



Verification Report for CAR768 – Terra Yazoo City # 9, Nitrous Oxide
Abatement Project
December 9, 2017 – September 17, 2018 Reporting Period

Prepared for:
CF Industries Nitrogen, LLC

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1.0 Introduction

Ruby Canyon Engineering, Inc. (RCE) was contracted by ClimeCo America Corporation (ClimeCo) to perform the verification of the CF Industries Nitrogen, LLC (CFIN) Terra Yazoo City # 9, Nitrous Oxide Abatement Project (Project) for the reporting period December 9, 2017 through September 17, 2018 to the Climate Action Reserve (Reserve) Nitric Acid Production Project Protocol Version 1.0 (Protocol). The Project involves GHG emission reductions from the destruction of nitrous oxide (N₂O).

1.1 Project Background & Site Description

The Project activity consists of the installation and operation of a secondary abatement catalyst at a nitric acid plant in Yazoo City, MS. The secondary catalyst was installed below the oxidation gauzes for the purpose of decomposing N₂O and reducing the quantity of N₂O that would have otherwise been released to the atmosphere. The Project is at Nitric Acid Plant #9 at CFIN's facility. CFIN is the project owner and is responsible for ongoing operation and maintenance of the monitoring system and data acquisition and handling system. ClimeCo is the technical consultant to CFIN and is responsible for overall program management, development of monitoring reports, and oversight of the verification process.

This is the verification of the twelfth reporting period for the Project. The reporting period includes two full campaigns, December 9, 2017 to May 8, 2018 and May 9, 2018 to September 17, 2018.

1.2 Responsible Parties

Project Developer

CF Industries Nitrogen, LLC
4608 Highway 49 East
Yazoo City, MS 39194

Technical Consultant

ClimeCo America Corporation
10 North Reading Avenue
Boyertown, PA 19512

1.3 Verification Team

The RCE verification team consisted of the following individuals who were selected based upon verification experience under the Reserve's program and knowledge of U.S. EPA regulations and the nitric acid plant sector.

Lead Verifier: Nina Pinette
Senior Internal Reviewer: Zach Eyler

1.4 Objectives

The goal of the verification activities was to ensure that the claimed GHG emission reductions are complete, consistent, accurate, transparent, and permanent and that the Project was in compliance with the Protocol's project additionality, monitoring, and reporting requirements. Furthermore, the verification activities ensure that the data provided to RCE is well documented and free of any material errors or omissions.

1.5 Scope

The scope of the verification consisted of the following independent and objective activities:

- Review the reporting period's Project Monitoring Plan,
- Conduct a site visit to the Project,
- Review Project boundaries,
- Review Project eligibility,
- Review Project data acquisition and quality control procedures,
- Review Project's historical campaign data and calculation of permitted operating conditions and HNO_3max ,
- Review the Project's baseline campaign data,
- Review the Project's emission reduction calculations,
- Review Project documents and data against the Verification Criteria listed in Table 1,
- Issue requests for corrective actions, additional documentation, and clarifications, as necessary, and
- Issue a Verification Report, List of Findings, and Verification Statement to CFIN and the Reserve.

1.6 Verification Criteria

Table 1 - Verification Criteria

Criteria	Details
Standard of Verification	• Nitric Acid Production Project Protocol Version 1.0 (December 2, 2009) (Protocol) • Errata and Clarifications to Nitric Acid Production Protocol Version 1.0 (January 3, 2017) • Verification Program Manual (February 8, 2017) • Program Manual (September 1, 2015) • Variance Determination dated December 3, 2018
Verification Process	The Reserve Verification Program Manual and ISO 14064-3:2006 "Greenhouse gases – Part 3: Specification with guidance for the validation and verification of greenhouse gas assertions"
Level of Assurance	Reasonable assurance
Materiality	97% materiality threshold (<3% error) because total annual ERs are >25,000 but ≤100,000 tCO ₂ e.

2.0 Verification Activities Summary

RCE developed a verification plan to be followed throughout the verification. The verification plan consisted of the following activities:

- RCE completed the Project NOVA/COI form to identify any potential conflicts of interest with the Project or Project developer. The NOVA/COI form was submitted to the Reserve's website, and the COI assessment revealed no conflicts of interest and was approved by the Reserve on September 6, 2018.

- RCE held a verification kickoff meeting with ClimeCo and CFIN on September 13, 2018. During the kickoff meeting RCE reviewed the verification objectives and process, the verification schedule, and requested the verification background documents.
- RCE performed a strategic review and risk assessment of the received data and support documents in order to understand the scope and areas of potential risk in the GHG emissions reductions.
- RCE developed a risk-based sampling plan based upon the strategic review and risk assessment. The verification plan and sampling plan were used throughout the verification and were revised as needed based upon additional risk assessments.
- RCE conducted a site visit to the Project on October 4, 2018. During the site visit RCE inspected the continuous emission monitoring system (CEMS) equipment; observed the onsite GHG management systems and data gathering, monitoring and handling practices; and interviewed key personnel.
- RCE conducted a detailed desktop review of submitted material including evidence of regulatory compliance, documentation of ongoing QA/QC procedures, source data, and emission reduction calculations.
- RCE submitted requests for corrective actions and additional documentation to ClimeCo throughout the verification.
- RCE's Senior Internal Reviewer conducted a review of the verification sampling, Verification Report, and Verification Statement.
- RCE issued a final Verification Report, Verification Statement, and List of Findings.
- RCE held an exit meeting with ClimeCo.

3.0 Verification Findings

3.1 *Assessment of the GHG Reduction Project Operations*

The Project destroys N₂O from a nitric acid plant (NAP) via a secondary abatement catalyst below the oxidation gauzes located within the ammonia oxidation reactor (AOR). The N₂O emissions per unit of nitric acid production were measured during the baseline campaign using only a primary catalyst in the ammonia oxidation process. The monitoring procedure was repeated in the project campaign after the secondary abatement catalyst was installed in April 2009.

Direct measurements of the N₂O concentration in the stack gas are monitored continuously using a CEMS. The data acquisition and handling system (DAHS) along with the Distributed Control System (DCS) and server are used for CEMS data monitoring, recordkeeping and reporting. The system monitors gas flow rate, N₂O concentration, process temperature, pressure, and ammonia-to-air ratio on a continuous basis and records the data every minute, meeting Protocol requirements.

RCE reviewed the installation and certification, calibration, and accuracy testing of the project monitoring equipment per manufacturer's specifications, confirmed that the requirements of the Protocol were met, and verified the data management systems in place at the Project. RCE confirmed the installation of a secondary abatement catalyst through a site inspection, company records, and previous verification reports. RCE also reviewed company records of NAP operation, maintenance, and downtime and verified that the CEMS monitoring data that CFIN provided to ClimeCo were used as the raw data for the GHG assertion. RCE determined that the Project adhered to the methodology defined in the Monitoring Plan

Version 3.2 throughout the verification and the parameters monitored are in accordance with Table 6.1 of the Protocol.

3.2 GHG Project Boundary (sources, sinks and/or reservoirs)

According to the Protocol, N₂O is the only GHG included from the Baseline and Project activities for secondary abatement projects.

Table 2 lists the sources of GHG emissions reviewed during the verification of the Project.

Table 2 - Project GHG Sources, Sinks and Reservoirs	
Activity	GHG Sources, Sinks & Reservoirs
Baseline	• N ₂ O vented to the atmosphere.
Project	• N ₂ O vented to the atmosphere

3.3 Project Eligibility Criteria

The Protocol specifies four eligibility rules that GHG Project developers must meet in order to register reductions with the Reserve. Below is a summary of the Protocol's eligibility rules and the Project's compliance to each requirement.

- **Eligibility Rule I: Location**

The Project is located at a nitric acid plant in Yazoo City, MS, U.S. The Project therefore meets the location eligibility requirement.

- **Eligibility Rule II: Project Start Date**

RCE verified April 16, 2009 as the project start date. RCE reviewed evidence to support this data including project CEMS data which compared monitored parameters before and after the installation of the catalyst: the N₂O concentration in the stack gas was lower after the catalyst was installed. This project start date is also consistent with the start date defined in verification reports for previous reporting periods. The Project's crediting period is April 16, 2009 to April 15, 2019.

- **Eligibility Rule III: Additionality**

Legal Requirement Test

During the site visit, RCE interviewed CFIN and ClimeCo about the procedures to ensure that the Project meets environmental compliance requirements and the Legal Requirement Test. RCE confirmed that there are currently no laws requiring the abatement of N₂O at the plant. In addition, CFIN's EH&S Corporate Director monitors any change in regulations that may affect eligibility. RCE reviewed CFIN's Title V Permit which was effective through October 31, 2018. RCE also verified that the project developer accurately completed the Attestation of Voluntary Implementation form and uploaded it to the Reserve website.

Performance Standard Test

RCE verified that the Project satisfies the Performance Standard by installing a new secondary N₂O abatement catalyst. RCE reviewed plant data indicating the installation of the catalyst in April 2009.

- **Eligibility Rule IV: Regulatory Compliance**

RCE verified that the Project was in material compliance with all applicable laws throughout the reporting period. RCE reviewed the ECHO database and any entries associated with the CFIN facility.

The Yazoo City facility, along with all CFIN plants (Terra Industries, Inc at the time the consent decree was entered into), was subject to a consent decree with the U.S. EPA from June 2011. The consent

decree resulted from an issue at another CFIN plant. The consent decree required all CFIN plants to comply with NO_x emissions limits. The consent decree was terminated during this reporting period on January 19, 2018. RCE verified that Plant #9 was in compliance with the NO_x emissions limits as required by the consent decree during this reporting period.

RCE contacted the Mississippi Department of Environmental Quality (MDEQ) water branch and a contact from that department confirmed that the CFIN Yazoo City facility did not have any water quality violations during the reporting period. RCE also submitted a Public Records Request Form to the MDEQ air branch and the records returned did not document any violations related to the Project during the reporting period.

Finally, RCE verified that the Attestation of Regulatory Compliance was correctly completed and uploaded to the Reserve.

3.4 Ownership of GHG reductions

CFIN owns the nitric acid plant and thus owns full right to any emission reductions associated with the plant. ClimeCo serves only as a technical consultant to CFIN. RCE also verified that the Attestation of Title was correctly completed and uploaded to the Reserve website after the end of the reporting period.

3.5 Assessment of Information System Controls

The majority of the GHG management systems review took place during the site visit through observations of onsite procedures and interviews with Project key personnel. The onsite review included confirming that the Project monitoring was done by direct measurements from the CEMS for both gas flow rates and N₂O concentration. The Project uses a Rosemount 3051 SFA flow meter to measure gas flows in the stack and an ABB Uras 26 AO2000 Series analyzer to measure N₂O concentration. RCE confirmed the locations of the sample probes within the stack through onsite inspection.

The Project uses the CEMS DAHS coupled with the DCS to electronically log the data. The data is transferred to a long-term historian database on an Allen-Bradley PI software platform. RCE verified that the data management systems met the requirements of Section 6.2.2 of the Protocol.

3.6 CEMS Installation and Certification

The Protocol states that the project developers follow the CEMS installation and certification requirements:

- 40 CFR Part 60, Sec. 60.13
- 40 CFR Part 60, Appendix B, Performance Specification 2
- 40 CFR Part 75, Appendix A, Sec. 6

As is the case with most NAPs located in the U.S., parts of the Project CEMS were installed prior to the Project. RCE conducted a cursory check that the Project met the initial CEMS installation certification requirements. At the time the CEMs was installed, it was installed to meet the requirements of European Norm EN 14181. The Project requested a variance for the installation and certification which was granted to meet Protocol requirements for the first reporting period. From RCE's review, the Project met the initial CEMS installation and certification requirements as verified for the first Project reporting period. RCE verified that the Project met CEMS installation and certification requirements.

3.7 Ongoing CEMS QA/QC Program

RCE confirmed that the ongoing CEMS QA/QC requirements were met throughout the reporting period (project campaigns).

3.7.1 Daily Requirements

RCE reviewed evidence that the daily calibration error test is performed for the N₂O analyzer. The analyzer performs an automatic daily calibration error test. 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. RCE viewed the raw data and results of each test. RCE also confirmed that calibration adjustments are performed if necessary, data is validated daily, data is continuously monitored and recorded every minute, and QA checks are performed.

There were a few instances during the reporting period where the results of the automatic calibration error test were “failed”. Each time, the analyzer was automatically recalibrated. These periods correspond to periods for which the missing data substitution procedure was applied because concentration was not recorded until there was a successful calibration.

3.7.2 Quarterly Requirements

RCE verified that the following quarterly assessments were performed according to Protocol requirements:

Calibration Error Test:

RCE reviewed evidence that the quarterly calibration error test requirement was met for the flow meter. The tests were conducted on December 4, 2017, March 6, 2018, May 31, 2018, and August 29, 2018. RCE viewed the results of each quarterly test and verified that all results were within the +/-3 percent threshold as required by the Protocol. RCE also confirmed that calibration adjustments are performed if necessary, data is validated, data is continuously monitored and recorded every minute, and QA checks are performed.

Leak Check:

RCE reviewed evidence that the quarterly leak check requirement was met for the flow meter. The leak checks were conducted with the calibration error tests. RCE viewed the results of each quarterly check which indicated that the meter passed each time.

Flow-to-Load or Heat Rate Evaluations:

The Protocol states that units not producing electrical output or thermal output are exempted from the flow-to-load ratio test requirements. The Project meets this exemption and is therefore not required to perform this quarterly assessment.

Linearity Checks

RCE confirmed that the quarterly linearity checks were performed for the N₂O analyzer. Linearity checks were conducted in each quarter during the project campaigns: December 19, 2017, March 7, 2018, June 18, 2018, and September 12, 2018. RCE verified that the results of all checks met Protocol and Part 75

requirements. The results were within the required range (<5%) for high-level gas concentrations and low- and mid-level concentrations.

Data Validation

RCE confirmed that the results of all QA/QC checks were within the ranges required by the Protocol and 40 CFR Part 75 Appendix B requirements.

3.7.3 Annual and Semi-Annual Assessments

RCE reviewed the results of the November 8, 2017 RATA conducted by Environmental Monitoring Laboratories, Inc. using test methods described in 40 CFE 60 Appendix B. The results of the November 8, 2017 RATA showed the relative accuracy of the N₂O analyzer to be within the acceptable range and below 7.5 percent and the relative accuracy of the flow meter (9.51%) to be within the acceptable range but above 7.5 percent, requiring semiannual RATAs thereafter. The next RATA would have been due in May 2018. The Project was granted a variance from the Reserve which allows the Project to use the annual RATA on November 8, 2017 to compensate for the missed semiannual RA test pursuant to the following conditions:

- “The project developer must maintain the QA/QC schedule as described in the Monitoring Plan during future reporting periods.
- The project developer must show that RATA requirements were followed per the protocol and 40 CFR and that the bias adjustment factor was applied to data as necessary.”

RCE verified that RATA requirements were followed and that the bias adjustment factor was applied to the data.

The flow meter failed the bias test during the November 8, 2017 RATA. The bias adjustment factor (BAF) was applied to the gas flow for the entire reporting period as per the requirements of Part 75 Appendix A Section 7.6.5. The BAF was applied manually in the calculation database. RCE verified the BAF and that it was applied correctly to the raw data.

Table 3 - Bias Adjustment Factors

Equipment	12/9/2017 - 9/17/2018
N ₂ O Analyzer	None
Flow Meter	1.094

3.7.4 Missing Data Substitution

Missing data substitution methods were applied for a total of 8 hours for flow during the project campaigns and 90 hours for N₂O concentration during the Project campaigns. The DAHS automatically calculates the substitute values based on the guidance in the Protocol and Part 75 Section 75.33. ClimeCo manually inserts the substituted values into the raw data. RCE confirmed that these values were appropriately substituted.

3.8 Assessment of GHG Emissions Reductions Calculations

The emission reduction calculations assessment included a review of the historical, baseline, and project assumptions, data inputs, data management, and accuracy of calculations. RCE assessed the information generated from the historical, baseline, and project campaigns and evaluated the completeness of the data and how it is transferred from CFIN’s DAHS to ClimeCo’s GHG calculation database.

The Protocol requires a variety of data manipulations to the data as part of the quantification of GHG emission reductions. ClimeCo conducted the data management in a Microsoft Access database file using

various queries of the raw data and provided the data to RCE in a MS Excel spreadsheet. RCE reviewed the queries/formulas and data outputs for compliance with the Protocol.

RCE confirmed that all data was normalized to 0°C and 101.325 kPa in the calculation database/spreadsheets. ClimeCo also performed unit conversions for some monitoring parameters, and RCE confirmed that the conversions were performed correctly and that the raw data was converted to the units required by the protocol for all parameters.

Historical Campaigns

The project was implemented at an existing NAP. There was sufficient data for the project to use five historical years to calculate HNO₃max. RCE reviewed historical data for five campaigns between March 11, 2006 and June 9, 2008. RCE assessed the raw data and calculations used to determine HNO₃max and the permitted operating conditions (POCs) for temperature, pressure, and ammonia-to-air ratio. RCE confirmed that all parameters were calculated and measured according to the methods outlined in the Protocol.

- HNO₃max = 25.00 tHNO₃/hour
- Oxidation temperature: min. = 766°C, max. = 926°C
- Oxidation pressure: min. = 6.00 bar, max. = 7.00 bar
- Ammonia-to-Air Ratio: max. = 11.00%

RCE confirmed that values for each historical parameter were used in the calculations for these project campaigns.

Baseline Emissions

ClimeCo provided data from the Baseline campaign which occurred prior to the installation of the secondary catalyst. The baseline campaign lasted from December 3, 2008 to April 14, 2009. The plant was shut down for the installation of the secondary catalyst and the first project campaign began on April 16, 2009. The baseline exceeded CL_{cap} (79,529.14 tHNO₃) on April 12, 2009 and thus N₂O values and HNO₃ production measured beyond CL_{cap} were eliminated from the calculation of the baseline emission factor. ClimeCo calculated CPV_{cap} using the same five campaigns that were used to calculate the POCs.

RCE verified that the raw data from the Baseline campaign was correctly adjusted in accordance with the Protocol—including the exclusion of data points when the plant was not operating, elimination of data outside of the POCs, and the elimination of outliers—and appropriately used to determine the Baseline Emission Factor. RCE verified the assumptions and variables used in Equations 5.4 and 5.5 in the Protocol.

RCE verified that the Baseline campaign operated inside the established POCs greater than 50 percent of the campaign, meeting the requirement in the Protocol. RCE also confirmed that the operating conditions during the baseline sampling period are representative of POC by verifying that the mean values for oxidation temperature, oxidation pressure, and ammonia-to-air ratio are within the corresponding ranges defined for the POC.

Project Emissions

ClimeCo provided project data for the entire reporting period which included two full campaigns.

RCE verified that the Project campaigns operated inside the established POCs greater than 50 percent of the campaign, meeting the requirement in the Protocol. RCE also confirmed that the operating conditions during the Project campaigns are representative of POCs by verifying that the mean values for oxidation temperature, oxidation pressure, and ammonia-to-air ratio are within the corresponding ranges defined for the POCs.

RCE confirmed that $\text{HNO}_{3,\text{RP}}$ was less than $\text{HNO}_{3\text{max,scaled}}$ for both project campaigns. RCE also verified the total operating hours and application in the calculations.

RCE determined that the emission reduction calculations followed the Protocol and found no material misstatements in the final Project GHG reductions calculations and results.

4.0 Verification Results

ClimeCo and CFIN provided sufficient evidence and documentation of their emission reduction estimates, data collection procedures, monitoring, and quality control procedures. The verification process focused on verifying the historical emissions, baseline emissions, and full campaign project emission reductions and the source data used by ClimeCo to quantify the emission reductions in accordance with the Protocol.

During the verification process, RCE made requests for corrective actions and supplemental documentation to complete the verification. The details of RCE's findings are documented in the List of Findings provided to the Reserve and the project developer.

The Project reported emission reductions of 55,811 metric tons of CO_2 equivalents as per the information provided in the calculation summary spreadsheets. During the final review, RCE identified no material misstatements in the data or emission reduction calculations. Tables 4 and 5 define the emission reductions verified for this reporting period.

5.0 Conclusion

RCE conducted a risk-based analysis of the Terra Yazoo City #9, Nitrous Oxide Abatement Project assertion including a strategic review of the Project data and evidence. Based upon the processes and procedures and the evidence collected, RCE concludes that the Project emission reductions resulting from the destruction of N₂O during the reporting period December 9, 2017 through September 17, 2018 can be considered:

- In conformance with the Reserve's Nitric Acid Production Project Protocol Version 1.0 and ISO 14064-3 standards,
- Without material discrepancy, and
- Verified to a reasonable level of assurance.

The verified emission reductions are listed in Table 4 and Table 5 (note that while RCE confirmed the emission reduction calculations and the total emission reductions to be correct and within the materiality threshold, the values in the table below are summary data only with significant figures rounded for summary purposes in this report):

Table 4 - Emission Reductions Verified for December 9, 2017 – September 17, 2018 by Campaign

Campaign Start & End Dates	Emission Reductions CO ₂ e (metric tons)
12/9/2017 – 5/8/2018	34,787
5/8/2018 – 9/17/2018	21,024

Table 5 - Emission Reductions Verified for December 9, 2017 – September 17, 2018 by Vintage

Vintage	Emission Reductions CO ₂ e (metric tons)
2017	5,095
2018	50,716

Lead Verifier Signature



Nina Pinette

Senior Internal Reviewer Signature



Zach Eyler