording frequency required for CO and O_2 is addressed in Attachment 16 of the State permit.

4.1.7 Hourly Rolling Average Calculation

The CO rolling average is calculated using the 60 most recent one-minute averages. The one-minute averages are calculated using a sample taken at least once every 15 seconds. This calculated one hour rolling average is evaluated against the automatic waste feed cutoff setpoint.

4.2 Specific Data Quality Objectives for Aragonite CEMS

Specific data quality objectives for the Aragonite CEMS are listed in Table 4.1. These objectives are derived from the applicable regulations and permits. Aragonite performs daily, quarterly, and annual checks to ensure that the data quality objectives are met.

TABLE 4.1

CEMS DATA QUALITY OBJECTIVES

CRITERIA	CO	O_2
Instrument Zero and Span	1.25 to 2X the average potential emission concentration 0 - 200 ppm (low range) 0 - 2000 ppm (high range)	1.25 to 2X the average potential emission concentration 0 - 25% by volume
Calibration Drift (CD)	< 3% of span value for 7 days consecutively < 6 ppm (low range) < 60 ppm (high range)	< 0.5 % from reference value < 0.5 % O_2
Relative Accuracy (RA)	≤ 10% mean of RM tests or ≤ 10 ppm of the RM results, whichever is less restrictive.	incorporated into CO RA by requirement for CO corrected to 7% O_2
Response Time	< 2 min.	< 2 min
Calibration Error	≤ 5 percent of span ≤ 10 ppm (low range) ≤ 100 ppm (high range)	< 0.5 percent
Measuring and Recording Frequency	see Attachment 16	see Attachment 16

5. PERFORMANCE SPECIFICATION TESTING

Performance specification testing (PST) refers to the annual quality audits performed on the CEMS. This testing is required by the hazardous waste regulations, and it provides a baseline of reference data for system audits.

5.1 General Information

The purpose of the performance specification testing is to assure that the CEMS has been designed, installed, maintained, and operated properly and meets the data quality objectives. The specific data quality requirements and test procedures are given in 40 CFR 266, Appendix IX, section 2.1.6. Performance specification testing involves comparing data collected from approximately the same location in the stack using alternate Reference Methods.

Performance specification testing was performed when the CEMS were originally installed, and will be repeated at least annually. Aragonite conducts the performance specification tests using qualified in-house personnel, experienced outside contractors, or both.

5.2 Components of the Performance Specification Test

The performance specification testing includes the following required steps: pretest preparation, calibration drift test, response time test, calibration error test, relative accuracy test, calculations, and reporting. These steps are outlined below.

5.2.1 Pretest Preparation

To prepare for the PST each CEMS is inspected to verify the operational status of the entire CEMS. Because of daily inspections and maintenance checks throughout the year, it is not expected that significant maintenance or repairs will be required. Also included is preparation for contracted RATA testing. This includes setting up equipment, ensuring needed power connections are available, notification of regulators, and having needed supplies on hand.

5.2.2 Calibration Drift Test (7-day drift test)

During the calibration drift test, the facility is operating at normal conditions. During the seven-day drift test, the calibration drift is determined once each day at approximately 24-hour intervals for seven consecutive days. All of the seven-day high and low CD values must be within the allowable CD limits for CO and O_2 as specified by 40 CFR 266, Appendix IX.

The determination of CD is to verify the stability of the monitors over time and to verify that the CEMS conform with the established calibration used for calculating emission rates. The test procedures used are identical to those performed during daily calibrations. The CD test is conducted using both zero level and high level calibration gases. The calibration gases (reference gases) are introduced to the CEMS, and the CEMS response data are recorded. The CD is calculated by determining the difference between the CEMS response and the value of the reference gas. All data are recorded on the calibration drift data sheets. A separate form has been developed for the seven-day calibration drift test (Appendix E). In section 5.3 below, further details of the CD performance specification testing is provided.

5.2.3 Response Time Test

A determination of the response time is also conducted during the Performance Specification Test period.

General Information: This test procedure is required annually for the CO and O_2 monitors. The testing must be completed within two weeks of the annual relative accuracy test audit (RATA). This test is done on the CEMS while they are not on-line. The test gases must pass through the entire CEM system (tubing, gas conditioning, etc.). The test involves measuring the time required for the instruments to respond to a change in concentration. For each monitor, the response time for going from zero concentration to the stack effluent concentration, and from the high or span concentration back down to the stack concentration is measured.

Equipment/Materials Required:

1. Zero and Span gas for CO and O_2 instruments. The O_2 span gas must be higher than the stack effluent concentration.

2. Stopwatch or other timing device.

3. Response Time Determination Form (see Appendix D).

Procedure:

1. All measurements are done while CEM is off-line to minimize fluctuations in the stack concentrations of CO and O_2.

2. Upscale Measurements-- For each instrument, first switch milliamp (mA) meter to observe the output reading while measuring the stack gas.

- Allow the instrument to stabilize.
- The 95% of final stable output reading is determined by:
  95% of stable value (upscale) = [stack output mA - 4.0] x .95 + 4.0
  95% of stable value (downscale) = [stack output mA - 4.0] x 1.05 + 4.0

(Aragonite CEMS zero scale output current equals 4 mA, 20 mA equals full scale)

Next introduce zero gas or nitrogen, and wait till the instrument has stabilized at the zero reading (no change greater than 1% of full scale (" .16 mA) for 30 seconds).

- Switch the instrument over to sample and measure from the stack.
- Using a stopwatch, measure the time required for the instrument to reach 95% of the final stable value, as determined above.

- Repeat this three times for each instrument, and enter the data on the form.

3. Downscale Measurements- For each instrument, switch over to read stack gas concentrations and determine the mA reading for 95% of the final stable output using the same procedure as for the upscale measurements. Next, introduce high level (span) concentration of gas, and wait until the instruments have stabilized. Switch the instruments over to sample and measure from the stack. Using a stopwatch, measure the time required for the instrument to reach 95% of the final stable value. Repeat three times for each instrument, and enter the data on the form. For the O_2 monitor, air may be used for the high level if the calibration gas concentration is lower than the stack O_2 concentration.

4. For the CO instrument in the upscale measurement, the instrument is going to be changing from zero gas, to essentially zero concentration in the stack. Therefore, the response time is zero. For the CO downscale measurement, measure the time required to reach 5 ppm, rather than

zero. For the CO instruments, 4.4 mA is the output for 5 ppm for the 0-200 ppm range, and 4.04 mA is the output for 5 ppm for the 0-2000 range.

5. Calculate the average response times for both the upscale and downscale measurements. The longer of the two averages is the system response time.

5.2.4 Calibration Error Test

The calibration error test procedure is conducted as per 40 CFR 266, Appendix IX, section 2.1.6.3. This test is conducted during the calibration drift test period.

Challenge the CO low, CO high, and O_2 monitors with zero gas and EPA protocol gas at the following concentrations:

Measurement Point	CO lo (ppm)	CO hi (ppm)	O_2 (percent)
1	0 - 40	0 - 600	0 - 2
2	60 - 80	900 - 1200	8 - 10
3	140 - 160	1800 - 2000*	14 - 16

* (the regulations require 2100 - 2400 ppm for the third point of a CO monitor with a span of 3000 ppm; these values were chosen by Aragonite for use with a 0 - 2000 ppm instrument range)

Challenge the CEMS at three non-consecutive times at each measurement point as defined above, and record the responses on a Calibration Error Data sheet (see Appendix C). The duration of each gas injection would be sufficient to ensure that the CEMS detectors have fully responded.

Average the differences between the instrument response and the certified value for each gas. Calculate three CE values for the three ranges for each instrument using the Calibration Error equation:

$$CE = \frac{|d|}{FS} * 100$$

where: d = mean difference between the CEMS response and the known reference value
FS = the full scale range of the monitor.

5.2.5 Relative Accuracy Test

This test is performed as detailed in 40 CFR 266, Appendix IX, section 2.1.6.4. During the test, the incinerator is operating at least 50 percent of normal load (BTU limit). Relative accuracy is a measure of the difference between the emission rate as determined by the CEMS and that determined using reference methods. The reference method values are determined by sampling from a different port on the stack. Each reference method value is compared against the CEMS value corresponding to the same time under similar conditions (i.e., corrected from dry standard to wet actual conditions).

5.2.6 Calculations and Equations

The calculations for CD involve converting milli amp (mA) output readings to concentration and simple arithmetic subtraction. These calculations are specified on the CD drift data sheets (Appendix B).

The calculations for CE were given above in section 5.2.4. For RA, the equations are more complex and are provided in section 8.2.

5.2.7 Reporting

The results of the PST are incorporated into a report upon completion of the tests. This report includes test dates, a description of the procedures used, and a summary of the test results. Appendices to the report include data sheets, calculations, data records, and cylinder gas concentration certifications. The report is provided to State and Federal regulatory agencies 30 days following the completion of the last segment of the PST.

5.3 Performance Specification Testing Details

The CO and O_2 CEMS performance specification testing is repeated annually. The annual performance test is conducted simultaneously with the annual Relative Accuracy Test Audit.

Table 5.1 outlines the PST, Reference Method test, and performance specifications for each constituent monitored by the CEMS at Aragonite. The procedures detailed in 40 CFR 266, Appendix IX are incorporated.

TABLE 5.1

PERFORMANCE SPECIFICATION TESTS FOR CEMS AT ARAGONITE

	O_2	CO, low	CO, high
40 CFR 266, Appendix IX Procedures	2.1	2.1	2.1
Calibration Drift (CD) Specification	≤ 0.5% (vol) from reference value	≤ 5% of span (6 ppm)	≤ 5% of span (60 ppm)
CD Passing Tests	7 consecutive days	7 consecutive days	7 consecutive days
Relative Accuracy (RA) Specification	Incorporated into CO RA calculation	≤ 10% of mean value of RM test data in units of emission standards, or within 10 ppm of the RM data	≤ 10% of mean value of RM test data in units of emission standards, or within 10 ppm of the RM data
RA Passing Tests	Incorporated into CO RA calculation	≥ 9 passing tests, with ≤ 3 failing tests	≥ 9 passing tests, with ≤ 3 failing tests
Calibration Error (CE) Specification	< 0.5% (vol) O_2	< 10 ppm	< 100 ppm
Response Time Specification	< 2 minutes	< 2 minutes	< 2 minutes

6. CALIBRATION PROCEDURES AND FREQUENCY

Calibration checks are conducted once each 24 hours on the CO and O_2 monitors. As long as one CEMS is on line and properly calibrated, the plant remains on waste during CEM calibrations. After the CEMS is calibrated, the control board operator switches to the off line CEMS to complete the calibration process while the plant continues to process waste.

The calibration drift check data is compared to the calibration drift limits to determine the acceptability of the CEMS calibration results. Calibrations and drift checks may also be performed in conjunction with other test procedures outlined in this QAP or whenever the CEMS response needs to be verified. The CEMS may also need to be recalibrated after any necessary maintenance procedure (see section 9.3) which could affect the operating condition, or anytime that results indicate the CEMS data may be questionable.

6.1 Calibration Procedures

A basic overview of the calibration procedures is given below.

6.1.1 General Calibration Sequence

The monitors are checked for each constituent against two standard gases of known concentrations, a zero value and a span value. From these checks, the calibration drift (CD) assessments are made. For the CO dual range instrument (#2 CEMS) there will be a different span concentration for each range.

6.1.2 Automatic Calibration

Currently, all calibrations and drift checks are made manually. Aragonite is investigating equipment and software for a possible future automatic calibration system. Provisions have been made for the use of an automatic calibration system. Solenoids are installed which allow both zero and span gas for each instrument to be sent to the sample probe. These solenoids are connected to the same line used with the manual calibration solenoids. These solenoids allow for sequencing the calibration gases used for all the instruments without interference.

6.1.3 Manual Calibration

Prior to the daily calibration checks, the instrument technicians will request that the CBO switch to the other CEMS (if the CEMS are fully operational and properly calibrated) or go off waste if the alternate CEMS is not available.

During manual calibration, the instrument technician directs the flow of calibration gas into the sampling ports in the stack. When this happens, the CEMS are receiving calibration gas rather than stack gas.

Each CEMS response is converted into a concentration value which is compared to the reference calibration gas values. If the calibration drift exceeds the operating limits that appear on the calibration forms (Appendix B), a calibration adjustment is performed.

6.2 Instrument Calibration Frequencies

The O_2 and CO monitors undergo daily calibration drift checks and are checked when questionable data is being transmitted to the plant control system. They are adjusted and recalibrated whenever the drift limits are exceeded.

7. SYSTEM AND COMPONENT AUDITS

To ensure data quality, regular auditing of the CEMS calibration data and inspections is conducted. Aragonite conducts daily, quarterly, and annual audits of the CEMS as required by pertinent regulations. These audit procedures are described in the sections that follow.

7.1 Daily CEMS Audits

The CD data for the CO and O_2 CEMS are audited on a daily basis, as required by 40 CFR 266, Appendix IX, section 2.1.10. The quality of the CEMS data undergoes a review to check for completeness, accuracy, and whether or not necessary actions were taken.

The calibration drift data sheet is given in Appendix B. The calibration drift data sheet contains instructions as to what actions are to be taken in response to the calibration drift checks. (Note: the calibration forms pertain also to other CEM analyzers regulated under 40 CFR 60, Air Quality regulations).

7.1.1 Daily Inspection Records

The daily audit includes a review of the records of daily inspections of the CEMS. These inspections include the sample transport and interface system (sample cooling system, moisture traps, pre-cooler fan, cooling system temperature). The daily audit forms include a checklist to confirm that all required inspections have been completed and space to identify any necessary or recommended action that results from the inspections.

The plant control system generates alarm signals resulting from out of range monitor readings and low sample flow rate. Sample cooling system temperature, sample moisture levels, and moisture trap liquid levels alarm in the local control panel. Any of these alarm signals will automatically shut down the sample vacuum pump and an automatic waste feed cutoff (WFCO) will result.

The data recording function is handled by the plant control system and data archiving systems. Bad data from the CEMS will result in an automatic waste feed cutoff (WFCO). Also, the data is viewed by the control board operator (CBO).

7.2 Quarterly CEMS Audits

40 CFR 266, Appendix IX requires that a calibration error (CE) test be performed at least once each quarter. These regulations also allow a substitution of the Relative Accuracy (RA) test for the CE upon the approval of the Director on a case-by-case basis.

Each quarter, Aragonite performs a CE test for the CO and O_2 monitors of each CEMS. The CE test procedure checks the accuracy and linearity of these instruments. The pass/fail criteria for the CE test is given in Table 5.1.

7.3 Annual CEMS Audits

The annual CEMS audit consists of the required Performance Specification Testing for CO and O_2. The annual PST consists of the Calibration Drift, RATA, Response Time test, and quarterly Calibration Error test, as discussed in section 5.

Utah Air Quality regulations require 45 days advance notice to schedule a RATA test.

8. DATA RECORDING, CALCULATIONS, AND REPORTING

8.1 Records

As explained in section 3, the data from both CEMS is retrieved from the plant control system by the data archiving system. The data is archived electronically. Raw data from each individual CEM as well as calculated values determined from the selected CEMS are archived.

Calibration Data sheets and Cylinder Gas certificates of analysis are kept on site for a minimum of three years.

8.2 Calculations

The data archiving system's software performs the necessary calculations to convert the CEMS data into emission rates and CO waste feed cutoffs. All of the calculations are in compliance with the requirements of 40 CFR 266. The equations used for determining calibration drift and RA are provided in Table 8.1.

8.3 Reporting

The results of the quarterly calibration error (CE) audits are provided as required. The reports are kept on file at the Aragonite facility and are submitted to TSCA 30 days following completion of the audit.

The results of the annual performance specification testing (PST), which will include RATA, Response Time, Calibration Error, and Calibration Drift test are also provided.

Table 8.1

EQUATIONS

Equation 1: Emission rate (M)

Emission rate (M) = *Concentration (ppm)* (measured) x *Stack Flow (ACFM)* (measured) x $\frac{\text{Dry SCFM}}{\text{Wet ACFM}}$ x *Dimensional Constant*

Equation 2: Relative Accuracy (RA)

$$RA = \frac{|\overline{d}| + |CC|}{\overline{RM}}$$

$$|\overline{d}| = \text{absolute value of the mean of differences}$$

$$|CC| = \text{absolute value of confidence coefficient}$$

$$\overline{RM} = \text{average RM value or applicable standard}$$

Equation 3: Mean of differences ($\overline{d}$)

$$\overline{d} = \frac{1}{n} \sum_{i=1}^{n} d_i$$

Equation 4: Confidence Coefficient (CC)

$$CC = t_{0.975} \frac{S_d}{\sqrt{n}} \quad (Eq. 2-3)$$

Equation 5: Standard Deviation (S_d)

$$S_d = \left[\frac{\sum_{i=1}^{n} d_i^2 - \frac{\left(\sum_{i=1}^{n} d_i \right)^2}{n}}{n-1} \right]^{1/2}$$

9. PREVENTIVE MAINTENANCE

9.1 Daily Preventive Maintenance

The CEMS at Aragonite are calibrated manually each day. During the daily calibration and inspections, upkeep of the analyzer systems and associated equipment is accomplished. If the required maintenance is more involved or not immediately required, the work is scheduled for a later time. Because of the presence of two independent CEMS, much of the maintenance work can be completed while the plant is processing waste.

9.2 Semi-annual Preventive Maintenance

These maintenance checks are performed in accordance with Aragonite procedures. They include the following:

- clean condensate traps and ensure proper operation of floats
- clean or replace stack sample probe filter
- replace damaged heater components
- replace analyzer filters if necessary
- replace deteriorating tubing or other components
- replace internal vacuum pump if necessary

9.3 Preventive Maintenance and Analyzer Recalibration

For the minor maintenance procedures listed below, the affected analyzers undergo a calibration drift check (and calibration adjustment if required) following the completion of the maintenance work.

- cleaning, or replacing filter elements
- tubing replacement
- trap or float cleaning or replacement
- minor adjustments (zero and span potentiometers on front panels of all analyzers and the sample flow adjustment on the oxygen analyzer)

For the following major maintenance procedures, the affected monitors must pass all of the annual performance specification test (PST) procedures, with the exception of the RATA, before being returned to service:

- replacement of monitor amplifier components
- replacement of detectors
- factory performed repairs or overhaul
- replacement of analyzers with identical units or ones operating on an identical measurement principle.

These guidelines for monitor recalibration and recertification are summarized in Table 9.1.

The PST procedures specified above ensure that the affected instruments have passed all of the requirements for accuracy, response time, linearity, and stability over time. Since all of the other components of the CEM system (sample collection and transport, sample conditioning, data collection, calculations, and archiving) are unaffected, there is no need to perform a RATA, during which the entire CEM system is tested by generating an emission rate.

Any further modifications to the CEMS require a QAP modification, followed by a complete CEM system certification.

9.4 Spare Parts Inventory

The Aragonite facility has two separate redundant CEM systems. Because of the availability of a redundant CEM system, major components such as spare analyzers, are not normally maintained in stock. Smaller common parts are kept on hand for maintaining the subsystems of the CEMS.

TABLE 9.1

MONITOR MAINTENANCE AND RECALIBRATION GUIDELINES

Maintenance Operation	**Recalibration or Recertification Requirements**
Minor Maintenance: •cleaning / replacing filter elements •tubing replacement •moisture trap or float cleaning / replacement •minor adjustments	Perform Zero and Span calibration checks. If necessary recalibrate in accordance with Appendix C.
Major Maintenance Operations: •replacement of circuit boards, amplifiers, or other components used in signal processing. •replacement of detectors or measurement cells •repairs performed by the factory •replacement of an analyzer with either an identical unit or one having the same operating principle.	Perform all of the performance specification test procedures outlined in section 5 of this plan *except* for the relative accuracy test audit (RATA).
Modification of Critical Components: •replacement of analyzers with units employing a different measurement principal. •replacement of sample probes with different type.	Perform complete set of performance test procedures, in accordance with section 5.

10. CORRECTIVE ACTION

The calibration checks, audits, and inspections outlined in this plan are designed to evaluate whether each CEMS is operating within the allowable limits as defined in the relevant regulations and permits.

10.1 System Audits

Generated data, calibration checks, or inspections may occasionally show that the CEMS are not operating within the allowable limits. Any CEMS equipment or components that are found to be operating improperly shall be adjusted, repaired, or replaced. The equipment is not to be used unless calibrations are successfully performed.

If the CEMS data are determined to be invalid, operation is switched to the backup CEMS. If the backup CEMS is also not working properly, waste feed to the incinerator ceases.

If problems become apparent during the system or performance audits, corrective action is implemented.

10.2 Inspection and Preventive Maintenance

Problems identified during inspections and preventive activities are subject to corrective actions. This may involve equipment adjustments, cleaning, equipment repair, or equipment replacement.

APPENDIX A

CEMS CYLINDER GAS RANGES

CYLINDER GAS RANGES FOR ARAGONITE CEMS

	CO low	CO high	O_2
Daily Calibration, Zero	Nitrogen, Industrial Grade or Plant Nitrogen (liq.) 99.99% min. purity	Nitrogen, Industrial Grade or Plant Nitrogen (liq.) 99.99% min. purity	Nitrogen, Industrial Grade or Plant Nitrogen (liq.) 99.99% min. purity
Daily Calibration, Span	100 - 180 ppm CO in N_2 certified traceable to NIST	1000-1800 ppm CO in N_2 certified traceable to NIST	12.5 - 22.5 % O_2 in N_2 certified traceable to NIST
Response Time Test	daily calibration gas	daily calibration gas	daily calibration gas
Calibration Drift Test	daily calibration gas	daily calibration gas	daily calibration gas
Calibration Error Test point 1	0 - 40 ppm CO in N_2 EPA Protocol Gas	0 - 600 ppm CO in N_2 EPA Protocol Gas	0 - 2 % O_2 in N_2 EPA Protocol Gas
Calibration Error Test point 2	60 - 80 ppm CO in N_2 EPA Protocol Gas	900 - 1200 ppm CO in N_2 EPA Protocol Gas	8 - 10 % O_2 in N_2 EPA Protocol Gas
Calibration Error Test point 3	140 - 160 ppm CO in N_2 EPA Protocol Gas	1800-2000 ppm CO in N_2 EPA Protocol Gas (1)	14 - 16 % O_2 in N_2 EPA Protocol Gas

Note (1): The Aragonite CO monitor has range of 0-2000 ppm. The regulations call for 2100-2400 ppm for a 0-3000 ppm CO monitor.

APPENDIX B

CALIBRATION DRIFT DATA SHEET

Clean Harbors Aragonite, LLC

CEM CALIBRATION DRIFT DATA SHEET

CEM# DATE: ____________

Signature: ______________________________

Start Time: __________

End Time: __________

Reviewed by:
Date:

	Calibration Gas Concentration	mA Reading (Zero)	% or ppm (Zero)	mA Reading (Span)	% or ppm (Span)	Instrument Drift (Zero)	Instrument Drift (Span)	mA Reading (Zero) after calibration	% or ppm (Zero) after calibration	mA Reading (Span) after calibration	% or ppm (Span) after calibration
CO2											
CO low											
CO high											
O2											
NOx											

Daily Operating Drift Limits
(Recalibrate when exceeded)

CO2	0.50%
CO low	6 ppm
CO high	60 ppm
O2	0.50%
NOx	50 ppm

5-day Out-of-Control Drift limits **
contact Instrumentation Supervisor

CO2	1.00%
CO low	20 ppm
CO high	200 ppm
O2	1.00%
NOx	50 ppm

** instrument is out of control when these limits are exceeded for 5 consecutive days

Daily Out-of-Control Drift Limits ***
see note 7.

CO2	2.00%
CO low	40 ppm
CO high	400 ppm
O2	2.00%
NOx	100 ppm

*** instrument is out of control when these limits are exceeded

Instrument scale ranges are:

CO2	0 - 20 %
CO low (A)	0 - 200 ppm
CO high (B)	0 - 2000 ppm
O2	0 - 25 %
NOx	0 - 1000 ppm

INSTRUCTIONS

1. enter cal gas concentrations on form
2. introduce zero gas and record mA reading, for each instrument
3. calculate instrument zero response as % (or ppm) = (mA - 4)/16 x instrument scale, and enter value, for each instrument
4. introduce span gas and record mA reading, for each instrument
5. calculate instrument span response as % (or ppm) = (mA - 4)/16 x instrument scale, and enter value, for each instrument
6. recalibrate if the Daily Operating Drift Limits are exceeded, and enter recalibrated zero and span values (mA and % or ppm) on form.
7. notify Maintenance Manager or his / her designee immediately if daily Out-of-Control Drift Limits are exceeded.

COMMENTS:

APPENDIX C

CALIBRATION ERROR TEST DATA SHEET

Continuous Emission Monitor
Calibration Error Test
Field Data Sheet

Date of Test:
Quarter:
Monitor Type:
Manufacturer:
Serial number:

Test technicians:

Span value:

Run number	Calibration Value	mA Value	Monitor Response	Difference zero/low	Difference mid	Difference high
1 - zero						
2 - mid						
3 - high						
4 - mid						
5 - zero						
6 - high						
7 - zero						
8 - mid						
9 - high						
			mean difference =			
			calibration error =	%	%	%

Cylinder ID no.

Certification Date:

Expiration Date:

Test times (start and Finish):

Comments:

APPENDIX D

RESPONSE TIME TEST DATA SHEET

CEM no. ____________

CONTINUOUS EMISSIONS MONITORING SYSTEM
RESPONSE TIME DETERMINATION

Clean Harbors
Aragonite, LLC

DATE: ____________

OPERATORS: ____________

Instrument Measurement Parameter	Manufacturer / Model no.	Serial no.		Stack Conc.	Stack Conc. (mA)	Target (mA) (see note)	Response Time 1 (seconds)	Response Time 2 (seconds)	Response Time 3 (seconds)	Average Response Time (seconds)
			ZERO TO STACK CONCENTRATION							
			HIGH TO STACK CONCENTRATION							
			ZERO TO STACK CONCENTRATION							
			HIGH TO STACK CONCENTRATION							
			ZERO TO STACK CONCENTRATION							
			HIGH TO STACK CONCENTRATION							
			ZERO TO STACK CONCENTRATION							
			HIGH TO STACK CONCENTRATION							
			ZERO TO STACK CONCENTRATION							
			HIGH TO STACK CONCENTRATION							
			ZERO TO STACK CONCENTRATION							
			HIGH TO STACK CONCENTRATION							
			ZERO TO STACK CONCENTRATION							
			HIGH TO STACK CONCENTRATION							
			ZERO TO STACK CONCENTRATION							
			HIGH TO STACK CONCENTRATION							
			ZERO TO STACK CONCENTRATION							
			HIGH TO STACK CONCENTRATION							

(The longer of the two averages is the system response time)

Target mA (upscale) = [stack mA - 4.0] x .95 + 4.0

Target mA (downscale) = [stack mA - 4.0] x 1.05 + 4.0

APPENDIX E

SEVEN-DAY CALIBRATION DRIFT TEST DATA SHEET

CEM 7-DAY CALIBRATION DRIFT DATA SHEET

CEM # ______________

Start Date: ____________________

	Date	CO2	CO (low)	CO (high)	O2	NOx	Signature
Day #1							
Day #2							
Day #3							
Day #4							
Day #5							
Day #6							
Day #7							

INSTRUCTIONS

1. enter the date of each day of the 7 day drift period
2. place a check mark in each daily square for each monitor that passes the 7-day drift limits listed on this form.
3. enter the word "fail" in the square for any monitor having a calibration drift greater than the limit listed on this form.
4. if a monitor exceeds the 7-day drift limit, recalibrate and start a new 7-day cal. drift form for the monitor(s) that fail.

7-Day Calibration Drift Limits	
CO2	0.50%
CO low	6 ppm
CO high	60 ppm
O2	0.50%
NOx	25 ppm

Monitor	Manufacturer	Serial No.
CO2		
CO low		
CO high		
O2		
NOx		