



Verification Report for CAR811 – Rentech Energy Midwest Corporation –
Nitric Acid Plant 1
December 10, 2016 – July 15, 2017 Reporting Period

Prepared for:
East Dubuque Nitrogen Fertilizers, LLC

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1.0 Introduction

ClimeCo Corporation (ClimeCo) contracted Ruby Canyon Engineering, Inc. (RCE) to verify the Rentech Energy Midwest Corporation Nitric Acid Plant 1 (NAP) project (Project) owned and operated by East Dubuque Nitrogen Fertilizers, LLC (EDNF) for the reporting period December 10, 2016 through July 15, 2017 to the Climate Action Reserve (Reserve) Nitric Acid Project Protocol Version 2.0 (Protocol). The Project involves GHG emission reductions using a tertiary abatement catalyst to destroy nitrous oxide (N₂O) at a nitric acid plant located in East Dubuque, Illinois.

1.1 *Project Background & Site Description*

The Project involves the installation of a new catalyst in the tail gas leaving the secondary absorption tower, catalytically decomposing the nitrous oxide that would have otherwise been vented to the atmosphere. The Project is at the single pressure Nitric Acid Plant 1 at EDNF's facility in East Dubuque, Illinois. Nitric Acid Plant 1 has been in operation since 1978. The facility also includes a plant for ammonia production, a plant for urea production, and a second plant producing nitric acid. EDNF 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 EDNF and is responsible for overall program management, development of monitoring reports, and oversight of the verification process.

This is the verification of the eighth reporting period for the Project. The reporting period includes two full campaigns (Campaigns 17 and 18). Campaign 17 began on December 10, 2016 and ended on April 10, 2017 and campaign 18 began on April 11, 2017 and ended on July 15, 2017.

1.2 *Responsible Parties*

Project Developer

East Dubuque Nitrogen Fertilizers, LLC
16675 U.S. Highway 20 W
East Dubuque, IL 61025

Technical Consultant

ClimeCo Corporation
1 East Philadelphia 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: Phillip Cunningham

Senior Internal Reviewer: Nina Pinette

1.4 Objectives

The goal of the verification activities was to ensure that the claimed GHG emission reductions were 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,
- Review Project boundaries,
- Review Project eligibility,
- Conduct a site visit to the Project,
- Review Project data acquisition and quality control procedures,
- Review Project's historical emissions to ensure that historical parameter values have not changed from the previous reporting period,
- Review Project's baseline emissions,
- Review the Project's emission reduction calculations,
- Review Project documents and data against the Verification Criteria listed in Table 1,
- Issue requests for additional documentation, clarifications, and corrective actions as necessary, and
- Issue a Verification Report, List of Findings, and Verification Statement to EDNF and the Reserve.

1.6 Verification Criteria

Table 1 - Verification Criteria

Criteria	Details
Standard of Verification	• Nitric Acid Production Project Protocol Version 2.0 (September 28, 2011) (Protocol) • Errata and Clarifications to Nitric Acid Production Protocol Version 2.0 (January 3, 2017) • Verification Program Manual (February 8, 2017) • Program Manual (September 1, 2015)
Verification Process	The Reserve Verification Program Manual and ISO 14064-3 Specification with guidance for the validation and verification of greenhouse gas assertions
Level of Assurance	Reasonable assurance
Materiality	99 percent materiality threshold (<1% error) because total annual ERs are greater than 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 and submitted the form to the Reserve's website to identify any potential conflicts of interest with the Project or Project developer. The COI assessment revealed no conflicts of interest and the Reserve approved the form on July 18, 2017.
- RCE held a verification kickoff meeting with ClimeCo, EDNF, and the Reserve on July 27, 2017. 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 founded upon the strategic review and risk assessment and used the verification and sampling plan throughout the verification. The Lead Verifier revised the plans as needed based upon additional risk assessments.
- RCE conducted a site visit to the Project on October 26, 2017. 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. There were no significant changes onsite between the site visit date and the end of the reporting period.
- 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 additional documentation, clarifications, and corrective actions to ClimeCo as necessary 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 and EDNF.

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 tertiary abatement catalyst in the tail gas stream located between the re-heater and expander. RCE confirmed that a non-selective catalytic reduction (NSCR) unit was not operating at the plant at any time since December 2, 2007.

A CEMS directly measures the N₂O concentration in the stack gas and the tail gas. The data acquisition and handling system (DAHS) along with the programmable logic controller (PLC) and server performs 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.

During the verification of the first reporting period, RCE confirmed that the Plant completed installation and initial certification of the CEMS according to manufacturer's specifications and the requirements of the Protocol. RCE verified the installation of the tertiary abatement catalyst and campaign dates through review of plant gauge records. RCE confirmed that this reporting period included two full campaigns. Finally, RCE determined that EDNF

adhered to the methodology defined in the Monitoring Plan Version 3.3 throughout the verification and monitored all applicable parameters in accordance with Table 6.2 of the Protocol.

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

According to the Protocol, CO₂, CH₄, and N₂O are included from the Baseline and Project activities for tertiary abatement projects. Since the Project has no ammonia input to the N₂O destruction facility, uses no hydrocarbons as reducing agents or for reheating the tail gas, and has no external energy input to reheat the tail gas, N₂O is the only GHG included from the Baseline and Project activities for this Project.

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	N₂O vented to the atmosphere.
Project	N₂O 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. RCE confirmed that the Project's location and Project start date met Protocol requirements during the first verification cycle. 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 East Dubuque, Illinois, U.S. The Project therefore meets the location eligibility requirement.

- Eligibility Rule II: Project Start Date**

During the first verification cycle, RCE reviewed evidence including Excel files that recorded plant monitoring data and showed that plant operations were shut down on June 27-28, 2011 for installation of the catalyst. The Project start date for a tertiary catalyst project is defined as the date on which nitric acid production first commences after installation of the tertiary N₂O abatement technology. The plant was restarted and production of nitric acid commenced on June 29, 2011, which is the Project start date and was the start date of the first reporting period.

- Eligibility Rule III: Additionality**

Legal Requirement Test

RCE confirmed that there are currently no laws requiring the abatement of N₂O at the plant. In addition, EDNF's Environmental, Health, Safety, and Security Manager checks periodicals, websites, newsletters, and other materials provided by trade associations and legal advocacy groups such as the Chemical Industry Council of Illinois and the Fertilizer Institute. RCE reviewed EDNF's renewal Title V Permit, but the permit does not address N₂O. EDNF's nitric acid plant 1 has not triggered the PSD Tailoring Rule for GHGs; the plant does not exceed the emission threshold and is therefore not subject to this rule. 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 tertiary N₂O abatement catalyst. RCE reviewed plant records indicating the installation of the catalyst on June 27-28, 2011.

- **Eligibility Rule IV: Regulatory Compliance**

The Project was in material compliance with all applicable laws throughout the reporting period. RCE reviewed the U.S. EPA's ECHO database and any entries associated with the EDNF facility.

RCE reviewed the U.S. EPA's Enforcement and Compliance History Online (ECHO) database and found a Clean Water Act violation during the period 04/01/17 – 06/30/17 and 10/01/17 – 03/02/18. RCE interviewed site personnel who explained that the issue noted in ECHO was the result of chlorine levels in the cooling towers of another plant onsite that is not associated with the NAPs.

The Lead Verifier also requested confirmation from the Illinois EPA that the NAP had no regulatory violations during the reporting period. A Freedom of Information Act Officer confirmed that there was no information regarding any environmental violations related to the NAP during the reporting period. RCE also reviewed the Illinois Facility Compliance Tracking System (F.A.C.T.S.) and found no records for EDNF. Finally, RCE verified that the Attestation of Regulatory Compliance was correctly completed and uploaded to the Reserve.

3.4 Ownership of GHG reductions

EDNF 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 EDNF. RCE reviewed the "Designation of Authority" in which Rentech Nitrogen, LLC (now EDNF) designated authority to ClimeCo as the Account Holder Agent on the Reserve website. 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 a CEMS for both gas flow rates and N₂O concentrations. The Project uses a Kurz insertion mass flow meter to measure gas flows in the stack. These flow measurements are used in both baseline and project emission calculations. The Project uses two N₂O analyzers, one upstream of the tertiary abatement system (inlet) and one downstream of the system (outlet). Both are EcoChem infrared gas analyzers. RCE confirmed the locations of the sample probes within the stack through review of plant diagrams.

The Project uses the CEMS DAHS coupled with a PLC that consolidates the data. The data is stored locally and on a server with regular backup.

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 EDNF CEMS were installed prior to the Project. All CEMS components were installed by the manufacturers of the equipment or electrical contractors. RCE verified that the Project met all CEMS installation and certification requirements during the first verification cycle.

RCE verified that the following requirements were met for installation and certification of the CEMS:

7-day Calibration Error Test:

RCE reviewed the results of the 7-day calibration error tests performed for the flow meter (7/14/2010 – 7/20/2010), the inlet analyzer (6/22/2011 – 6/28/2011), and the outlet analyzer (7/14/2010 – 7/20/2010). All tests were completed prior to the project start date and the percent calibration errors were within the allowable range.

Linearity Check:

RCE reviewed the results of the linearity checks performed for the inlet analyzer (6/21/2011) and the outlet analyzer (6/20/2011). Both checks took place prior to the project start date and both met the requirement of less than 5.0 percent error.

RATA and bias tests:

RCE reviewed the results of the RATA that was conducted on June 22, 2011 for the flow meter, inlet analyzer, and outlet analyzer. The relative accuracy (RA) for all three was within the allowable range and all three pieces of equipment passed the bias test.

Cycle Time Test:

RCE reviewed the results of the cycle time test on August 16, 2010 which ensures that the monitoring system is capable of completing at least one cycle of sampling, analyzing, and data recording every 15 minutes.

3.7 Ongoing CEMS QA/QC Program

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

3.7.1 Daily Requirements

RCE reviewed evidence that the daily calibration error test is performed for both N₂O analyzers. The analyzers perform an automatic daily calibration error test; the analyzers are very stable as demonstrated by minimal variation in the calibration results. 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 for the inlet and the outlet analyzers where the results of the automatic calibration error test indicated “warning” or “out of control”. Each time, the analyzer was automatically recalibrated and another test was performed until the result indicated “cal OK”.

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 meter performs an automatic daily calibration error test; the flow meter is very stable as demonstrated by minimal variation in the daily calibration results. RCE viewed the raw data and results of each test. 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. There were no instances during the reporting period when the flow meter was out of calibration.

Leak Check

The Protocol states that leak checks are required for differential pressure flow meters only. Because the Project utilizes a thermal mass flow meter, this quarterly assessment is not required.

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 ("Checks") were performed for both N₂O analyzers. A RATA was performed in the fourth quarter of 2016. According to section 6.2.1 of the Protocol, linearity checks are not required in quarters for which there is a RATA.

The Checks for the outlet analyzer were performed on February 8, May 10 and August 22, 2017. The Checks for the inlet analyzer were performed on February 7, May 9 and August 17, 2017. ENDF performed a RATA in the fourth quarter of 2016 and a linearity check was not needed in this quarter. RCE verified that the results of all checks met Protocol and Part 75 requirements.

The Checks for the inlet and outlet analyzer were all within the required range (less than 5 percent error).

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 October 4, 2016 RATA conducted by Airtech Environmental Services which is a testing body that conforms to the requirements of ASTM D7036-04. The results of the RATA showed the relative accuracy for the inlet and outlet N₂O analyzers and the flow meter to be within the acceptable range and below 7.5 percent.

The inlet N₂O analyzer was the only relevant piece of equipment to fail the bias test during the October 4, 2016 RATA. EDNF applied a Bias Adjustment Factor (BAF) to the inlet gas concentrations for the relevant periods during

this 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 confirmed that all BAFs were applied to the raw data.

Table 3 - Bias Adjustment Factors

Equipment	12/10/16 – 7/15/17
Inlet Analyzer	1.022
Outlet Analyzer	None
Flow Meter	None

3.7.4 Missing Data Substitution

The Project Developer applied missing data substitution according to section 6.3 of the Protocol and section 75.33 of 40 CFR Part 75. EDNF applied missing data substitution methods for a total of 2 hours for inlet concentration and 11 hours for outlet concentration. There was no missing data substitution for flow. The DAHS automatically calculates the substitute values based on the guidance in the Protocol.

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. During the first verification cycle, RCE assessed the information generated from the Historical campaigns. For this reporting period, RCE assessed the data generated from the project campaigns and evaluated the completeness of the data and how it is transferred from EDNF's DAHS to ClimeCo's GHG calculation database.

The Protocol requires a variety of unit conversions to the data as part of the quantification of GHG emission reductions. ClimeCo conducted the data management in a MS Access database file using various queries of the raw data and provided the data to RCE in an MS Excel spreadsheet. RCE reviewed the queries/formulas and data outputs for compliance with the Protocol.

The flow meter and analyzers record at 68°F and 1 atmosphere; 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. RCE confirmed that five years of historical data were not available because there was not reliable data with enough of the needed parameters prior to May 20, 2008; therefore ClimeCo used historical data from the eight previous consecutive campaigns dating from May 20, 2008 to March 20, 2011. The last historical campaign ended immediately prior to the start of the first campaign included in the first reporting period of the Project (accounting for the first 28 days of the reporting period). RCE assessed the raw data and calculations used to determine HNO₃max and the allowable operating conditions (AOCs) for temperature, pressure, and ammonia-to-air ratio (AIFR). RCE confirmed that all parameters were calculated and measured according to the methods outlined in the Protocol.

- HNO₃max = 204.45 Mg HNO₃/day
- Oxidation temperature: min. = 843.89°C, max. = 911.11°C
- Oxidation pressure: min. = 6.76 bar, max. = 8.62* bar
- Ammonia-to-Air Ratio: max. = 10.75%

On April 21, 2015 EDNF installed a new air compressor at the NAP. This is classified as an “upgrade”, and thus the Project revised its previously defined AOCs. This upgrade affected only the maximum oxidation pressure and maximum ammonia to air ratio.

EDNF followed the guidance in Protocol Section 5.1.2 for an upgrade at the facility as well as Clarification 2 in the Errata and Clarifications. The plant provided a letter from a professional engineer involved with the compressor replacement which stated that the only values affected by the upgrade were the upper pressure limit and maximum ammonia-to-air ratio. EDNF revised the upper pressure limit from 8.00 bar to 8.62 bar and the maximum ammonia-to-air ratio from 9.87 percent to 10.75 percent. RCE confirmed that the mean campaign pressure was within the new limits and that the mean campaign maximum ammonia to air ratio was below 10.75 percent.

EDNF used the above values, except for upper and lower pressure limits and the maximum AIFR, to determine data points and days within the AOCs for both campaigns during the reporting period. EDNF’s use of incorrect values for the upper and lower pressure limits and the maximum AIFR exclude the same data points from the data set as would using the correct AOC values. Additionally, the plant operated within the AOCs, defined above, for more than 50% of the reporting period. Therefore, this error has no impact on the emission reductions. RCE listed this as a non-material finding.

Baseline Emissions

Tertiary abatement projects must sample the tail gas prior to entering the tertiary abatement catalyst. The inlet analyzer continuously measures the N_2O concentration in the gas. EDNF calculated baseline emissions following section 5.2.2 for any time periods when actual average daily operating conditions for pressure, temperature, and ammonia-to-air ratio were outside of the AOCs. EDNF uses the lower of the two options provided for each hour outside of the average daily operating conditions. RCE confirmed that the calculations for percent of time that the plant operated outside of the AOCs were materially correct, less than 50 percent of the reporting period, and mean values for oxidation temperature, oxidation pressure, and ammonia-to-air ratio were within the corresponding AOC ranges.

Project Emissions

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

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

RCE confirmed that $HNO_{3,RP}$ was less than $HNO_{3max,scaled}$ for both project campaigns. RCE also verified the operating hours for each campaign.

There were no project emissions from ammonia input to operate the tertiary catalyst, from the use of hydrocarbons as a reducing agent, or from hydrocarbons or external energy to reheat tail gas. RCE determined that the emission reduction calculations followed the Protocol and found no material misstatements in the Project GHG reductions calculations and results.

4.0 Verification Results

ClimeCo and EDNF provided sufficient evidence and documentation of the emission reduction estimates, data collection procedures, monitoring, and quality control procedures. The verification process focused on verifying

the historical emissions, baseline emissions, and 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 additional documentation and clarifications to complete the verification. The details of RCE's requests are documented in the List of Findings provided to the Reserve and the project developer.

The Project reported emission reductions of 84,513 metric tons of CO₂ 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. Table 4 defines the emission reductions verified for this reporting period.

5.0 Conclusion

RCE conducted a risk-based analysis of the Rentech Energy Midwest Corporation Nitric Acid Plant 1 Project GHG 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 10, 2016 through July 15, 2017 can be considered:

- In conformance with the Reserve's Nitric Acid Production Project Protocol Version 2.0 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 (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 10, 2016 – July 15, 2017 by Campaign

Emissions Verified	Baseline Emissions CO₂e (metric tons)	Project Emissions CO₂e (metric tons)	Emission Reductions CO₂e (metric tons)
Campaign 17 12/10/2016 – 4/10/2017	62,050	11,610	50,440
Campaign 18 4/11/17 – 7/15/2017	37,935	3,861	34,073
Total	99,985	15,471	84,513

Lead Verifier



Phillip Cunningham

Senior Internal Reviewer Signature



Nina Pinette