Operator Responsibilities
Standard Operating Procedure for Sulfur Dioxide Data Requirements Rule Monitoring Sites

Revision 2
Effective Date: May 1, 2018

Approval Sign-Off Sheet

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2.48.2.1 General Background Information and Initial Site Checks

On June 22, 2010, the EPA revised the primary sulfur dioxide (SO2) National Ambient Air Quality Standard (NAAQS) (75 FR 35520). The EPA promulgated a new 1-hour daily maximum primary SO2 standard at a level of 75 parts per billion (ppb), based on the 3-year average of the annual 99th percentile of 1-hour daily maximum concentrations.

On May 13, 2014, the EPA proposed the Data Requirements Rule (DRR) for the 1-Hour SO2 NAAQS (79 FR 27445). The final DRR was promulgated on Aug. 21, 2015 (80 FR 51051) and requires states to gather and submit to the EPA additional information characterizing SO2 air quality in areas with larger sources of SO2 emissions. In the DRR, air agencies have the choice to use either monitoring or modeling to characterize SO2 air quality in the vicinity of priority SO2 sources and submit the modeling and/or monitoring to the EPA on a schedule specified by the rule. If choosing to monitor the facility, monitoring activities must start by January 1, 2017.

This analysis was conducted to identify suitable 1-hour SO2 source oriented monitoring site locations for the 2017-2019 monitoring period to satisfy the DRR for five industrial facilities within the state of North Carolina. Two of these monitors will be operated by Duke Energy, and three of them will be operated by NC DAQ.

The goal of this document is to establish a continuous, verifiable and defensible set of procedures and a means to record events and activities with regard to the site and the instrument as required by the United States Environmental Protection Agency (US EPA), 40 CFR 50, 53, and 58, and to ensure that accurate, meaningful data is collected from the monitors in a consistent manner.

All original records must be legible, complete, accurate, dated, and signed or initialed by the operator and retained as part of the permanent analyzer operational record. This includes both the electronic logbook (e-log) and the site logbook. The operator's name and/or initials presented on the e-log will certify that the activities indicated have been performed in accordance with this Standard Operating Procedure (SOP); see Appendix C of this SOP for an example the e-log. All records will be reviewed and verified by the Regional Chemist or Monitoring Coordinator and audited by the responsible chemist at the North Carolina Division of Air Quality (NC DAQ) Central Office.

This document includes updates as given in "40 CFR Parts 53 and 58, Revisions to Ambient Air Monitoring Regulations; Final Rule" effective on August 23, 2010 and supplemented by information provided in the update to 40 CFR Part 58 Appendix A, published in March 2016, along with the guidance document "Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Ambient Air Quality Monitoring Program", EPA-454/B-17-001, January 2017.

2.48.2.1.1 Instrumentation and Equipment for Continuous SO2 Monitoring

- Thermo Environmental 43i/43i-TLE SO2 Analyzer - Designated Equivalent Method Number: EQSA-0486-060
  The Model 43i/43i-TLE meets EPA designation requirements when operated as follows:

Range	50 to 1000 ppb
Averaging Time	10 to 300 seconds
Temperature Range	20 to 30 °C
Line Voltage	90 to 110 Vac @50/60 Hertz
	105 to 125 Vac @50/60 Hertz
	210 to 250 Vac @50/60 Hertz
Pressure Compensation	ON or OFF
Temperature Compensation	ON or OFF
Flow Rate	0.5 to 1.0 LPM
	RS-232/RS-485 Interface

- Thermo 146i Dynamic Gas Calibrator
- Certified SO2 Protocol compressed gas cylinder
- Teledyne Air Generator Model 701
- Teledyne T700U Calibrator
- Dedicated site PC
- Modem and Moxa Serial Server

Note: Reference SOP 2.8.1 Section I: ECB Responsibilities Version 10 for instruction on using the Thermo Model 43i/43i-TLE SO2 Analyzers, Thermo Model 146i Dynamic Gas Calibrator, T700U Calibrator, and Teledyne Model 701 Zero Air Generator.

2.48.2.1.2 Common Continuous Monitoring Principles Applicable to the SO2 System

- Calibration: A calibration is required: 1) at the initial start-up of a new site; 2) when the monitor itself is replaced; 3) when the results of two valid consecutive daily auto-calibration check results fail to meet acceptance criteria; 4) when the operation is interrupted for more than 2 days without power (such as in the case with hurricanes or shelter repairs); and 5) once every 365 days (even if running smoothly over that time span) per EPA guidance. See Section 2.48.2.2.3 of this SOP for details.
- Calibration Check: In lieu of the 14-day manually performed calibration check, the results of the daily auto-calibration check results will be used. The NC DAQ daily auto-calibration check includes a zero point, a span point, and the precision point. The precision point for the daily auto-calibration check is now called the **one-point QC check (1-pt QC)**, to align terminology with that of the EPA. The daily auto-calibration checks occur in the early morning hours of each day. The daily auto-calibration check can also be used for the calibration check prior to a cylinder/calibrator change out and the daily

auto-calibration check on the day following such equipment changes can be used in lieu of a recalibration. The auto-calibration check may also be used as the final check when a site is closed and as a check on the calibration after the operation is restored following a power outage lasting for 2 days or less. The operator can, at his/her discretion, perform a calibration check or calibration at any time he/she feels it is necessary to ensure the collection of quality data.

- The clock times of the components at the site are to be verified, and if necessary corrected, during each site visit.
- At each site visit the site is to be inspected for general maintenance issues such as condition of the shelter and sample lines.
- Operators are to visit the site at least once every 30 days.
- No checks, that affect data, are to be made during periods when the potential for the exceedance of the SO2 National Ambient Air Quality Standards (NAAQS) exists.

2.48.2.1.3 Site Visit and Checks

Upon arrival at the site, observe the outside of the shelter and probe inlet, looking for vandalism or security breaches. Verify that the probe inlet is in place and that the sample line is not blocked by insects or other debris. Document all observations and actions on the e-log. More information on locating and opening the e-log can be found in Section 2.48.2.3.1 of this SOP. If there is any evidence of vandalism the operator should contact the appropriate law enforcement department (generally this is the city police department if the monitor is within city limits or the county sheriff's department if outside city limits) as well as the Regional Office (RO) Chemist, the Central Office (CO), and the Electronics and Calibration Branch (ECB) of DAQ. Check the site PC for appropriate date/time and concentration readings (see Section 2.48.2.1.5 of this SOP for details). The RO chemist and a member of the Projects and Procedures Branch (PPB) of the Central Office should review the data generated during any "out-of-control" period to determine if the data should be flagged or invalidated. See Appendix A of this SOP for the schedule of activities required when site Operators visit the site.

A) Shelter Temperature

Measure the internal temperature of the building in °C using a NIST traceable thermometer. Place the NIST traceable thermometer next to the shelter temperature sensor which should be co-located with the HOBO Temperature data logger (backup). If the NIST traceable thermometer was brought to the site, allow sufficient time for the reading to stabilize. Compare the temperatures for all three and record in the appropriate locations in the e-log. If the shelter temperature sensor is reading greater than ± 2° of the reference, contact the ECB.

NOTE: The HOBO temperature data will need to be exported at least once every 30 days from the logger; refer to RCO Guidance Documents under the Documents section on NC DAQ's Ambient Monitoring Sharepoint page for instructions.

The exported data are considered site files and kept in accordance with section 2.48.2.3.2 Data Handling and Validation of this SOP. HOBO temperature data may be imported into Envista ARM when needed as a backup; refer to RCO Guidance Documents under the Documents section on NC DAQ's Ambient Monitoring Sharepoint page for instructions.

The site thermostat should be adjusted as necessary to maintain the shelter temperature within a 20° to 30°C range. If the temperature cannot be stabilized and controlled within this range, notify the RO Chemist and the ECB that corrective action is required.

NOTE: The shelter temperature should remain constant and not vary more than ± 2° C standard deviation over 24 hours. The statistician in the Central Office keeps track of this statistic. The RO Chemist will be notified of any shelter temperature issues that arise.

B) Electrical Power and Sample Line Check

Observe the analyzer, calibrator, and site computer for indications of a power failure, and if needed, correct the cause. If there is a loss of power, allow an equilibration period of approximately 24 hours for the instrument(s) to stabilize after being powered up. The instrument can remain offline during this time. Visually inspect the sample line tubing, especially at any bends, to ensure that it has not been accidentally kinked, crimped, cut, or to ensure that insects have not nested in the lines. Particulate matter and/or water may also collect in the sample line leading to the instrument. Ensure that the shelter air conditioner is not blowing on the sample line, as this can cause condensation to build up in the line. The ECB is required to replace the sample line every two years, and will perform a sample line integrity check during their annual audit (Reference SOP 2.8.1 Section I: ECB Responsibilities Version 10 for details). Record the site inspection observations in the e-log as indicated.

C) Gas Cylinder and Calibrator Check

Verify that the calibration gas cylinder and calibrator are in certification and document certification dates in the e-log. Calibrator certification is valid for twelve months and the calibration and/or expiration date(s) should be indicated on a sticker on the front panel. Gas cylinders at a concentration of 40 ppm or greater are certified for two years from the original date of the manufacturer's certification. If the cylinder pressure is less than

500 psig, the ECB should be notified that a new cylinder is required. The delivery of a new cylinder or calibrator must be coordinated with the region. The cylinder is not to be used if the pressure is below 200 psig.

Verify that the calibrator has the correct cylinder SO2 concentration stored in memory.

Cylinder concentration can be accessed on the 146i through the following steps:

1. On the calibrator's Main Menu, press the MENU button to display if on run screen etc.
2. Navigate using the arrow buttons to "Gas Setup" and press ENTER button.
3. Gas A, B, C will display, use arrow keys and select "Gas C" and press ENTER button.
4. The "Tank Conc." displayed should match concentration indicated on the gas cylinder's tag.
5. If the "Tank Conc." needs to be changed, then use the arrows and select "Tank Conc." and press ENTER button.
6. Use the arrow keys to change the value to match the current gas cylinder concentration and save.

Cylinder concentration can be accessed on the T700U through the following steps:

1. On the calibrator's main screen, press the Setup button.
2. Press the Gas button.
3. Press the (Cyl) cylinder button.
4. Select Port 3.
5. If the cylinder concentration needs to be changed, press the Edit button.
6. Enter the correct concentration, and press Enter.

NOTE: Record the cylinder concentration stored in the calibrator in the appropriate location in the e-log.

In lieu of a manual calibration check, the daily auto-calibration check is performed during the early morning hours. Immediately following the installation of a new cylinder or calibrator, the regional office must verify that the system is functioning properly. This will be accomplished by observing the results of the daily auto-calibration check performed the morning of the day immediately following the equipment exchange. The operators may, at their discretion, perform a calibration or calibration check. However, a calibration is no longer required as long as the daily auto-calibration check is within control limits (See Table 3 of this SOP for limits). The procedures for performing a calibration or calibration check are provided in Sections 2.48.2.2.3 and 2.48.2.2.4 of this SOP. Update any calibrator and cylinder information requested in the e-log.

D) Standard and Service Mode

There are two modes on the analyzer. While sampling in the field, the SO2 analyzer should always be in its default operating mode, referred to as "Standard mode" within this SOP. When performing any maintenance, the analyzer will need to be switched to Service mode.

To turn Service mode on or off:

- Press the Menu button to go to the Main Menu.
- Use the arrow buttons to toggle to Instrument Controls, and then press Enter. Then toggle to Service Mode
- When on the Service Mode screen, press Enter to toggle Service mode on or off.

If Service mode was turned on, be sure to always turn Service mode off prior to starting regular sampling. Refer to Figure 1: Thermo Model 43i/43i-TLE Flowchart for a description of the instrument menu.

2.48.2.1.4 Analyzer and Calibrator Operational Checks

On the front panel press the Menu button to get to the Main Menu. The Main Menu contains many submenus (see Figure 1 for the 43i/43i-TLE or Figure 2 for the 146i). Instrument parameters and settings can be found within the submenus according to their function. To select a submenu screen, use the up and down arrow buttons to move cursor up or down, select the submenu and press ENTER. No values are to be changed without calling the ECB and getting their approval. If the ECB approves changing a value, document the change in the logbook. To exit a screen, press MENU to return to Main Menu and choose another submenu or press RUN to return to the Run Screen.

A) Alarm Checks (Thermo 43i/43i-TLE Analyzer, Thermo 146i Calibrator or Teledyne T700U Calibrator)

Check for "Alarm" on the displays. If no alarms are present, record the Alarm On check box in the e-log as "no" and continue. If either screen shows an alarm, record the Alarm On check box as "yes" in the e-log for the appropriate instrument/s. View the Alarm menu to determine the cause and enter the alarm description in the Notes section of the e-log. ECB should be notified when an alarm has been detected. Follow the instructions below to view alarms on the instrument.

To view the alarms:

1. Press the MENU button on the front of the instrument.
2. Use the arrow buttons to select the Alarm Submenu.
3. Press the ENTER button.
4. Use the arrow buttons to select the item that is in Alarm Status.
   NOTE: Items that are not in alarm status are labeled "OK".

5. Press the ENTER button.
6. Determine the cause of the alarm and consult with the ECB prior to performing calibrations or maintenance.
7. Press the MENU button twice to return to the main menu screen.

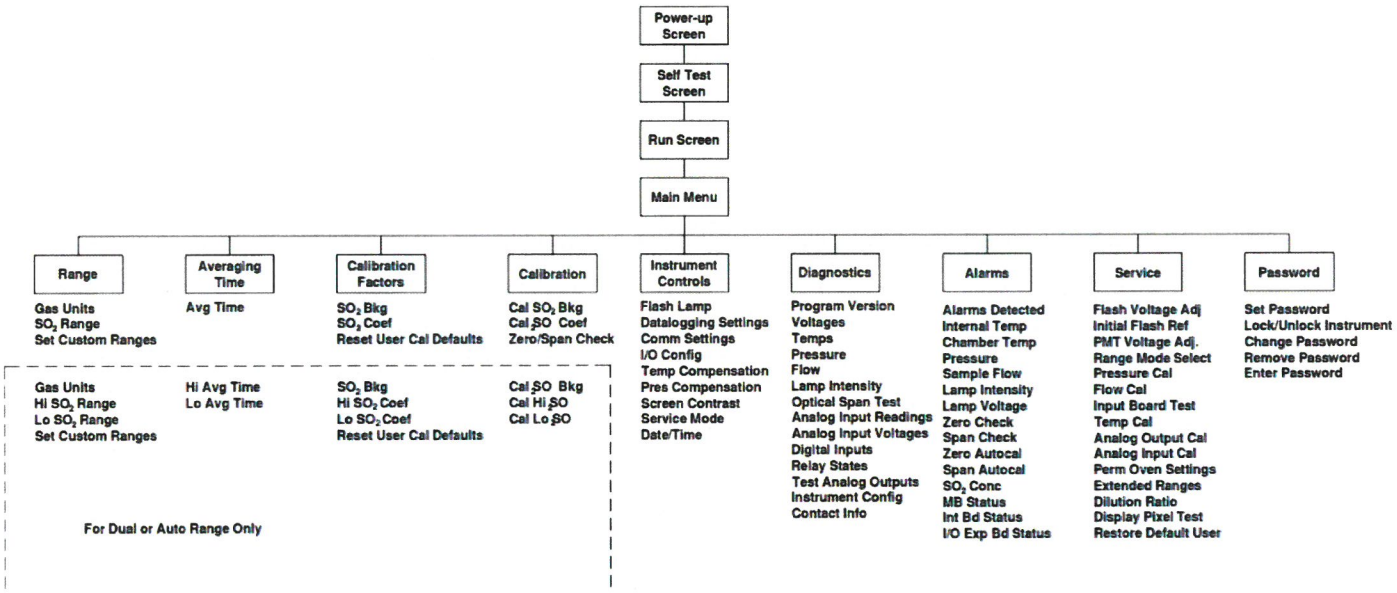

Figure 1: Thermo Model 43i/43i-TLE SO2 Analyzer Flowchart

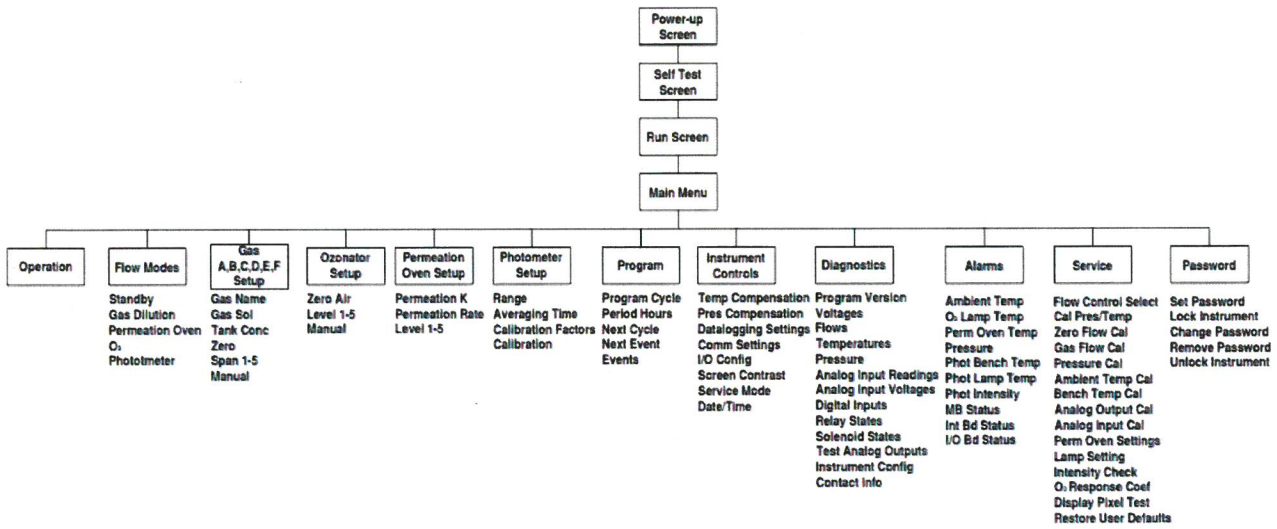

Figure 2: Thermo 146i Calibrator Flowchart

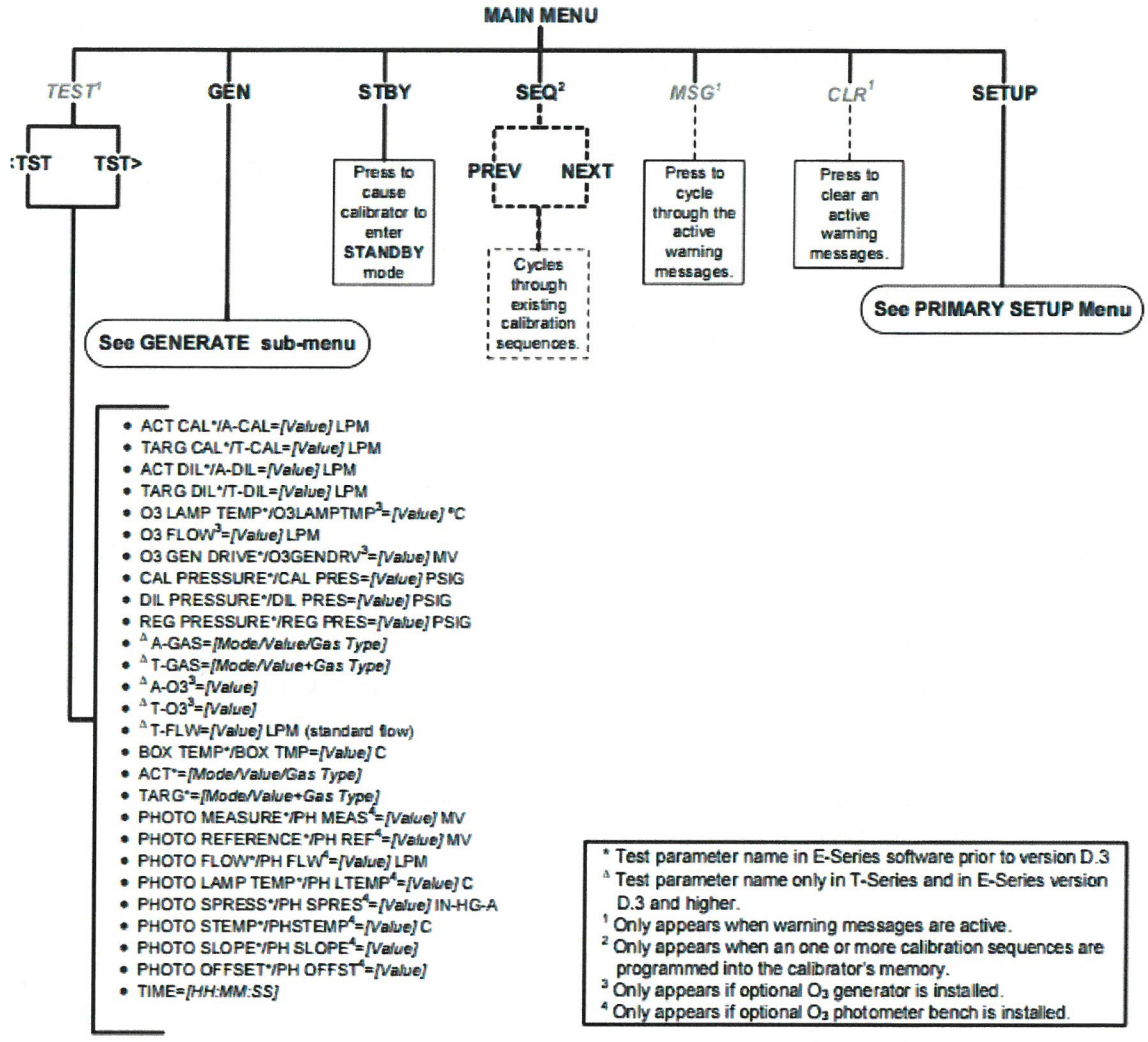

Figure 3: Teledyne T700U Calibrator Flowchart

2.48.2.1.5 Time and Date Checks and Adjustments

Record the times from the site computer, analyzer, HOBO Temperature Data Logger, and from NIST on the e-log created for the site visit.

The times for the site computer and the analyzer must be set to EASTERN STANDARD TIME (UTC-5h) for North Carolina. Additionally, they must have the same time and be synched to the NIST time. Time Synchronization on the analyzer and site computer is an automated

process that occurs once per day and was programmed during Envidas installation on the site computer.

NOTE: The HOBO data logger time is set to the site computer's time whenever the device is launched. Launching is required after the battery replacement, and should be performed at least once every 30 days to synch time with site computer and to export and save the monthly HOBO logger data. Refer to RCO Guidance Documents under the Documents section on NC DAQ's Ambient Monitoring Sharepoint page for instructions.

If the times for either the analyzer, HOBO Temperature data logger or site computer are not within 1 minute of NIST time, call the ECB and they will assist with correcting the issue.

Sources for getting NIST time:

1. Call the ECB and ask for the NIST time
2. Call the NIST Colorado time at (303) 499-7111
3. Correct time loaded into cell phone
4. Correct time websites, https://www.time.gov/ or https://nist.time.gov/

2.48.2.2 Detailed Procedures

2.48.2.2.1 Leak Check Procedure

A Leak Check must be performed at least once every 30 days in conjunction with a filter change.

A) **For the Analyzer SAMPLE port**, perform the following on the analyzer:

1. Mark the SO2 channel down; refer to RCO Guidance Documents under the Documents section on NC DAQ's Ambient Monitoring Sharepoint page for instructions.
2. Disconnect the sample line from the sample inlet port on the rear of the instrument and block the opening with a leak-tight cap. (Do not disconnect the lines going to the filter inlet or the filter outlet.)
3. From the Diagnostics Menu, use the arrow buttons to select "Pressure" and press "Enter". The pressure reading should start to drop.
4. Wait until the pressure drops below 180 mm Hg which should take approximately 2 minutes.
5. Now, using the Diagnostics Menu, toggle back and forth between "Pressure" and "Flow" monitoring both readings. The flow should drop to "zero" liters per minute (LPM), but may take an additional 1-3 minutes after the pressure has dropped below 180 mm Hg. If the flow does not read exactly 0.000, but displays a value of 0.1 LPM or lower, the flow criteria for the leak check still passes. (Inform the ECB if this situation occurs so that the ECB can make a small adjustment to the flow meter at some convenient future time.)

NOTE: If the pressure has not dropped below 180 mm Hg in approximately 2 minutes, remove the cap. Check to see that all fittings (leak-tight cap, filter housing, and filter inlet/outlet fittings) are tight and input lines are not cracked or broken and retest. If either the flow or the pressure is not acceptable, the leak check fails. Contact the ECB for assistance.

6. Remove the cap and Press Run to return to the home screen on the analyzer.
7. Update the e-log LOGBOOK sheet where appropriate.

B) **For the Analyzer SPAN port** begin the procedure by first running a zero:

In Envidas VIEWER:
1. Select [Operational]
2. Select [Phase from Sequence]
3. Left click "SO2MAN"
4. In the SO2MAN window,
   Phase = "Zero"
   Change Value For = "01:00:00" [default]
   Click "Start"

Window will countdown to the top of the minute and start the 'zero span' actuating the span solenoid on the instrument

On the analyzer, perform the following steps:
1. Disconnect the calibrator Teflon® line from the calibration gas inlet port on the rear of the analyzer. Block off the calibration gas inlet port on the back of the analyzer with a leak-tight cap.
2. From the Diagnostics Menu, press "Menu", use the arrow buttons to select "Pressure", and press "Enter". The pressure reading should start to drop.
3. Wait until the pressure drops below 180 mm Hg which should take approximately 2 minutes.
4. Now, using the Diagnostics Menu, toggle back and forth between "Pressure" and "Flow" monitoring both readings. The flow should drop to "zero" liters per minute (LPM), but may take an additional 1-3 minutes after the pressure has dropped below 180 mm Hg. If the flow does not read exactly 0.000, but displays a value of 0.1 LPM or lower, the flow criteria for the check still passes. (Inform the ECB if this situation occurs so that the ECB can make a small adjustment to the flow meter at some convenient future time.)

   NOTE: If the pressure has not dropped below 180 mm Hg within three minutes, immediately remove the cap. Check to see that all fittings (leak-tight cap, filter housing, and filter inlet/outlet fittings) are tight and input lines are not cracked or

broken and retest. Do not cap off the line for more than 5-6 minutes or the system may pressurize. If either the flow or pressure is unacceptable, the leak check fails; contact the ECB for assistance.

5. If the leak check passes, remove the cap, reconnect the calibrator line to the span port and the sample line to the sample inlet. Clear the zero mode by aborting the zero cal.
6. Remove the cap and document results in the e-log. Press Run to return to the home screen on the analyzer.

2.48.2.2.2 Filter Change Procedure

The particulate filter (5.0-micron 47 mm Teflon®) must be replaced at a minimum of every 30 days. The filter is replaced as follows:

1. Mark the SO2 channel down; refer to RCO Guidance Documents under the Documents section on NC DAQ's Ambient Monitoring Sharepoint page for instructions.
2. Perform a leak check of the system. Leak checks are performed on both the Span and Sample ports prior to and after changing the filter (See Section 2.48.2.2.1 of this SOP for instructions). This will ensure the integrity of the system prior to making any changes to the filter.
3. On the back of the analyzer, remove the filter holder (if necessary) and disassemble using the special filter wrenches.
4. Remove the existing filter and discard. Remove any extraneous material from filter housing.
5. Touching only the outer edges, place a new filter in the holder (orientation of filter is not critical). EPA recommends the use of gloves to limit filter contamination which can impact filter performance, and should be used by operators during this process.
6. Reassemble the filter holder and reattach to instrument in same orientation as before removal (i.e., filter inlet/outlet connected to proper lines). Do not over tighten the filter holder for this can tear the filter and/or damage the holder.
7. Perform a post-filter change leak check (See section 2.48.2.2.1 of this SOP for instructions).
8. Record the new the filter change date and the leak check results in the e-log.

2.48.2.2.3 Calibration

A calibration **IS** required:

- During initial set-up.
- When the SO2 analyzer is replaced.
- After two consecutive span point results from the daily auto-calibration check did not pass the acceptance criteria given in Table 3 of this SOP.

- When the analyzer has not been in operation for more than 2 consecutive days (such as in cases with hurricanes or shelter repairs when the daily auto-calibration check results **cannot** be used in place of the 14-day calibration check).
- Once every 365 days per EPA guidance.

NOTE: A calibration is **NOT** required after the replacement of any of the following components:

- The zero air supply
- The calibrator
- The SO2 cylinder

This is applicable only when the very next daily auto-calibration check is shown to be within acceptance limits (see Table 3). If this auto-calibration check fails, a calibration is required. It is imperative that the operator be aware of when components are changed so that the results of the next daily auto-calibration check can be reviewed. Therefore, arrangements with the ECB for delivery should be scheduled in advance.

A calibration consists of 1) setting the "Zero" using a source of zero air and 2) setting the SPAN (SO2 coefficient) using calibration gas with a concentration of nominally 80% of the analyzer's range (i.e., 400 ppb SO2). Zero adjustments affect the span; however, span adjustments do not affect the zero. The procedures to calibrate the analyzer are provided below.

NOTE: The SO_2 channel should still be marked down from the required checks performed previously. If the channel is still enabled, mark down the channel before proceeding.

A) Set Zero Procedure:

1. Open Envidas VIEWER module on the site computer-Icon on desktop.
2. Enter username & password – this will have been added to your site by ECB personnel beforehand.
3. In the "Dynamic" tab, select [Tabular] and choose the site to view current data stream.
4. Under 'Channel' Right click SO2.
5. In the options window, mover cursor over "Set Channel Flag".
6. Choose a status (i.e. "To Maintain").
7. In the "Force Status Time" window, Select [Change Status For] and specify a duration (i.e. "Hr" and "2").
8. Click "Force Now".
9. In the "Operational" tab, Select [Phase From Sequence], choose "SO2MAN" (start single phase calibration).

10. Select Phase "Zero" "SO2CAL".
11. Select Change Value For "01:00:00" "SPAN0".
12. Click "Start" - the phase will start at the top of the next minute. A countdown will appear in the dialog box.
    NOTE: Leave the Sequence dialogue box open.

13. Display the minute data and graph; refer to RCO Guidance Documents under the Documents section on NC DAQ's Ambient Monitoring Sharepoint page for instructions.

On the Analyzer

The data in Envidas VIEWER should read nominally 0.0 ± 3.0 ppb on the SO2 channel.

Adjust the *analyzer* zero setting by doing the following:

1. From the Main Menu use the arrow buttons to select Calibration Factors and then select SO2 Background.
2. Record this value on the e-log as the "SO2 background" BEFORE CALIBRATION. (If this value is outside of a 0 to 50 ppb range, contact the ECB.)
3. Return to the Main Menu, and use the arrow buttons to select Calibration Factors and then select SO2 Coefficient.
4. Record this value in the e-log as the SO2 Coefficient BEFORE CALIBRATION. If this value is outside of a 0.900 to 1.100 ppb range, contact the ECB.
5. Return to the Main Menu and "Press" the Menu button on the front of the analyzer and, using the arrow buttons, move the cursor to select Calibration menu.
6. Press the ENTER button to display the Calibration menu.
7. In the Calibration menu select "Cal SO2 Background" and press the ENTER button.
8. The "Calibrate Zero" screen will appear with the first line of the display showing the current SO2 reading.
9. With the analyzer producing a stable reading for at least 20 minutes (constant within 0.0 ± 2.0 ppb and not trending up or down) on zero air, press the ENTER button to set the SO2 reading to zero. The display flashes the message "Saving" and the SO2 reading is added to the background correction.
10. Record this value on the e-log as the "SO2 Background" AFTER CALIBRATION
11. Allow the analyzer to stabilize and then record the next five one-minute data concentration values from Envidas on the e-log. The e-log will compute the average of these five one minute values. If the values are not within ± 1.0 ppb of zero, repeat steps 2 and 3 listed above.

Stopping the zero

In Envidas VIEWER select the RED "Abort" button at the bottom of the dialogue box (Configuration Menu).

NOTE: If the Dialogue box was closed, reopen by:

a. Selecting the "Operational" tab,
b. Selecting "Phase From Sequence"
c. Selecting "SO2MAN" which is currently running.

B) Set Span Procedure:

The span concentrations are preset values as specified in Table 1 of this SOP. The analyzer needs to stabilize for at least 20 minutes prior to recording any concentration values. After the analyzer has stabilized (values not changing by more than ± 3.0 ppb and not continuing to trend up or down), follow the steps below to adjust/calibrate the instrument:

1. Open Envidas VIEWER module on the site computer.
2. In the "Operational" tab select [Phase From Sequence], and then choose "SO2MAN".
3. Select Phase "SPAN".
4. Select Change Value For "01:00:00".
5. Click "Start" - the phase will start at the top of the next minute. A countdown will appear in the dialog box.

   NOTE: Leave the Sequence dialogue box open.

6. Display the minute data and graph; refer to RCO Guidance Documents under the Documents section on NC DAQ's Ambient Monitoring Sharepoint page for instructions.
7. Record the concentration value in the e-log, this may be calculated with flows and should be recorded in the e-log if being used, see below for instructions for obtaining flows.

To get the flow readings for the e-log:

On the 146i calibrator

- Press the **Diags** button
- Toggle using arrow keys to **Flows**
- Record the flows in the appropriate boxes in the e-log

On the T700U calibrator

- the flow rates are displayed on the **Home** screen (Cal flow and dil flow)
- Record "Actual" flows on the display in the appropriate boxes in the e-log.

On the analyzer

The values displayed on the analyzer should read within ± 5% of the expected value on the SO2 channel. Adjust the analyzer span by doing the following:

1. Press the Menu button and use the arrows to select "Calibration". Press Enter.
2. Use the arrows to toggle to Cal SO2 Coefficient and press Enter.
3. The first line of the display shows the current SO2 reading, and the third line shows the calibration gas concentration. To adjust the calibration gas concentration, use the left and right arrow buttons to move the cursor to a different digit. Use the up and down arrow buttons to adjust each digit to the true SO2 Span concentration.
4. Press Enter to calibrate the analyzer to the true 146i/T700U "Output PPB" display SO2 calibration gas concentration. The screen will flash the message "Saving" and will display the corrected SO2 reading.
5. Record this value on the e-log as the "SO2 Coefficient" AFTER CALIBRATION. Press Run to return to the "Run screen".
6. Allow the analyzer to stabilize and record the next 5 one-minute concentration values from Envidas REPORTER in the e-log. The e-log will compute the average of these 5 one-minute values. If the values are not within ± 5% of the "True Span concentration", repeat steps 2, 3, and 4 listed above.

To stop the Span gas flow:

In Envidas VIEWER select the RED "Abort" button at the bottom of the dialogue box (Configuration Menu).

NOTE: If the Dialogue box was closed, reopen by:

a. Selecting the "Operational" tab,
b. Selecting "Phase From Sequence"
c. Selecting "SO2MAN" which is currently running.

Table 1: Criteria for Calibrations

	Zero	Span
Concentration[A] (ppb)	0	400
Acceptance (±)	1 ppb	5%

[A] Concentrations are nominal values

C) Calibration Verification Procedure:

The purpose of this procedure is to "verify" the linearity of the analyzer at multiple concentrations after the completion of a calibration.

The Span average values from the "Span Procedure" and the average **Zero** values from the "Set Zero procedure" under "Calibration" may be used if "passing". This will eliminate having to repeat/run these two points.

1. Open Envidas VIEWER module on the site computer.
2. In the "Operational" tab select [Phase From Sequence], and then choose "SO2MAN".
3. Select Zero or the appropriate point needed.
4. Confirm Phase Duration is 1 hour and click "Start".
5. The phase will start at the top of the next minute. A countdown will appear in the dialog box.
   NOTE: Leave the Sequence dialogue box open.
6. Allow the instrument to stabilize for a minimum of 10 minutes to produce a stable reading.
7. Record the 5 one-minute values following the 10-minute stabilization period in the e-log.
8. The e-log will compute the average of these five one-minute values.
9. Abort the completed point by clicking the RED "Abort" button at the bottom of the dialogue box.
10. Repeat the previous steps for all required points indicated in Table 2 of this SOP.

Table 2: Criteria for Multi-Point Calibrations/Verifications

	Zero	Span	Span 2	Span 4
Concentration [A] (ppb)	0	400	100	50, 20[B]
Acceptance (±)	1 ppb	5%	5%	7% (% Diff.)

[A] Concentrations are nominal values
[B] 20 ppb run at Bayview site only

NOTE: If any of the points run are outside the specifications of the criteria given in Tables 1 or 2, the Calibration/Calibration verification must be re-run to identify and correct any problems. If a second attempt fails, contact the ECB for guidance.

2.48.2.2.4 Calibration Checks

The purpose of a calibration check is to correlate the output of a monitoring system with known traceable concentrations of SO2, and to periodically confirm that the analyzer's calibration has not drifted outside the acceptable range. The EPA refers to calibration checks as "One-Point QC Checks" and requires that they be performed at least once every 14-days. DAQ uses daily auto-calibration check results in lieu of the 14-day calibration check.

For the auto-calibration checks to be successful, the subsequent activities must be followed:

- Continued daily review (by the regional office) of the daily auto-calibration check results which occur in the early morning hours of each day.
- A three (3) point daily auto-calibration check using Zero Air, Span (400 ppb) and appropriate 1-pt QC point (50 or 20 ppb) indicated in Table 3 of this SOP.
- The submittal of all valid 1-pt QC results from the daily auto-calibration check are reported to AQS by the Central Office.
- Immediate action is required if the 1-pt QC point from the daily auto-calibration check is >7% (percent difference). In the case a calibration must be performed.
- Immediate action is required by the operator if one or more of the three (3) Points listed above are outside of the acceptance criteria provided in Table 3 for two consecutive days. This immediate action will be taken on the second of the two consecutive days experiencing an out-of-control situation. If the consecutive days fall on a weekend or extended weekend, then action must take place on the first work day following such a period.

- Immediate action will consist of performing an "investigative" or manual calibration check (called SO2MAN in Envidas VIEWER) using the same points provided in Table 3 of this SOP which includes: Zero Air, Span (400 ppb), and 1-pt QC (50, 20 ppb). This calibration check should ideally be performed at the monitoring site, but may be done so remotely from the regional office with ECB assistance if necessary. Refer to RCO Guidance Documents under the Documents section on NC DAQ's Ambient Monitoring Sharepoint page for instructions.
- EPA recommends reporting any additional investigative calibration check points run between 80 and 5 ppb, and shall be done so by way of the AQ98 form or via the e-log.
- A calibration IS required if the calibration check confirms an out-of-control situation.

NOTE: No checks that affect data will be performed during periods of ambient exceedances.

Table 3: Criteria for Daily Auto-Calibration Checks

	Zero	Span	1-pt QC (Span 1)
Concentration[A] (ppb)	0	400	50[B], 20[C]
Acceptance (±)	<3.1 ppb	<10.1% (% Diff.)	<10.1% (% Diff.)
Action Limit (±)	>1 ppb	>5% Diff.	>7% (% Diff.)

[A] Concentrations are nominal values
[B] Value must be between 5 and 80 ppb per EPA
[C] 20 ppb run at Bayview site only

Manual Calibration Check Procedure

An investigative calibration check must be performed if the daily auto-calibration check results are outside of the acceptance criteria listed in Table 3 for two consecutive days or if the action limit was exceeded during the daily auto-calibration check. In this case the Zero, Span and 1-pt QC (Span 1) are run. The operator may report the 1-pt QC check using the AQ98 form or via the e-log. Should an operator run a Span 6 instead of the -1 pt QC (Span 1) point during an investigative check, it would not need to be reported to AQS.

NOTE: No adjustments should be made to the analyzer before the calibration check.

To perform a calibration check:

1. Mark the SO2 channel down using Envidas VIEWER icon on Desktop of site PC; refer to RCO Guidance Documents under the Documents section on NC DAQ's Ambient Monitoring Sharepoint page for instructions.
2. In the Envidas "VIEWER" module, under the "Operational" tab, select "Phase From Sequence" and choose "SO2MAN"
3. Select Phase "Zero"to run an initial "zero" (then Span followed by any additional spans, i.e. Span 1/Span 2/Span 4/Span 6)
   NOTE: Confirm Phase Duration time of "01:00:00"
4. Click "Start" - the phase will start at the top of the next minute. A countdown will appear in the dialog box.
   NOTE: Leave the Sequence dialogue box open.
5. Open the "Reporter" module in Envidas (username/password)
6. In the "Reports" tab, select "Sites"
7. In the 'Site Report' window select the "Site" from the drop-down menu
8. Select the "SO2" and "146i_gas conc/ T700_ACTCONC" check boxes
9. Choose the report 'Output' type ("Excel" works very well for recording in e-logs)
10. Choose how much data to display in 'Duration' ("Period" works well for displaying cal-check data)
11. Specify the start/stop 'Date and Time'
12. Select "Status" tab, check box "Separated Status\Value".
13. In the "type" tab specify "AVG" data and timebase = "1 Minute" and click "OK"
14. In Envidas VIEWER select the RED "Abort" button at the bottom of the dialogue box (Configuration Menu).
    NOTE: If the Dialogue box was closed, reopen by:
    Selecting the "Operational" tab,
    Selecting "Phase From Sequence"
    Selecting "SO2MAN" which is currently running.
15. Repeat for the remaining points and conclude the procedure by running a final "zero" phase.
16. Record the results from each Phase initiated in the e-log where indicated.
17. If the calibration check is found to be unacceptable, then perform the required calibration.
18. Mark the SO2 channel back up after the completion of the calibration check; refer to RCO Guidance Documents under the Documents section on NC DAQ's Ambient Monitoring Sharepoint page for instructions.

Table 4: Criteria for Manual Calibration Checks

	Zero	Span	Span 2	1-pt QC (Span 1)	Span 6
Concentration [A](ppb)	0	400	100	50[B], 20[C]	85, 4[D]
Acceptance (±)	<3.1 ppb	5%	5%	<10.1 % (% Diff.)	4 ppb, 2 ppb
Action Limit (±)	>1 ppb	>5% Diff.	>5% Diff.	>7% (% Diff.)	>4 ppb, >2 ppb

[A] Concentrations are nominal values
[B] Value must be between 5 and 80 ppb per EPA
[C] 20 ppb run at Bayview site only
[D] Concentration run for Trace Level Instruments or if deemed appropriate for site mean/median concentrations

2.48.2.2.5 Data Retrieval and End Processing

Every business day, the CO statistician initiates a data review for the previous day by providing a raw data report (in a spreadsheet format) to each Regional Office (Reference Section III: Regional Office Polling and Data Review and Section IV: Data Review and Validation QA Plan for Continuous Gaseous and Non-Speciated Particulate Monitors for details on data review). The CO may request the Regional Office to send additional data that are needed beyond what the CO requires for verifying any missing data supplied by the Regional Office. These data can be retrieved from the "site analyzer"; refer to RCO Guidance Documents under the Documents section on NC DAQ's Ambient Monitoring Sharepoint page for instructions.

2.48.2.3 File Management

Field operators must have a PC (or lap top) to generate the e-log files from a Microsoft Excel template file. These e-logs are provided by the Central Office and updated periodically. The file naming protocol is provided below. A formalized file naming convention has been established through consensus of the regions and the Central Office and should be used by all regions.

2.48.2.3.1 Opening, Naming and Storing the site files

The e-log template file used at the site should be stored on the PC used for field operations by the field technician; see Appendix C of this SOP for an example of the e-log. E-logs can also be found in IBEAM or on Sharepoint. To access this file, open the e-log template file using Excel. Every time a new e-log is filled out using the template, it must be renamed and

saved as a separate and complete workbook (all sheets, i.e., tabs, saved) to preserve the record. Do **NOT** copy over a previously completed e-log.

NOTE: Refer to the Logbook file naming convention "Policy Memorandum" dated January 1, 2011 located in the DAQ IBEAM module (summarized below).

Renaming and Saving the E-log

1. Open the e-log workbook template file using Excel.
2. Left click the "file" toolbar icon. Scroll down to "save as" and left click.
3. Under file name (highlighted in blue) change workbook file name using the following format: Site ID SO2 Date Activity. For example, BV SO2 20120730 BC.xlsx is a calibration at Bayview on July 30, 2012
4. Change save location to operator's choice of folders (example: previously created folder named SO2).
5. Left click "save".
6. Find the tab needed for the task involved. The first tab selected should be the Logbook. Fill in information as indicated.
7. Open other tabs as needed and fill in information as indicated.
8. Save the workbook when finished entering data.

2.48.2.3.2 Data Handling and Validation

All site files, e-logs or other supporting documents, generated in the field will be stored on dedicated server space in the Regional Office, in a folder named for the official site operation files. These files should be transferred to the Official File on a frequent and regular schedule as established by the Region. This is necessary to prevent the potential loss of such files from the field computer and to maintain a "paper trail" for providing defensible data. This also makes the data easily and readily available for review by the RO Chemist and transfer to the P: drive for review by the Central Office. The files on the site/operator PC can be copied and transferred to the common hard drive via email or flash drive for storage in the official file folder.

The site files should be transferred every two weeks, and backed up monthly. This serves as a backup system in the event the official PC fails or is removed or the site files are damaged. These files will be retained for a minimum of five years. When the need arises to review a file for data validation or site operations the official folder is used or a hardcopy is created from this file. For details on data validation procedures, please reference Section III (SOP 2.8.3): Regional Office Polling and Data Review and Section IV (SOP 2.41.4): Data Review and Validation QA Plan for Continuous Gaseous and Non-Speciated Particulate Monitors.

SO2 DRR exceedances must be evaluated and validated within an appropriate amount of time following the exceedance day. An exceedance is any day in which at least 1 hourly SO2 value exceeds the NAAQS of 75 ppb.

The DRR facility will be notified by the state of an hourly exceedance the next business day following the day of the exceedance.

2.48.2.3.3 SO_2 Monthly Data Validation

The following validation checks shall be completed every month:

1. Providing proper null codes indicating calibrations, audits etc.
2. Providing missing valid data.
3. Documenting any invalid data as to reason with proper null code.
4. Identifying any data that may be associated with exceptional events.

In some cases, "valid" data that are judged to be out of the ordinary are retained and an informational flag is added in AQS by the CO. An example would be high concentration values resulting from an exceptional event. EPA has recently begun applying stricter standards for what it will accept as an exceptional event. In any case where the Region wishes data to be considered "exceptional", the Region should gather sufficient documentation to support the claim in accordance with a policy memorandum from the CO dated June 29, 2007. Unusually high concentration values that may be the result of an exceptional event must be noted as such on the AQS monthly data summary reports, but not deleted. Any exceptional event data will be flagged in AQS by the Central Office using the appropriate qualifier code.

A list of Null Codes that are routinely used during data validation on the AQS monthly summary report are listed in the following table.

Table 5: Commonly Used EPA-AQS Null Value Codes (partial list)

AE	Shelter Temperature outside Limits
AN	Machine or Equipment Malfunction
AS	Poor Quality Assurance Results
AT	Calibration (by ECB)
AV	Power Failure
AZ	QC (ECB) Audit
BA	Maintenance and Routine Repairs (including filter changes)
BC	Multi-point Calibration
BF	Precision/Zero/Span
BJ	Operator Error
BK	Site Computer/Data Logger Down
EC	Exceeds Critical Criteria

2.48.2.3.4 SO_2 Exceedance Validation

In the event of an SO2 exceedance at an SO2 DRR monitoring site, an exceedance report will be filled out. Please see Appendix B of this SOP for an example of the blank exceedance report.

If an exceedance is recorded, the DRR facility will be notified. Operator personnel will then retrieve the following data:

1. Most recent calibration data prior to the exceedance.
2. Both 1-pt QC checks bracketing the exceedance.
3. Copy of e-log with the date of the most recent filter change and leak check.
4. Hourly SO2 data from the day of the exceedance.
5. Documentation of any discussion with the facility.

The exceedance report will be completed by the site operator, and signed electronically by the regional office supervisor. The signed report will be submitted to the central office within ten business days of the exceedance. The central office chemist will review the form and all accompanying documentation. Once the form and documentation have been reviewed and are free from errors, the central office chemist will electronically sign the report and store it in the appropriate folder on the shared drive.

2.48.2.4 Revision History

1. Updated Revision Number throughout document.
2. Removed references to data loggers (ESC 8832 or 8816) throughout document.
3. Added EPA Designated Equivalent Method Number and operational specs for the Thermo 43i/43i TLE to section 2.48.2.1.1 Instrumentation and Equipment for Continuous SO2 Monitoring per EPA recommendation.
4. Changed site visit schedule to once every 30 days to section 2.48.2.1.2.
5. Deleted Figure 1: Diagram of the 43i and 146i front panel buttons and Figure 2: Diagram of the Thermo 43i rear panel to Section 2.8.2.1.3. Diagram of Thermo 43i/43i-TLE rear panel from the document.
6. Renumbered Figure 3, 4, and 5 to 1,2, and 3 respectively.
7. Updated the referenced edition of the QA Handbook in section 2.48.2.1 General Background Information and Initial Site Checks.
8. Added EPA Designated Equivalent Method Number and operational specs for the Thermo 43i/43i TLE to section 2.48.2.1.1 Instrumentation and Equipment for Continuous SO2 Monitoring.
9. Updated Equipment list in section 2.48.2.1.1 Instrumentation and Equipment for Continuous SO2 Monitoring.
10. Removed the note regarding the differences values used for precision point and 1 point QC for a manual calibration check in section 2.48.2.1.2 Common Continuous Monitoring Principles Applicable to the SO2 System.
11. Removed Figure 1: Diagram of the 43i/43i-TLE and 146i front panel buttons and references to it in the text in from section 2.48.2.1.3 Site Visit and Checks.
12. Changed requirement for minimum site visit frequency from every 28 days to every 30 days.
13. Changed reference to Figure 1 instead of Figure 3 in section 2.48.2.1.3 Site Visit and Checks: D) Standard and Service Mode.
14. Modified Appendix A to remove references to Loggers, reflect every 30 days instead of 28, and note about NCore site calibrations required every 90 days.
15. Removed guidance materials for procedures from Appendix-those have been added to NC DAQ's Sharepoint page.
16. Added updated e-log to Appendix.
17. Reconfigured Tables and now have 4 tables instead of three.
18. Added references for Sharepoint throughout.

Appendix A: Schedule of Activities

Schedule of Required Activities

Activity	Daily	Every 30 Days	Section Reference
Review data and daily auto-calibration results	x		2.48.2.3.3
Site Visit		x	2.48.2.1.3
Analyzer/Computer date/time check		x	2.48.2.1.5
Verify shelter temperature	x		2.48.2.1.3
Manual calibration check	(As needed)	(As needed)	2.48.2.2.4
Change filter		x	2.48.2.2.1
Perform leak check		x	2.48.2.2.2
Calibration[A] & Calibration Verification Check	(As needed)	(As needed)	2.48.2.2.3

[A] Calibration is required at least once every 365 days per EPA guidance and every 90 days at the NCore site.

Appendix B: SO2 DRR Exceedance Report

Sulfur Dioxide Monitoring System Exceedance Form

Region _____
Site _____
AQS # _____
Operator _____
Date of Exceedance _____

Maximum 1-Hour Exceedance Details

Concentration (ppb) _____
Hour _____
Site Wind Direction (degrees) _____
Nearest Airport Wind Direction (degrees) _____

Number of Additional Exceedances _____
Date of Last Calibration _____
Date of Last Leak Check and Filter Change _____

Attach Copies of:
_____ 1. Most recent calibration prior to exceedance
_____ 2. Logbook from most recent filter and leak check
_____ 3. Prior and post exceedance nightly auto calibration checks
_____ 4. Raw data printout for the exceedance day
_____ 5. Documentation of discussion with facility

Notes: _____

Regional Supervisor Review:

Signature: _____
Date: _____

DAQ Central Office Review:

Signature: _____
Date: _____

Regional office should submit form and all documentation to the P: drive within 10 business days of exceedance.
Central office will validate form within 3 business days of reciept.

Appendix C: SO2 DRR e-log

LOGBOOK sheet

SO_2 SITE INFORMATION

Version 9.5, April 2018

Site: | Time (hh:mm): | Date (mm/dd/yy): | Operator:

ID: #N/A

Routine Site Inspection

Bldg Secure? (Y/N):
Sample Line Inlet in Place? (Y/N):
Bldg Power On (Y/N):
Sample Line OK? (Y/N):

NIST Temp (°C): | Serial No.:
NIST Thermometer | Expiration Date:
Bldg Temp (°C): | OK
HOBO Temp (°C): | OK
(+/- 2 °C of NIST)
HOBO Battery >1 bar?

SO_2 Analyzer

Model Type: | Serial No.: | Range (ppb):

Cooling Fan/Filter OK? (Y/N):
Date Fan Filter Cleaned:
Date of Most Recent Calibration:
Internal Temp. (15-45°C):
Chamber Temp. (43-47°C):
Pressure: 400-1000mmHg
Flow (0.35-0.75 lpm):

Date Particulate Filter Changed:
Pre-filter Change Sample Port Leak Check OK? (Y/N):
Pre-filter Change Span Port Leak Check OK? (Y/N):
Post-filter Change Sample Port Leak Check OK? (Y/N):
Post-filter Change Span Port Leak Check OK? (Y/N):
Alarms?: *List alarm details in Notes section below*

Calibrator Information

Serial No.:
Expiration Date: (mm/dd/yy)
Days Left: 0
Cooling Fan/Filter OK? (Y/N):
Date Fan Filter Cleaned:
Cal. Gas Conc. Entered (ppm):
Alarms?:
List alarm details in Notes section

Cylinder Information

Cylinder No.:
Expiration Date:
Days Left: 0
Concentration: (ppm)
Cylinder Press. (>500 psig):
Delivery Press. (30 psig):

Zero Air Generator

Serial No.:
Expiration Date: (mm/dd/yy)
Days Left: 0

Delivery Air Pressure (30 +/- 2 psig)

Time and Date Information

	Date (mm/dd/yy)	Time (hh:mm)
NIST:		
Analyzer:		
Site Computer:		
HOBO launched: ☐		

(All Must Be Within ±1 Minute of NIST Time)

Notes

Calibration sheet

SO_2 CALIBRATION

Version 9.5, April 2018

Site: 0 Date: 01/00/00 Operator: 0

Analyzer Range (ppb): 0

Cylinder Conc. (ppm): 0.0

Calibrator Readings

	Flow Rate (Cal.Gas)	Flow Rate (Zero Air)	Calculated Conc. (ppb)	Expected Conc. (ppb)	Target Value Nominal (ppb)
Zero			#DIV/0!		0.0
Span			#DIV/0!		#N/A
Span 2			#DIV/0!		#N/A
Span 4			#DIV/0!		#N/A

Calibration Factor Information

	Before Calibration	After Calibration	Expected Range
SO2 Background			0-50 ppb
SO2 Coefficient			0.900-1.100

CALIBRATION

(record 5 consecutive 1-minute average values from Envidas)

1st Attempt						2nd Attempt, If Needed					
ZERO			SPAN (70-90% of Full Scale)			ZERO			SPAN (70-90% of Full Scale)		
Reading Number	Time hh:mm	ppb	Reading Number	Time hh:mm	ppb	Reading Number	Time hh:mm	ppb	Reading Number	Time hh:mm	ppb
1			1			1			1		
2			2			2			2		
3			3			3			3		
4			4			4			4		
5			5			5			5		
Avg ppb		#DIV/0!	Avg ppb		#DIV/0!	Avg ppb		#DIV/0!	Avg ppb		#DIV/0!
Difference (ppb)		#DIV/0!	Difference (ppb)		#DIV/0!	Difference (ppb)		#DIV/0!	Difference (ppb)		#DIV/0!
Acceptable (Yes/No):		#DIV/0!			#DIV/0!			#DIV/0!			#DIV/0!
Acceptable Range:	Difference ± 1 ppb			Difference ± 5%			Difference ± 1 ppb			Difference ± 5%	

CALIBRATION VERIFICATION

(record 5 consecutive 1-minute average values from Envidas)

ZERO			SPAN (70-90% of Full Scale)			SPAN 2			SPAN 4		
Reading Number	Time hh:mm	ppb	Reading Number	Time hh:mm	ppb	Reading Number	Time hh:mm	ppb	Reading Number	Time hh:mm	ppb
1			1			1			1		
2			2			2			2		
3			3			3			3		
4			4			4			4		
5			5			5			5		
Avg ppb		#DIV/0!	Avg ppb		#DIV/0!	Avg ppb		#DIV/0!	Avg ppb		#DIV/0!
Difference (ppb)		#DIV/0!	Difference (ppb)		#DIV/0!	Difference (ppb)		#DIV/0!	Difference (ppb)		#DIV/0!
Acceptable (Yes/No):		#DIV/0!			#DIV/0!			#DIV/0!			#DIV/0!
Acceptable Range:	Difference ± 1 ppb			Difference ± 5%			Difference ± 5%			Difference <= ± 7% (%Diff.)	

Cal Check sheet

SO_2 CALIBRATION CHECK

Version 9.5, April 2018

Site: Date: Operator:

Remote check?

Analyzer Range (ppb):

Cylinder Conc. (ppm):

Calibrator Readings

	Flow Rate (Cal.Gas)	Flow Rate (Zero Air)	Calculated Conc. (ppb)	Expected Conc. (ppb)	Target Value (ppb)
Zero			#DIV/0!		0.0
Span			#DIV/0!		#N/A
Span 2			#DIV/0!		#N/A
Span 1			#DIV/0!		#N/A
Span 6			#DIV/0!		#N/A

ZERO			SPAN (70-90% of FullScale)			SPAN 2			SPAN 1			SPAN 6		
Reading Number	Time hh:mm	ppb	Reading Number	Time hh:mm	ppb	Reading Number	Time hh:mm	ppb	Reading Number	Time hh:mm	ppb	Reading Number	Time hh:mm	ppb
1			1			1			1			1		
2			2			2			2			2		
3			3			3			3			3		
4			4			4			4			4		
5			5			5			5			5		
Avg ppb		#DIV/0!	Avg ppb		#DIV/0!	Avg ppb		#DIV/0!	Avg ppb		#DIV/0!	Avg ppb		#DIV/0!
Difference (ppb)		#DIV/0!	Difference (ppb)		#DIV/0!	Difference (ppb)		#DIV/0!	Difference (ppb)		#DIV/0!	Difference (ppb)		#DIV/0!
Acceptable (Yes/No):		#DIV/0!			#DIV/0!			#DIV/0!			#DIV/0!	High (85 ppb)		#N/A
												Low (4 ppb)		#N/A

Acceptable Range: Difference < ± 3.1 ppb Action Required? #DIV/0!

Difference < ± 10.1 % (%Diff.) Action Required? #DIV/0!

Difference ± 5%

Difference < ± 10.1 % (%Diff.) Action Required? #DIV/0!

± 4 ppb (85 ppb)
± 2 ppb (4 ppb)

Notes