Monitoring Plan

Nitrous Oxide Abatement Project Yazoo City AOP #9

CF Industries Holdings, Inc.
Northbrook, Illinois

Version 4.3
April 2, 2025

Authorization Sheet

Approval:

Approved By:  **Date** 4/2/2025

Scott Tassin
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History of Revisions

Revision	Date	Description of Change	Proposed By:	Approved By:
1.0	01-12-08	New document	--	D. Beaird
2.0	15-10-10	Monitoring requirements and QA/QC program sections were adapted to CAR Protocol requirements as granted variation period terminated.	Mandated update	D. Beaird
3.0	09-10-12	Monitoring Requirements and QA/QC provisions updated to better reflect 40 CFR Part 75 requirements.	ClimeCo America Corporation	D. Beaird
3.1	01-19-15	Updated flow meter information	ClimeCo America Corporation	J. Winch
3.2	04-20-16	Changed errata reference date and added $HNO_{3\ MAX,\ scaled}$.	ClimeCo Corporation	J. Winch
4.0	10-19-20	Updated tables of monitoring parameters to reflect requirements of CAR NA Protocol v2.2. Updated references to Protocol v2.2. Updated GWP of N_2O from 310 to 298.	ClimeCo Corporation	J. Winch
4.1	09-21-22	Updated AOC ranges to reflect revised figures approved by Climate Action Reserve in Variance Determination Date 09/15/2022. Added description of HNO3 production reporting and accounting practices to Monitoring Parameters Tables.	ClimeCo LLC	E. Ipek & J. Shustack
4.2	10-24-22	Updated N2O GWP referenced to latest AR5 values accepted by CAR for use under the protocol (265).	ClimeCo LLC	J. Shustack
4.3	4-2-25	Included paragraph in Section 4.3.3c regarding procedures to ensure timely quarterly QA/QC checks. Removed references to Climeco. Other minor updating of nomenclature	CF Industries	T. Fleming

Document Purpose

The purpose of this document is the establishment of a Monitoring Plan per the Climate Action

Reserve (CAR) Nitric Acid Production Project Protocol v2.2 for all monitoring and reporting activities associated with the N_2O Secondary Abatement Project at the Yazoo City AOP #9 Nitric Acid Plant (NAP) in Yazoo City, Mississippi. The Monitoring Plan will serve as the basis for verifiers to confirm that the monitoring and reporting requirements in Section 6 and Section 7 of the Nitric Acid

Production Project Protocol v2.2 have been and will continue to be met, and that consistent, rigorous monitoring and record-keeping is ongoing at the project site. The Monitoring Plan must cover all aspects of monitoring and reporting contained in this protocol and must specify how data for all relevant parameters will be collected and recorded.

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1 Introduction

Nitrous Oxide (N_2O) is an undesired by-product gas from the manufacture of nitric acid. N_2O is formed during the catalytic oxidation of ammonia. Over a suitable catalyst, a maximum 98% (typically 92-96%) of ammonia fed is converted to nitric oxide (NO). The remainder participates are undesirable side reactions that lead to the production of N_2O, among other compounds.

Waste N_2O from nitric acid production is typically released into the atmosphere, as it does not have any economic value or toxicity at typical emission levels. N_2O is an important greenhouse gas (GHG) which has a high global warming potential (GWP) of 265.

The current project activity involves the installation of a secondary catalyst to abate N_2O inside the reactor once it is formed. The project boundary encompasses the complete Terra Yazoo City AOP#9 Nitric Acid Production Plant, from the inlet of the ammonia burner to the waste gas stack.

The baseline scenario is determined to be the release of N_2O emissions to the atmosphere at the currently measured rate, in the absence of regulations to restrict N_2O emissions. If regulations on N_2O emissions are introduced during the crediting period, the baseline scenario shall be adjusted accordingly.

The baseline emission rate was determined by measuring the N_2O emission factor during the complete production campaign before project implementation. To ensure the data obtained during the initial N_2O measurement campaign used to determine the baseline emission factor is representative of actual GHG emission from the source plant, a set of process parameters known to affect N_2O generation under the control of the plant operator will be monitored from historical data.

Baseline emissions will be dynamically adjusted from activity levels on an ex-post basis through monitoring the amount of nitric acid production. Project N_2O emissions will be monitored directly in real time. Additional N_2O monitoring and recording facilities will be installed to measure the amount of N_2O emitted by the project activity.

The project activity will reduce N_2O emissions and will neither increase nor decrease direct emissions of other air pollutants. The project does not impact local communities or access of services in the area.

2 Project Summary

2.1 Project Description

The current project activity involves the installation of a new (not previously installed) catalyst below the oxidation gauzes (a "secondary catalyst") whose sole purpose is the decomposition of N_2O. Due to high temperature and the pressure of the secondary catalyst, the N_2O previously formed is converted into N_2 and O_2.

The secondary approach has the following advantages:

- The catalyst does not consume electricity, steam, fuels or reducing agents (all sources of leakage) to eliminate N_2O emissions.
- Installation is relatively simple and does not require any new process unit or re-design of existing ones (in some cases, the reactor basket may need some modifications to accommodate the new catalyst).
- Installation can be done simultaneously with a primary gauze changeover; thus, the loss in production due to incremental downtime will be eliminated.
- Considerably lower capital cost when compared to other approaches.

The secondary abatement technology has been tested in several industrial trials in which it has proven to be reliable at reducing N_2O as well as environmentally safe. Most notably, its implementation does not lead to increased NO_x emissions, nor is the environment directly or indirectly harmed in any other way. There are several secondary catalyst suppliers which in essence offer the same technical approach (high temperature N_2O heterogeneous decomposition).

3 Project Monitoring

3.1 Monitoring Parameters

The following parameters will be monitored in order to calculate baseline and project emissions.

3.1.1 General Parameters

Data / Parameter:	**Regulations**
Description:	Project Developer attestation to compliance with legal requirements relating to the project
Data unit:	Environmental Regulations
Source of data:	Local and Federal environmental agencies
Measurement procedures (if any):	N/A
Value Applied:	N/A
Measurement frequency:	Each verification
QA/QC procedures:	N/A
Any comment:	Information used to: 1. Demonstrate ability to meet the Legal Requirements Test – where regulation would require the abatement of N_2O or the installation of certain NOx emission control technology that will impact N_2O emissions

	2. Demonstrate compliance with associated environmental rules, e.g. criteria pollutant emission standards

Data / Parameter:	**OT_h**
Description:	Oxidation temperature
Data Unit:	ºC (and ºF)
Source of data:	The parameter is recorded every hour during baseline and project monitoring and compared with the normal range of oxidation temperature according to the Protocol.
Measurement Procedures (if any):	Reactor temperature is measured by multiple thermocouples installed below the oxidation catalyst; signals are acquired by the plant DCS and stored electronically at discrete time intervals.
Value Applied:	
Monitoring Frequency:	Every hour
QA/QC procedures:	Critical process instrumentation is maintained on a routine basis. Instruments are changed during each gauze change regardless of their condition.
Any comment:	Control board alarms are set for the #9 AOP plant at the Allowable Operating Conditions (AOC) limits, which correspond with the Safe Operating Control Limits (SOCL) in the plant operating procedures. A control board alarm will trigger any time an AOC is reached, and prompt corrective action will be taken to return the plant operations to within the AOCs.

Data / Parameter:	**OP_h**
Description:	Oxidation pressure
Data unit:	Bar (and lb./in^2)
Source of data:	The parameter is recorded every hour during baseline and project monitoring periods and compared with the normal range of oxidation pressure according to the Protocol
Measurement Procedures (if any):	Oxidation pressure is tracked by an electronic pressure transducer located at the compressor's outlet. Signals are acquired by the plant DCS and stored electronically at discrete time intervals.
Value Applied:	
Monitoring frequency:	Every hour
QA/QC procedures:	Critical process instrumentation is maintained on a routine basis. Accuracy check (transmitter) scheduled once every year.
Any comment:	Control board alarms are set for the #9 AOP plant at the Allowable Operating Conditions (AOC) limits, which correspond with the Safe Operating Control Limits (SOCL) in the plant operating procedures. A control board alarm will trigger any time an AOC is reached, and prompt corrective action will be taken to return the plant operations to within the AOCs.

Data / Parameter:	**OT_{normal}**
Description:	Permitted range for oxidation temperature
Data unit:	ºC
Source of Data:	The temperature range has been obtained from the facility's Safe Operating Control Limits. (SOCLs).
Measurement Procedures (if any):	
Value Applied:	760.0 °C (1400 °F) – 956.7 °C (1754 °F)
QA/QC procedures:	N.A.

Additional information:	Previous limits determined based on historical data imposed undesirable production rate limitations on plant following N_2O and additional NO_x abatement catalyst installations. Revised limits ("Value Applied" above) were requested via variance and were accepted by Climate Action Reserve in variance determination dated 9/15/2022.

Data / Parameter:	**OP_{normal}**
Description:	Permitted range for oxidation pressure
Data unit:	Bar
Source of data:	The pressure range has been obtained from the facility's Safe Operating Control Limits (SOCLs).
Measurement procedures (if any):	
Value Applied:	5.52 bar (80.0 psi) – 7.45 bar (108 psi)
QA/QC procedures:	N.A.
Additional information:	Previous limits determined based on historical data imposed undesirable production rate limitations on plant following N_2O and additional NO_x abatement catalyst installations. Revised limits ("Value Applied" above) were requested via variance and were accepted by Climate Action Reserve in variance determination dated 9/15/2022.

Data / Parameter:	**AIFR**
Description:	Ammonia to air ratio
Data unit:	% (dimensionless, from volumetric flows)
Source of Data:	The parameter is recorded every hour during baseline and project monitoring periods and compared with the normal range of oxidation temperature according to the Protocol
Measurement procedures (if any)	Air flow to oxidation reactor is tracked by mass flow measuring device and ammonia flow to oxidation reactor is tracked by a differential pressure measuring device (orifice plate type); signals are acquired by the plant DCS and stored electronically at discrete time intervals.
Value Applied:	
Monitoring frequency:	Every hour
QA/QC procedures:	Critical process instrumentation is maintained on a routine basis. Accuracy check (transmitter) scheduled once every year for both Ammonia and Air flow meters.
Additional information:	Control board alarms are set for the #9 AOP plant at the Allowable Operating Conditions (AOC) limits, which correspond with the Safe Operating Control Limits (SOCL) in the plant operating procedures. A control board alarm will trigger any time an AOC is reached, and prompt corrective action will be taken to return the plant operations to within the AOCs.

Data / Parameter:	**$AIFR_{MAX}$**
Description:	Maximum ammonia to air ratio
Data unit:	% (dimensionless)
Source of data:	The parameter is recorded every hour during baseline and project monitoring periods and compared with the maximum ratio according to the Protocol. The maximum ratio has been determined from the facility's Safe Operating Control Limits (SOCLs).
Measurement procedures (if any):	
Monitoring frequency:	once

Value Applied:	11.8%
Additional information:	Previous limit determined based on historical data imposed undesirable production rate limitations on plant following N_2O and additional NO_x abatement catalyst installations. Revised limits ("Value Applied" above) was requested via variance and were accepted by Climate Action Reserve in variance determination dated 9/15/2022.

Data / Parameter:	**CPV_{cap}**
Description:	Campaign production volume cap
Data unit:	Ton (metric) HNO_3
Source of data:	Calculated from nitric acid plant production data
Measurement procedures (if any):	N.A.
Value Applied:	
Monitoring frequency:	once
QA/QC procedures:	N.A.
Additional information:	Calculated once considering historical data from 5 campaigns previous to the baseline campaign. This limits the length of the baseline sampling period by ending data collection when nitric acid production meets the value of the cap.

Data / Parameter:	**ER**
Description:	Emission reductions for the reporting period
Data unit:	tCO_2e
Source of data:	Calculated
Measurement procedures (if any):	N/A
Value Applied:	N/A
Monitoring frequency:	Per reporting period
QA/QC procedures:	
Any comment:	The information will be stored in electronic records for 10 years from the date of generation or a minimum of 7 years from the date of the last verification.

Data / Parameter:	**HNO_{3MAX}**
Description:	Historical maximum annual average nitric acid production
Data unit:	tHNO3/day
Source of data:	Calculated from the historical production data for 5 years previous to the baseline campaign, considering daily data.
Measurement procedures (if any):	N.A.
Value Applied:	
Monitoring frequency:	Once
QA/QC procedures:	Production data will be cross checked against accounting records.
Additional information:	Calculated once from historical production data, averaged over 12-month intervals

Data / Parameter:	**$HNO_{3\ MAX,\ scaled}$**
Description:	Historical maximum annual average nitric acid production scaled to length of campaign
Data unit:	$tHNO_3$
Source of data:	Calculated from $HNO_{3\ MAX}$ and scaled to campaign hours

Measurement procedures (if any):	N/A
Value Applied:	
Monitoring frequency:	Each Campaign
QA/QC procedures:	Production data will be cross checked against accounting records.
Any comment:	The information will be stored in electronic records for 10 years from the date of generation or a minimum of 7 years from the date of the last verification.

Data / Parameter:	**OD_n**
Description:	Days of operation in the campaign for which $HNO_{3,MAX,scaled}$ is being calculated
Data unit:	Days
Source of data:	Operating Records
Measurement procedures (if any):	N/A
Value Applied:	
Monitoring frequency:	Per campaign
QA/QC procedures:	
Any comment:	

3.1.2 Baseline Calibration Parameters

Data / Parameter:	**$N_2O_{conc,\ BL}$**
Description:	Baseline N_2O concentration in the stack gas at normal conditions (101.325 Pa, 0ºC)
Data unit:	$tN_2O\ /m^3$ (from cm^3/m^3 or ppmv)
Source of data:	N_2O analyzer - Data minimally stored every one minute per the protocol.
Measurement procedures (if any):	N_2O concentration is measured by an on-line analyzer (non-dispersive infrared principle). A gas stream is continuously drawn from the stack by the sampling system, properly conditioned and transported to the infrared cell. The device is set up to measure concentration and record the output electronically every one minute.
Value Applied:	
Monitoring frequency:	Every1 minute
QA/QC activities:	Maintenance and verification according to vendor specifications. Ongoing QA/QC activities as per EN 14181. (Note – CAR variance received to allow the use of EN 14181 during the baseline period).
Any comment:	Measured during a complete campaign before project implementation to properly characterize the baseline emission factor. Determined value = 2,083 mg/Nm^3

Data / Parameter:	**F_{BL}**
Description:	Baseline gas volume flow rate in the stack expressed in normal conditions (101.325 kPa, 0ºC)
Data unit:	Nm^3/hour (and ft^3/min)
Source of data:	Rosemount 3051 SFA - Data minimally stored every one minute per the protocol.
Measurement procedures (if any):	Stack flow is measured by a Rosemount 3051 SFA device. The device is set up to measure flow and record the output electronically every one minute.
QA/QC activities:	Maintenance according to vendor specifications. Ongoing QA/QC activities as per EN 14181. (Note – CAR variance received to allow the use of EN 14181 during the baseline period).

Additional information:	Measured during a complete campaign before project implementation to properly characterize baseline emission factor. English units are used for continuous (day to day) follow up by the project management team. Determined value = 80,239 Nm^3/h.

Data / Parameter:	**OH_{BL}**
Description:	Total operating hours for the baseline campaign
Data unit:	Hours, hr
Source of data:	Operating records - Daily, compiled for the entire campaign
Measurement procedures (if any):	Plant operating status (on/off) is determined on the basis of preset thresholds for oxidation temperature and/or ammonia flow to the oxidation reactor.
Value Applied:	
QA/QC activities:	Critical process instrumentation is maintained on a routine basis.
Additional information:	Measured during a complete campaign before project implementation to properly characterize baseline emission factor. Determined value = 3,106 hrs.

Data / Parameter:	**$HNO_{3,BL}$**
Description:	Nitric acid (100% concentrated) produced over the baseline campaign
Data unit:	$tHNO_3$
Source of data:	Calculated from campaign-specific production data, compiled for the entire campaign
Measurement procedures (if any):	Daily production is measured by an accurate mass flow meter (Coriolis type) and corrected by the average of several concentration checkups performed in the analytical lab.
Value Applied:	80,266 t
Monitoring frequency:	Daily, compiled for entire campaign
QA/QC activities:	Critical instrumentation is maintained on a routine basis.
Additional information:	Measured during a complete campaign before project implementation to properly characterize baseline emission factor. Determined value = 80,266 metric tons

Data / Parameter:	**BE**
Data unit:	tCO_2e
Description:	Baseline emissions for the reporting period
Source of data:	Calculated
Measurement procedures (if any):	N/A
Value Applied:	
Monitoring frequency:	Per reporting period
QA/QC procedures:	
Any comment:	Emissions that would have occurred in the absence of the project activity, determined through the baseline sampling period. The information will be stored in electronic records for 10 years from the date of generation or a minimum of 7 years from the date of the last verification.

Data / Parameter:	**EF_{BL}**
Data unit:	$tN_2O/tHNO_3$
Description:	Baseline emission factor
Source of data:	Calculated
Measurement procedures (if any):	N/A

Value Applied:	
Monitoring frequency:	Per reporting period
QA/QC procedures:	
Any comment:	The information will be stored in electronic records for 10 years from the date of generation or a minimum of 7 years from the date of the last verification.

Data / Parameter:	**N_2O_{BL}**
Data unit:	tN_2O
Description:	Total N_2O emissions during the baseline sampling period
Source of data:	Measured
Measurement procedures (if any):	N/A
Value Applied:	
Monitoring frequency:	Continuously, compiled for the entire campaign
QA/QC procedures:	
Any comment:	The information will be stored in electronic records for 10 years from the date of generation or a minimum of 7 years from the date of the last verification.

Data / Parameter:	**$HNO_{3,RP,scaled}$**
Data unit:	tHNO3
Description:	Quantity of nitric acid production used to quantify emission reductions, not exceeding HNO3,MAX,scaled
Source of data:	Calculated
Measurement procedures (if any):	Nitric Acid Production is calculated as follows: 1. The volume of acid produced is measured using a Micromotion flow meter, which is certified annually. The flow rate data is recorded by the plant's PI system (data historian) as a daily total (midnight to midnight). The daily total acid flow is automatically populated from PI into a Midnight Report spreadsheet, which is the source of daily total HNO3 production for accounting records. 2. Product acid samples are collected every four hours and taken to the plant's QC lab. The samples are then analyzed using a densitometer (recertified regularly), which first measures the sample's density. The density is then converted automatically to a specific gravity and finally to an acid concentration (% by mass). The acid strength values are called by the QC lab to the control room, where they are logged on daily sheets. Once the final strength analysis for a day has been conducted and logged, NAP personnel average the six strength samples and enter the result in the Midnight Report spreadsheet. 3. Tons of acid (100% strength basis) is then computed by multiplying total volume produced for the 24-hour (midnight to midnight) period by the average strength covering the same 24-hour period. Raw data is reported in kilo-pounds and multiplied by a factor of 0.5 to convert that to short tons. $HNO_{3,RP}$ for each project campaign will be sourced from the relevant CF Industries Nitrogen LLC, Gauze Change Memo for the campaign. The figure provided in the Gauze Change Memo is the final accounting figure that has been sourced from Midnight Report spreadsheet data and adjusted for campaign start/end times. Daily

	production values from the Midnight Report spreadsheet will be used as necessary to corroborate the Campaign Memo figures. It should be noted that the campaign total HNO3 production figures sourced from Gauze Change Memos may not match exactly the sums of daily production figures from the Midnight Report spreadsheet data covering the same date range as a campaign. This is because production figures from partial days (i.e., day of startup following gauze change, or day of shutdown to perform gauze change) are manually adjusted to attribute fractions of the daily total production figure to the proper campaign. These manual adjustments are not reflected in the Midnight Report spreadsheet data.
Value Applied:	
Monitoring frequency:	Per reporting period
QA/QC procedures:	
Any comment:	Equal to the lesser of HNO3,MAX,scaled or HNO3,RP.

Data / Parameter:	**EF_{New}**
Data unit:	tN2O/tHNO3
Description:	Default baseline emission factor for production above HNO3,max,scaled
Source of data:	Reference
Measurement procedures (if any):	N/A
Value Applied:	
Monitoring frequency:	Per reporting period, whenever necessary
QA/QC procedures:	
Any comment:	Choose the default factor corresponding to the calendar year of the reporting period (see Table B.1 of protocol). If a reporting period spans multiple calendar years, the more conservative (i.e. lower) EFNew should be used

Data / Parameter:	**$HNO_{3,New}$**
Data unit:	tHNO3
Description:	Quantity of nitric acid production by which HNO3,RP exceeds HNO3,MAX,scaled
Source of data:	Calculated
Measurement procedures (if any):	N/A
Value Applied:	
Monitoring frequency:	Per reporting period
QA/QC procedures:	
Any comment:	Equal to the difference between HNO3,MAX,scaled and HNO3,RP

3.1.3 Project Calibration Parameters

Data / Parameter:	**$N_2O_{conc,n}$**
Data unit:	tN_2O/m^3 (from cm^3/m^3 or ppmv)
Description:	Project N_2O concentration in the stack gas at normal conditions (101.325 Pa, 0ºC)

Source of data:	N_2O analyzer - Data minimally stored every one minute per the protocol
Measurement procedures (if any):	N_2O concentration is measured by an on-line analyzer (non-dispersive infrared principle). A gas stream is continuously drawn from the stack by the sampling system, properly conditioned and transported to the infrared cell. The device is set up to measure concentration and record the output electronically every one minute.
Value Applied:	
Monitoring frequency:	Every one minute
QA/QC procedures:	Maintenance and verification according to vendor specifications. Ongoing QA/QC activities as per CAR Protocol requirements.
Any comment:	Measured during the complete lifetime of the project activity.

Data / Parameter:	**F_n**
Data unit:	Nm^3/hour (and ft^3/min)
Description:	Project gas volume flow rate in the stack gas expressed in normal conditions (101.325 Pa, 0ºC)
Source of data:	Rosemount 3051 SFA device - Data minimally stored every one minute per the protocol.
Measurement procedures (if any):	Stack flow is measured by a Rosemount 3051 SFA device. The device is set up to measure flow and record the output electronically every one minute.
Value Applied:	
Monitoring frequency:	Every 1 minute
QA/QC activities:	Maintenance according to vendor specifications. Ongoing QA/QC activities as per CAR Protocol requirements.
Additional information:	English units are used for continuous (day to day) follow up by the project management team. Measured during the complete lifetime of the project activity.

Data / Parameter:	**OH_n**
Data unit:	Hours, hr
Description:	Total operating hours for the "n" project campaign
Source of data:	Operating records - Daily, compiled for the entire campaign
Measurement procedures (if any):	Plant operating status (on/off) is determined on the basis of preset thresholds for oxidation temperature and/or ammonia flow to the oxidation reactor.
Value Applied:	
Monitoring frequency:	Daily, compiled for full campaign
QA/QC activities:	Critical process instrumentation is maintained on a routine basis.
Additional information:	Measured during the complete lifetime of the project activity.

Data / Parameter:	**PE**
Data unit:	tCO_2e
Description:	Project emissions for the reporting period
Source of data:	Calculated
Measurement procedures (if any):	
Value Applied:	
Monitoring frequency:	Per reporting period
QA/QC procedures:	

Any comment:	Emissions resulting from project activities. The information will be stored in electronic records for 10 years from the date of generation or a minimum of 7 years from the date of the last verification.

Data / Parameter:	**N_2O_n**
Data unit:	tN_2O
Description:	Total N_2O emissions during the project campaign
Source of data:	Calculated
Measurement procedures (if any):	
Value Applied:	
Monitoring frequency:	Per campaign
QA/QC procedures:	
Any comment:	The information will be stored in electronic records for 10 years from the date of generation or a minimum of 7 years from the date of the last verification.

3.2 Monitoring Requirements

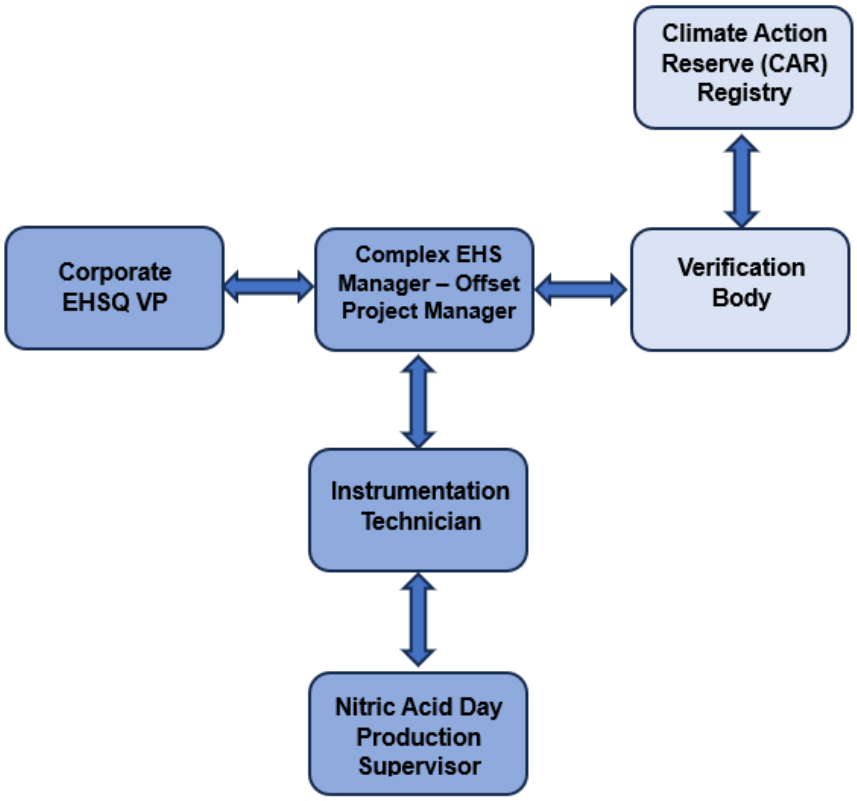
The current carbon offset project will measure on a quasi-continuous basis (uninterrupted sampling of the flue gases with concentration and normalized flow analysis in short, discrete time periods) the N_2O mass flow leaving nitric acid plant through a Continuous Emission Monitoring System (CEMS).

The management and operation of the proposed nitrous oxide abatement project will be handled by the plant operating team. Written procedures describing roles and responsibilities, as well as key project activities (such as calibration of key instruments), will be developed to deploy the current monitoring plan. The emission reductions will be audited at least annually by an independent third-party verifier.

The tables above (section 3.1 Monitoring Parameters) describe the parameters to be acquired and recorded according to the current monitoring plan for project campaigns. The Protocol v2.2 requires that certain process parameters are monitored to be compared against the permitted operating conditions. Only those N_2O measurements taken when the plant is operating within the permitted range will be considered during the calculation of baseline emissions.

3.3 Operational and Management Structure

The relation between the project operational and management structure, and other participants of the proposed project, is as follows:



a) Nitric Acid Production Superintendent

- This is the person responsible for the normal operation of the Nitric Acid Plant.
- The Nitric Acid Production Supervisor's duties involve:
    - All plant operations and supervision within normal conditions and safety standards.
    - Report any deviations occurring in the plants to the EH&S Manager (including those affecting the offset project activities).
    - Responsible for monitoring data acquisition for offset project activities, for example: Honeywell log information and operator log sheets. It is his duty to review and check the log sheet to ensure that corrective/remedial actions are taken and to inform the EH&S Manager of any deviations.
    - Ensure that the analyzer and all measurement instrument and meters are calibrated as scheduled.
    - Ensure that calibration span gas is available when required.
    - Ensure that the CEMS and DAS (Data Acquisition System) are operating normal and properly maintained.
    - Report all relevant data to the Instrumentation Technician.

b) Instrumentation Group

- The Instrumentation group has about ten Instrument Technicians, and is a part of the Complex's Maintenance department as plant support services. This is the group of people primarily responsible for maintaining the nitric acid plant CEMS systems, processing the data generated by the data acquisition systems and forwarding this information to the relevant parties concerned.
- The Instrument Technician's duties involve:
    - Receive any relevant plant data from the Nitric Acid Day Supervisor and enter this data into a spreadsheet specially designed for monitoring purposes (monitoring spreadsheet).
    - Complete analytical cross-check to verify all meters and instruments.
    - Forward the spreadsheet and daily reports generated by the data acquisition system to the Project Consultant.
    - Correct or acquire special support services as needed to assist with any deviations he may identify and/or those reported by the Nitric Acid Day Supervisor.
    - Keep a maintenance log on the instrumentation and all changes made to the system.

c) EH&S Manager (Offset Project Manager)

- This is the person responsible to ensure that the offset project activity at the plant level is implemented in compliance with the Monitoring Plan and other relevant standards.
- The EH&S Manager's duties involve:
    - Work with the Project Developer in analyzing data and ensure appropriate and consistent procedural application during report preparation.
    - Routinely report to the Corporate EHS&Q VP as to the overall progress of the offset project activity.
    - At any time he wants or needs to follow the implementation, progress and monitoring of the offset project activity he will ask for a report from the I&E Technician.
    - Ensure that compliance with the monitoring methodology and the monitoring plan are completely assured at all times.

d) Corporate EHS&Q Vice President

- The CF Corporate Environmental, Health, Safety and Quality vice president (EHS&Q VP) acts as overall carbon initiative liaison, coordinating companywide policies and activities related to GHG inventories, internal and external reporting and offset projects and programs.
- The Corporate EHS&Q VP's duties involve:
    - Proposes initiatives and reports results to higher management related to GHG activities company-wide. For this project, responsibilities include seeking approval and reporting results from/to higher management.
    - Responsible for monitoring potential changes in legislation related to both NO_x and N_2O. This position serves as the primary contact with the national trade association which represents nitric acid production facilities in the United States (The Fertilizer Institute). TFI participates in all U.S. regulatory action applicable to TFI member companies and their associated manufacturing sites.

The Yazoo City Complex level structure, roles and responsibilities highlighted above ensure adherence to the protocol and monitoring plan provisions.

3.4 Procedure and Responsibility

CF Industries is a member of the Fertilizer Institute (TFI), a national trade association based in Washington DC. TFI is the leading voice in the fertilizer industry, representing the public policy, communication and statistical needs of producers, manufacturers, retailers and transporters of fertilizer. Issues of interest to TFI members include security, international trade, energy, transportation, the environment, worker health and safety, and farm bill and conservation programs to promote the use of enhanced efficiency fertilizer. TFI staff assists members with local, state, national, and international regulatory compliance support.

One of TFI's roles is keeping its members aware of both compliance voluntary rules and programs proposed by environmental authorities or other industry stakeholders that may affect its associates. TFI proactively participates in the program or rulemaking process in close interaction with its proponents.

The Corporate EHS&Q VP serves as the main point of contact with TFI, while specific plant EH&S Managers also participate in meetings and task forces on the association. The monitoring of regulations that may affect the current offset activity is done by the Corporate EHS&Q VP by formal communication (via e-mail, at least once per year) with the TFI chair.

Once the regulation becomes effective, it is the responsibility of the EH&S Manager of the Yazoo City Complex to implement the modifications necessary to comply with the newly modified regulation; i.e. adapting the project activity, monitoring plan, reporting and/or calculation procedures, with continuous support from the Project Developer.

4 CEMS Recordkeeping and Data Acquisition and Handling System (DAHS)

4.1 N_2O Instrumental Analyzer

The Yazoo City AOP#9 plant installed the AO2000 Series – Uras26 supplied by ABB. Each molecular compound has a unique combination of atoms, each producing a unique infrared spectrum. The continuous non-dispersive infrared (NDIR) industrial photometer Uras26, can selectively measure up to four sample components (gases). It uses one or two beam paths with one or two receivers in each beam path.

4.2 Stack Flow Measurement

The Yazoo City AOP#9 plant installed a Rosemount 3051 SFA flow meter. The Rosemount 3051 SFA is stainless steel, with the serial number 56247, and has stainless steel mounting brackets to mount it to the pitot tube. Depending on where the transmitter meets the pitot tube will determine possible leak points. A soap solution is sufficient for detecting possible leak points.

4.3 QA/QC Requirements

The QA/QC activities for the project are defined following sections 6.1 and 6.2 of the Nitric Acid Production Project Protocol, Version 2.2, as published on April 18, 2019.

The QA/QC program is based on requirements set on 40 CFR part 75 Appendix B and 40 CFR part 60 Appendix B. Other appendices and documents are used as appropriate when reference by this Monitoring Plan.

The following QA/QC requirements will be met:

- Procedures for preventive maintenance of the monitoring system
- Preventive maintenance record-keeping and reporting procedures
- Testing, maintenance and repair activity records for CEMS or any component of CEMS
- Insuring adequate spare parts inventory for timely repair of CEMS
- Calibration error test and linearity check, cycle time procedures
- RATA procedures, such as sampling and analysis methods
- Record-keeping and reporting procedures
- 7-day drift test

Note: Since the facility initially installed the CEM system consistent EN 14181 requirements per the approval of CAR, some of these requirements at system installation may not have been completed.

The tests and schedules for the frequency of testing for the current project are adopted from Section 2, Appendix B of 40 CFR Part 75 (as indicated on section 6.2.1 of the Protocol). Table below summarizes the test requirements:

Table 4-1. *Test Requirements.*

	Daily		Quarterly		Semi or Annually	
	C	F	C	F	C	F
Calibration Error Test	✓			✓		
Calibration Adjustments	✓			✓		
Data Validation	✓		✓	✓	✓	✓
Quality Assurance	✓					
Data Recording	✓					
Linearity Check			✓			
Leak Check				✓		
Linearity and Leak Check Grace Period			✓	✓		
Relative Accuracy Test Audit					✓	✓
RATA Grace Period					✓	✓
Bias Adjustment Factor applied					✓	✓

C = Concentration (activity to be performed over the concentration component of the CEMS)
F = Flow (activity to be performed over the flow compinent of the CEMS)
Items highlighted in bold are key tests/calibration activities. Items italicized are indicative of secondary activities which describe preparatory or procedural matters relative to the key tests.

As explained in the following section, the managing team at the Yazoo City plant is responsible for the implementation of the QA/QC activities as described on the schedule, as well as properly safeguarding activities results and documentation (such as log blocks, calibration data, third party reports, etc.).

4.3.1 System Installation and Commissioning

On July 30, 2010 (pursuant formal request by CF-Terra) CAR granted a variance approval for the period 16-April-09 to 15-November-10. Under the variance approval, the Project was allowed to follow the installation and certification QA/QC provisions of European Norm EN14181 (in lieu of the provisions based on EPA 40 CFR rules) during the given period. Then the specification, installation and commissioning of the CEMS was performed following QAL1 and QAL2 quality assurance levels as described on EN 14181. While these activities were audited during the 1st periodic verification, all related documentation and reports are well safeguarded and available for further review by any Verification team during the lifetime of the project.

It is necessary to note that the allowed variance mentioned above was approved for a period ending November 15, 2010 and that all current verifications will no longer follow the installation and certification QA/QC provisions of European Norm EN14181. Starting with Campaign 6, installation and certification QA/QC provisions will follow EPA 40 CFR part 75 requirements set out by the CAR protocol.

4.3.2 Daily CEMS Calibration Procedures

N_2O Analyzer:

A calibration will be conducted daily on the N_2O analyzer whether or not the process is operating. During each calibration, the gases will be exposed to as much of the sampling gas as practical. The gases will be directed to the system manifold, up to the probe assembly, and then to the analyzer. The gases will be injected until a stable reading is obtained by the DAHS. Certified grade gases will be used for the daily calibrations.

The calibration gases for the N_2O Analyzer:

- Zero gas – 0 to 20 percent of analyzer span (0 to 400 ppm)
- Span gas – 80-100 percent of analyzer span (1600to 2000 ppm)

The minimum pressure for the daily calibration cylinders will be 150 pounds per square inch (psi). A calibration gas will not be used (and will be replaced) if the minimum pressure is not maintained. Following completion of the calibrations, the analyzers may be adjusted depending on the calibration results. A summary of the daily analyzer calibration check criteria and corrective action items are provided in below.

Table 4-2. *Daily N_2O Analyzer Calibration Check Criteria and Corrective Action.*

Calibration Result	Action Required	CEMS in-Control*
Less than 2.5% of the N_2O analyzer span	No action required	Yes
Greater than 2.5% but less than 5.0% of the N_2O analyzer span	Recommend: Analyzer adjustment	Yes
Greater than 5.0% of the N_2O analyzer span	Corrective action and repair!	No

*CEMS remains out of control until a daily analyzer calibration is successfully passed.

CEMS data is prospectively validated for 26 clock hours (i.e., 24 hours plus a two-hour grace period) beginning with the hour in which a daily calibration is passed. CEMS data are invalid beginning with the first hour following the expiration of this 26-hour validation period. The validation period expires if no daily check is successfully passed within the period.

Routine calibration adjustments of a monitor are permitted after any successful daily calibration. These routine adjustments shall be made to bring the analyzer readings as close as practical to the calibration gas values. An additional complete (zero and span) calibration check is required following routine analyzer adjustments.

The CEMS automatically records the results of daily calibration checks. If the error is less than 2.5% no action is taken. If the error is 2.5% or higher and less than 5.0% for two consecutive days, a recalibration occurs. If the error is greater than or equal to 5.0% a recalibration occurs immediately. If the recalibration fails, the system sends a maintenance alarm to operations, and does not record concentration until there is a successful calibration.

4.3.3 Quarterly Test Procedures

A. Quarterly CEMs Linearity Checks

Linearity checks are to be conducted on the N_2O analyzers at least once during each Quality Assurance (QA) operating quarter for which no Relative Accuracy Test Audit (RATA) is conducted. If more than one linearity check is performed in a quarter, it can be no less than 30 days from the previous check (Part 75, Appendix B, Section 2.2.1). The linearity check will be conducted while the process is online and in accordance with general procedures outlines in section 6.2 of Appendix A, Part 75 using certified grade audit gases.

During the linearity check, the monitor is to be challenged three times with each audit gas at the low-, mid-, and high- range concentrations specified in section 5.2 of Appendix A, Part 75. Do not use the same gas twice in succession. While the monitor is operating at normal temperature and conditions, the audit gases will be introduced at the injection port, directed up to the sample probe and back to the monitor. For extraction and dilution type monitors, pass the calibration gas through all filters, scrubbers, conditioners, and other monitor components used during normal sampling and through as much of the sampling probe as is practical. The gases are to be injected for a period long enough to ensure that a stable reading is obtained from the DAHS.

To the extent practicable, the duration of each linearity check, from the hour of the first injection to the hour of the last injection, shall not exceed 24 unit operating hours. Record the monitor response from the DAHS. For each concentration, use the average of the responses to determine the error in linearity using the equation below.

$$LE = \frac{R-A}{R} * 100$$

LE = linearity error
R = reference value of the calibration gas
A = average of the monitoring system responses

Data validation procedures (Part 75, Appendix B, Section 2.2.3) state that a linearity check shall not be commenced if the monitoring system is operating out-of-control with respect to any of the daily or semiannual quality assurance assessments (Part 75, Appendix B, Section 2.1 and 2.3) or with respect to the additional calibration error test requirements (Part 75, Appendix B, Section 2.1.3).

Linearity checks are to be conducted "hands-off", or without corrective maintenance, repair, calibration adjustments, re-linearization or reprogramming of the monitor prior to the test. However, routine and non-routine calibration adjustments can be conducted at any of the three audit points prior to the linearity check. If any activities that are considered "hands-off" are required to be conducted prior to the linearity check, the monitor is required to be classified as out-of-control from the hour in which the repairs are commenced until the hour a linearity check has been successfully completed.

A.1. Linearity Check Criteria

For N_2O monitors, the linearity check results are considered acceptable if the error in linearity for each calibration gas concentration greater than 100ppm (low, mid, and high) does not exceed or deviate from the reference value by more than 5.0 percent (using equation A-4 from Part 75, Appendix A). For concentrations less than 100ppm, linearity check results will be considered acceptable if the absolute value of the difference between the average of the monitor response values and the average reference values is less than or equal to 5ppm.

If neither of these outcomes is achieved, the CEMS is considered out-of-control until corrective action has been taken, and a linearity check is passed. The timeframe for invalid data will be the hour in which the first linearity check failed until the start of the first hour after a passed linearity check.

The information will be stored in electronic records for 10 years from the date of generation or a minimum of 7 years from the date of last verification.

B. Flow rate Quarterly Leak Checks

The manufacturer of the Mid-West Delta Tube confirmed that leak check tests for installed systems are limited to visible leak checks. The leak checks are to be conducted at the flange connections from the Pitot tube instrument to the transmitter device. Each connection / flange shall be tested with a soapy solution once per quarter. If leaks are observed, the connection / flange shall be repaired and the leak recorded on the calibration data sheet.

C. Transmitter Calibration

The linearity of the transmitter shall be confirmed quarterly using a 4-20 milliamp (ma) signal. The transmitter shall be calibrated at five points, namely, 0%, 25%, 50%, 75% and 100% of span, corresponding to 4 ma, 8 ma, 12 ma, 16, ma and 20 ma, respectively. The technician shall record the as left readings and compute the percent of span on the data sheet. If the error exceeds 2% of span, it is recommended that the technician recalibrate the transmitter, leaving the revised reading in the as left column.

Quarterly QA/QC activities are tracked in the Maintenance planning process, which is a computerized system that tracks preventive maintenance scheduling to ensure timely execution. As an additional check, these same quarterly QA/QC activities will be entered into the corporate Environmental Management Information System (EMIS) software, which is used as a tool to track many other EHS-related action items.

4.3.4 Annual CEMS Relative Accuracy Test Audit (RATA) Procedures

Terra Industries Inc. will contract for a RATA to be conducted that follow the requirements in Appendix A and B of 40 CFR Part 60 and Appendix A od 40 CFR Part 75. Annual RATAs will be conducted if the Relative Accuracy meets the 7.5% requirement as specified in Appendix A of 40 CFR Part 75, Section 3.3. If the Relative Accuracy is greater than 7.5%, Terra Industries Inc. will be required to have semi-annual RATAs conducted.

A. Test Plan

A certification protocol will be submitted by the RATA contractor for facility approval prior to each CEMS certification. This protocol will be structured to ensure that the resultant RATA report will include, at a minimum, the following information:

- Process and CEMS description
- Stack and process schematics
- Process operating conditions during the testing
- Sampling test methods
- Test equipment QA/QC procedures
- Example Calculations
- Field test schedule

The test methods to be used during the RATA include:

- USEPA Method 1: Sample and Velocity Traverses for Stationary Sources
- USEPA Method 2: Determination of Stack Gas Velocity and Volumetric Flow Rate
- USEPA Method 3A: Oxygen and Carbon Dioxide Analysis (Instrument Analyzer Procedure)
- USEPA Method 4: Determination of Moisture Content in Stack Gases
- USEPA Method 320: Determination of Gaseous Compounds by Extractive Direct Interface Fourier Transform Infrared (FTIR) Spectroscopy.

B. General RATA Procedures and RA Criteria

The RATA will consist of nine to twelve 21-minute test runs during which the N_2O CEMS will be certified in units of parts per million on a wet basis (ppm, wet) and pounds per hour (lb./hour). The flow rate monitoring system (FRMS) will be certified in units of standard cubic feet per minute (scfm). Note that the RATA contractor will conform to the accreditation requirements outlines in ASTM D7036-04.

During the RATA, the process will operate at a normal load point which is greater than 50% of rated capacity. The RATA will be conducted at a single process set-point.

The following are RATA criteria for each certified unit.

N_2O, ppm, wet – 7.5% based on the reference method for annual certification or 10% of the reference method for semiannual certification

Volumetric flow, scfm – 7.5% based on the reference method for annual certification or 10% of the reference method for semiannual certification

C. Bias Test

Following completion of the CEMS RATA, the RATA contractor will conduct a bias test on the N_2O and flow monitoring systems in accordance with procedures outlined in 40 CFR Part 75, Appendix A, Section 7.6. If the mean difference between the reference method and facility data sets is greater than the absolute value of the confidence coefficient the monitoring system has failed the bias test and a bias adjustment factor (BAF) will be programmed in the CEMS DAHS and applied to N_2O mass emission rate data (lb/hr). This BAF will be used beginning with the first hour following the completion of the RATA and continuing until another bias test is conducted. Results of the bias test may also be included in the final RATA test report.

D. RATA Test Methods

CEMS certification testing will be conducted in accordance with procedures outlined in 40 CFR Part 60 Appendix A, and the Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods, and 40 CFR Part 75, as applicable. N_2O concentrations will be measured in accordance with any of the following test methods in accordance with USEPA Reference Method (RM) 7E certification and sampling procedures:

- USEPA RM 320
- ASTM D6348-03
- ISO/DIS 21258

- AM0034 or AM0028

Non-dispersive infrared (NDIR) or FTIR on-site instrumentation will be used to conduct the certification, depending on the test method selected. Volumetric flow rates will be measured in accordance with USEPA RMs 1 through 3A.

4.3.5 CEMS Recordkeeping

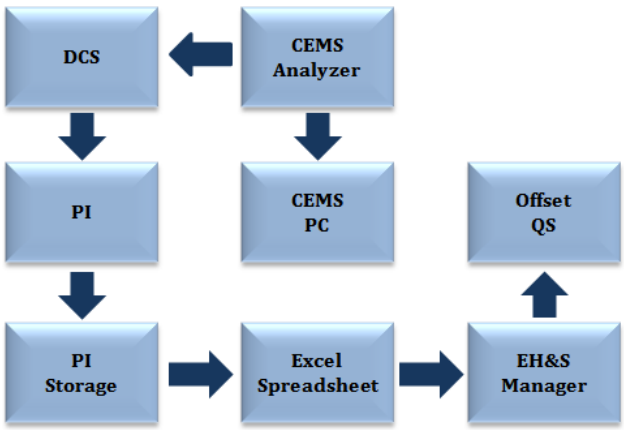
The following CEMS reports will be stored in electronic records for 10 years from the date of generation or a minimum of 7 years from the date of the last verification.

- CEMS certification reports
- CEMS quarterly linearity check results
- N_2O analyzer calibration results
- CEMS semiannual reports (if necessary for RATA)

All relevant instrumentation used to measure process parameters is to be maintained on a routine basis. The specific data generated by the CEMS are acquired and logged electronically in the DCS every minute. The signals generated by these instruments are acquired and logged electronically by the Distributed Control System (DCS) of the plant then transferred to a long term historian database on Allen Bradley's PI software platform. The PI information database is stored indefinitely.

The PI Server is backed up to tape automatically on a daily basis. Furthermore, data access is limited to secure information integrity as follows. Access to the PI system is password protected and limited key personnel on a read and read-export only basis. Only the plant's IT Manager (assigned as PI system administrator) is capable of modifying data stored at PI. No permission has been granted to the IT Manager related to manipulation of the offset data.

Data Flow Chart



4.4 DAHS Verification

Testing will be conducted in the DAHS to verify that hourly averages for pollutant concentrations and mass emission rates are accurately calculated. In addition, proper computation and application of missing data substitution procedures outlined in 40 CFR, Part 75, Subpart D and Bias Adjustment Factors (BAF) in Part 75, Appendix A, Section 7 will also be demonstrated. DAHS verification documentation may be included in the final test report.

The following sections provide descriptions of the CEMS emissions data handling, recordkeeping, and reporting procedures.

4.4.1 Data Substitute Requirements

The CEMS DAHS will substitute N_2O emissions data (hourly averages) for periods in which there is no valid data reported by the CEMS. Missing data will be substituted in accordance with procedures outlined in 40 CFR Part 75.33.

The substituted data used depends on the percentile of valid data available. The two CEMS units that require data substitution are the N2O concentration (ppm, wet) and volumetric flow rate (scfm). The following tables outline the various data substitution scenarios for non-load based units (units that do not produce electrical or thermal output).

Table 4-3. *CEMS N_2O Concentration Missing Data Substitution Routines*

CEMS Data Availability	Duration of CEMS Outage[a]	Calculation Method	Look-back Period (hours)[b]

Greater than or equal to 95%	Less than 24 hours	Average	2,160
	Greater than or equal to 24 hours	90th percentile	2,160
Greater than or equal to 90%, but less than 95%	Less than 8 hours	Average	2,160
	Greater than or equal to 8 hours	95th percentile	2,160
Greater than or equal to 80%, but less than 90%	Any hour	Maximum value[c]	2,160
Below 80%	Any hour	Maximum potential N_2O emission rate[d]	N/A

[a] During unit operation only.
[b] Look-back period consists of quality-assured (in-control) CEMS operating hours only.
[c] Maximum value is the highest CEMS reading observed in the look back period
[d] The maximum potential N_2O emission rate is established for use in the worst case scenario outlined above when the CEMS historical data availability falls below 80 percent. Defined as the highest hourly average measured by a certified CEMS during the previous 720 hours. It must be demonstrated that the control system was in operation during the missing data period. Note: Above table assumes 2160 hours have been achieved.

Table 4-4. *Volumetric Flow Rate Missing Data Substitution Routines.*

Data Availability	Duration of CEMS Outage[a]	Calculation Method	Look-back Period (hours)[b]
Greater than or equal to 95%	Less than 24 hours	Average	2,160
	Greater than or equal to 24 hours	Greater of the 90th percentile or average HB/HA	2,160
Greater than or equal to 90%, but less than 95%	Less than 8 hours	Average	2,160
	Greater than or equal to 8 hours	Greater of the 95th percentile or average HB/HA	2,160
Greater than or equal to 80%, but less than 90%	Any hour	Maximum value[c]	2,160
Below 80%	Any hour	Maximum potential N_2O emission rate[d]	N/A

[a] During unit operation only.
[b] Look-back period consists of quality-assured (in-control) CEMS operating hours only.
[c] Maximum value is the highest CEMS reading observed in the look back period
[d] The maximum potential N_2O emission rate is established for use in the worst case scenario outlined above when the CEMS historical data availability falls below 80 percent. Defined as the highest hourly average measured by a certified CEMS during the previous 720 hours. It must be demonstrated that the control system was in operation during the missing data period. Note: Above table assumes 2160 hours have been achieved

5 CEMS Modification and Change Procedure

Overview

In order to ensure that CEMS performance and data reporting percentages remain within specified criteria, significant changes or modifications to CEMS components (other than like-kind replacement parts), data acquisition systems, calibration procedures, or other operational procedures will be reviewed prior to changes being made. These modifications are typically the result of system component or software upgrades, replacement of CEMS components due to system degradation or malfunction, or technical improvements to the system. CEMS operational and maintenance procedural changes may be in response to changes in permit requirements, regulatory agency guidelines, or requirements of newly installed instrumentation.

CEMS Modifications

CEMS modifications will be assessed with respect to regulatory requirements and manufacturer's specifications to assure that the accuracy of reported CEMS data will not be affected by the modification. Terra Industries Inc. personnel will review the proposed modification to identify whether subsequent audit procedures are warranted as a result of the modification. When a CEMS modification is contemplated, the Project Developer will also review the proposed changes to ensure that they adhere to CAR Nitric Acid Protocol v2.2 requirements and USEPA Part 75. A summary of the CEMS modification will be prepared and will include:

- CEMS impacted by the change
- Reason for the modification
- description of the change
- Potential performance impacts
- Proposed implementation schedule
- Subsequent QA/QC procedures to be conducted (if any)