



DET NORSKE VERITAS

**CLIMATE ACTION RESERVE
VERIFICATION REPORT**

Report for:
TERRA MISSISSIPPI NITROGEN, INC.
CAR 768

DNV report number
2011-9643



VERIFICATION REPORT

Date of first issue: October 10, 2011		Project No.: PRJC-318921-2011-CCS-USA	
Approved by: Miguel Rescalvo Regional Manager Americas		Organizational unit: Sustainability and Innovation Climate Change and Environmental Services	
Client: Terra Mississippi Nitrogen, Inc.		Client ref.: Jim Schellhorn	
Summary: Det Norske Veritas (U.S.A.), Inc. (DNV) has performed the verification of the GHG emission reductions achieved by the project, "Terra Yazoo City #9, Nitrous Oxide Abatement Project" for the period of 22 June, 2010 to 1 March, 2011. In DNV's opinion, the GHG emission reductions reported to the Climate Action Reserve (CAR) are fairly stated. The GHG emissions reductions were calculated correctly on the basis of the approved CAR "Nitric Acid Production Project Protocol Version 1.0: Reducing Nitrous Oxide from Process Gas Emissions" and the supporting documentation. DNV is able to verify that the emission reductions from the "Terra Yazoo City #9, Nitrous Oxide Abatement Project" during the period 22 June, 2010 to 1 March, 2011 equate to 218 069 t CO₂e.			
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**ABBREVIATIONS**

AOR	Ammonia Oxidation Reactor
AIFR	Ammonia to Air Ratio
CAR	Climate Action Reserve
CDM	Clean Development Mechanism
CEMS	Continuous Emissions Monitoring System
CFR	Code of Federal Regulations
CH ₄	Methane
CI	Confidence Interval
COI	Conflict of Interest
CO ₂	Carbon Dioxide
CO ₂ e	Carbon Dioxide Equivalent
CRTs	Climate Reserve Tonnes
DNV	Det Norske Veritas
(EF _{BL})	Baseline Emission Factor
EN	European Norm
EU	European Union
GHG	Greenhouse Gas(es)
GWP	Global Warming Potential
HNO ₃	Nitric Acid
NH ₃	Ammonia
NAP	Nitric Acid Plant
NAPPP 1.0	Nitric Acid Production Project Protocol Version 1.0
N ₂ O	Nitrous Oxide
OH	Operating Hours
OP	Oxidation Pressure
OT	Oxidation Temperature
POCs	Permitted Operating Conditions
QA/QC	Quality Assurance & Quality Control
RATA	Relative Accuracy Audit Test
t	Metric Tonnes
UAN	Urea Ammonia Nitrate



1. INTRODUCTION

Det Norske Veritas (U.S.A.), Inc. (DNV) has been contracted by Terra Mississippi Nitrogen, Inc. (Terra) to verify the greenhouse gas (GHG) emission reductions generated by the Terra Yazoo City # 9, Nitrous Oxide Abatement Project (Yazoo Project) for the period of 22 June, 2010 – 1 March, 2011. The verification was completed as required in the Climate Action Reserve (CAR) Verification Program Manual released in December, 2010. This report contains the findings from the verification and a statement for the verified GHG emission reductions.

This is the second verification period for the project. The first period was from 16 April, 2009 to 22 June, 2010; the emission reductions for this period were also verified by DNV.

1.1 *Verification Objective*

Verification is the process through which a verification body assesses a project developer's GHG reduction assertions against verification criteria and standards that are defined by the CAR GHG program. The purpose of verification is to provide an independent third-party review of project data and information being submitted to the CAR, to ensure that the project is eligible as defined in the relevant project reporting protocols and that the reported GHG emission reductions meet the appropriate one percent (1%) materiality threshold.

The CAR requires third-party verification of all GHG projects, as specified in each project protocol. Climate Reserve Tonnes (CRTs) are issued for voluntary emission reductions only after a Verification Report and a Verification Statement attesting to their accuracy have been submitted by the verifier and accepted by the CAR.

The objective of this verification was to verify that the voluntary emission reductions (carbon dioxide equivalents (CO₂e)) reported for the Yazoo Project for the period 22 June, 2010 to 1 March, 2011 are real, verifiable, permanent and owned by Terra Mississippi Nitrogen, Inc.

1.2 *Verification Scope and Criteria*

The scope of the verification includes:

- Ensuring that the project is eligible according to the specific eligibility rules in the CAR's Nitric Acid Production Project Protocol Version 1.0 (NAPPP 1.0).¹
- Ensuring that the project boundary has been clearly defined and that the project emission sources in the baseline scenario and project activity have been identified and monitored as per the NAPPP 1.0.



- Reviewing GHG management systems and estimation methodologies.
- Verifying the emission estimates through a site visit, an in-depth review of source data and recalculation of a sample of GHG emission reduction estimates to ensure that the reported GHG reductions are within the 1% materiality threshold and calculated in line with the CAR's NAPPP 1.0 protocol.

According to the CAR, the criteria to be applied during this verification include those contained in the following documents:

- CAR Nitric Acid Production Project Protocol Version 1.0: Reducing Nitrous Oxide from Process Gas Emissions;¹
- CAR Nitric Acid Production Project Protocol Errata and Clarifications;²
- CAR Verification Program Manual;³
- CAR Program Manual;⁴
- ISO 14064-3:2006.⁵

1.3 Level of Assurance and Materiality Assessment

During the verification, DNV has focused on providing a reasonable level of assurance that:

- The GHG emission reduction calculation methodology used is appropriate and correctly applied.
- The GHG emission reductions have been monitored, calculated and reported within the 1% materiality criteria.

2. PROJECT INFORMATION

2.1 Project Background

The Yazoo Project is located in Yazoo, MS and is contained within Terra's Yazoo City nitrogen manufacturing facility. Terra's Yazoo City facility consists of one ammonia plant, four nitric acid plants, an ammonia nitrate plant, two urea plants, a urea ammonia nitrate plant and a dinitrogen tetroxide production facility.

The four nitric acid plants in the Yazoo City nitrogen manufacturing facility rely upon the catalytic oxidation of ammonia to produce nitric acid (HNO₃) as an intermediary product. Subsequently, the potent GHG nitrous oxide (N₂O) is directly released to the atmosphere as a waste by-product. The Yazoo Project is designed to reduce the release of N₂O during the HNO₃ production process in a nitric acid plant (NAP) through the installation of a secondary catalyst within the ammonia oxidization reactor (AOR) contained in the AOP # 9 Plant, one of the four NAPs located in the Yazoo City facility.



2.2 Project Activities

In 2008, Terra successfully installed a continuous emissions monitoring system (CEMS) to monitor the N₂O concentration and flow of the flue gas of the AOP #9 Plant.⁶ Subsequent to installation of the CEMS, Terra implemented and completed a baseline monitoring campaign between 03 December, 2008 and 14 April, 2009. On 15 April, 2009, Terra installed a secondary catalyst system below the gauze section of the AOR of the AOP #9 Plant.⁷ The following day, Terra began operating and monitoring the Yazoo project.

2.3 Project Ownership and Involved Parties

The Yazoo Project is operated by Terra Mississippi Nitrogen, Inc., which is a wholly owned subsidiary of Terra Industries, Inc. Ownership of the Yazoo Project and any emission reductions generated are retained by Terra Mississippi Nitrogen, Inc.

DNV reviewed multiple regulatory-related documents (water and air permits) filed with the State of Mississippi and receipts for project-related equipment and services, which confirm that the Yazoo City Plant is operated by Terra Mississippi Nitrogen, Inc. and that Terra Mississippi Nitrogen, Inc. is legally responsible for the facility.^{8 9} DNV subsequently confirmed that all documents submitted to the CAR contain the Terra Mississippi Nitrogen, Inc. name, including the Attestation of Title for credit ownership.¹⁰ Based upon these documents, it is DNV's opinion that emission reductions generated by the Yazoo Project are unambiguously owned by Terra Mississippi Nitrogen, Inc.

3. VERIFICATION ACTIVITIES

DNV has undertaken verification activities and compiled the verification team and tasks based on the complexity of Terra's GHG emission reductions and the underlying data supporting them. The verification team and process are summarized below and in Table 1.

Verification Team	
David DeVooght	Lead Verifier
Weidong Yang	Senior Internal Reviewer
Shruthi Bachamanda	Project Manager

**Table 1: Verification Activities**

Task	Activities	Completion Data
1	Conflict of Interest form approved by CAR.	26 July, 2011.
2	Verification kick-off meeting.	24 June, 2011.
3	Desk review.	18 – 29 July, 2011.
4	Site visit.	4 August, 2011.
5	Senior internal review.	22 September, 2011
6	Submission of verification report to Project Developer.	14 October, 2011.
7	Verification opinion uploaded to CAR project site.	23 October, 2011.

3.1 Desk Review

DNV assessed the documents provided by the project developer, including the project monitoring plan, GHG emission reductions spreadsheets, site design documentation and legal documents.^{11, 12, 13, 14} Initial risk areas related to the GHG emission reduction estimates were identified through the document review. The verification plan, sampling plan and on-site visit agenda were prepared according to items noted during the desk review.

3.2 Site Visit

On 4 August, 2011, DNV performed a site visit at Terra's Yazoo City nitrogen manufacturing facility in Yazoo City, MS. During the site visit, DNV reviewed records and interviewed staff members and was able to verify the project facility operation, including the monitoring practices related to the GHG emission reduction estimates. DNV conducted a walk-through survey of the Yazoo City AOP #9 and was able to confirm that the continued implementation of the project is in accordance with the initial Monitoring Plan.^{11,15}

4. VERIFICATION FINDINGS

4.1 Summary

DNV was able to verify that the GHG emission reductions reported for the Yazoo Project are fairly stated. Some clarification requests were identified during the verification. Responses were provided by Terra to the satisfaction of DNV.

4.2 Project Definition

Chapter 2.2 of the NAPPP 1.0 defines a GHG reduction project as the installation of a N₂O abatement technology at a single NAP that results in the reduction of N₂O emissions that otherwise would have been vented to the atmosphere. Additionally, Chapter 2.2 of the NAPPP 1.0 establishes four criteria for the disqualification of projects that operate



N₂O abatement projects. DNV verified that these four criteria do not apply to the Yazoo Project.

4.3 Project Eligibility

Chapter 3 of the NAPPP 1.0 establishes that a project must satisfy four eligibility rules to meet the definition of a GHG emission reduction project. DNV verified that the Yazoo Project is in conformance with these four eligibility requirements for the reporting period of 22 June, 2010 – 1 March, 2011.

4.3.1 Eligibility Rule I – Project Location

On 4 August, 2011, a qualified DNV lead verifier conducted a site visit at the Terra Yazoo nitrogen manufacturing plant in Yazoo City, MS. DNV verified that the Yazoo Project is located in the AOP #9 Plant of the Terra Yazoo nitrogen manufacturing plant.

4.3.2 Eligibility Rule II – Project Operation Start Date

During the first verification period, 16 April, 2009 to 22 June, 2010, DNV verified the Yazoo Project's conformance with this eligibility rule by confirming installation of the secondary catalyst on 15 April, 2009 and confirming that the project was submitted to the CAR on 04 June, 2010.^{16,17}

The submittal of the Yazoo Project on 04 June, 2010 complies with the CAR requirement that projects operating before the adoption of the NAPPP 1.0 submit within 12 months of the effective date (02 December, 2009). Installation of the secondary catalyst on 15 April, 2009 demonstrates that the project began operations within the 24 months before the effective date of the NAPPP 1.0 (02 December, 2007).

4.3.3 Eligibility Rule III – Project Additionality

The Performance Standard Test

During the first verification period, 16 April, 2009 to 22 June, 2010, DNV confirmed that on 15 April, 2009, Terra installed a secondary N₂O abatement catalyst within the AOR of the AOP #9 Plant in the Terra Yazoo City nitrogen manufacturing plant. Installation of the secondary catalyst within the AOR demonstrates compliance with the performance standard test.

The Legal Requirement Test

DNV verified the project's conformance with this eligibility rule as detailed below.

- Verified the Yazoo Project's conformance with this eligibility rule by confirming through a discussion with the Environmental Health and Safety Director that Terra had implemented the procedures described in the Monitoring Plan to ensure compliance with the Legal Requirement Test.^{11,18}



- Confirmed that for the verification period Terra submitted an Attestation of Voluntary Implementation to the CAR, which further demonstrates conformance with the requirement.¹⁹
- DNV monitors regulatory issues related to the implementation of emission reduction projects on a regional and national level. DNV is not aware of any regional or national regulatory requirements mandating the implementation of N₂O emission reduction projects at nitric acid facilities. Therefore, DNV can confirm that the Yazoo Project is not mandated to install N₂O reduction technology.

4.3.4 Eligibility Rule IV – Regulatory Compliance

DNV has verified that the Yazoo Project conforms to the Regulatory Compliance rule. This conclusion is based on Terra's submission of a signed Attestation of Regulatory Compliance to the CAR.²⁰ Additionally, during the site visit DNV reviewed Terra's operating permits relevant to the project and confirmed that the Yazoo City nitrogen manufacturing facility met all applicable state and local regulations.^{8,9,21,22,23,24} There were no periods of non-compliance identified during the two campaign periods. DNV also confirmed with Terra that monitoring mechanisms are instituted within the plant for managing continued compliance.¹⁸

4.4 Monitoring Plan

The Yazoo Project Monitoring Plan is in accordance with the NAPPP 1.0 and allows for the accurate measurements of actual GHG emissions reductions.¹¹

4.4.1 Monitoring Data

DNV can confirm the necessary data needed to estimate GHG emission reductions are included in the monitoring plan. GHG emission sources, HNO₃ production and operating parameters were measured for two project campaign periods. DNV confirms that the monitoring mechanisms and the monitoring frequency of these parameters are in accordance with the requirements of the NAPPP 1.0. These data are shown in Tables 2 and 3.

It must be noted that the verification period is the 22 June, 2010 to 1 March, 2011. Project Campaign 4 did not start until the 24 June, 2010, two days following the start of the verification period. This is due to Terra's method of tracking the start of reporting periods which corresponds to the end of a campaign period. Because of maintenance issues Terra did not begin generating emission reductions until 24 June, 2010 but the verification period began on 22 June, 2010. Additionally, due to the Reserve software the verification period start date is listed as 23 June, 2010. The reason for the difference is that the Reserve software does not allow for a subsequent verification period to start on the same day that the previous verification ended.

Table 2: Periods of Project Monitoring and HNO₃ Production

Project Period	Dates	HNO ₃ Production (tonnes)
Project Campaign 4	24 June, 2010 – 28 October, 2010	72 380
Project Campaign 5	29 October, 2010 – 1 March, 2011	74 187

Table 3: Monitored Parameters for Project Campaigns

Parameter	Metering Device	Calibration and QA/QC Procedures
HNO ₃	Micro – motion flow meter	1. Checked for proper operation annually.²⁵ 2. Successfully calibrated 27 April, 2010.²⁶ 3. Successfully calibrated 15 March, 2011.²⁷
OH	Fisher Provox DCS	1. N/A – Plant operating system does not require calibration.
OT	Thermocouple - Moore Industries TCT/R510MVFS	1. Checked for proper operation during each gauze change.^{28,29}
OP	Converter Pressure Transmitter – Yokogawa EJA 430-AWAS4B-92NB/FF1/01	1. Correct functioning of instrument is continuously monitored and verified during plant operation.^{30,31}
AIFR	Air Flow Transmitter – Rosemont NH ₃ Flow Transmitter – Rosemount	1. Adjusting transmitters during operation of the plant is not feasible. Therefore, calibration work is completed during gauze changes. 2. Meters were calibrated twice during the verification period.^{30,31}
NC _{SG}	Gas Analyzer – ABB 2000-Uras26	1. Annual third party Relative Accuracy Audit Test (RATA) to confirm that the CEMS was operating correctly in accordance with 40 CFR Part 75 requirements.³² 2. Weekly QAL 3 test including zero and span check for N₂O concentration.³³ 3. Daily calibration test including zero and span check for N₂O concentration.³⁴ 4. Flow meter linearity check conducted 1 March, 2011.³⁵ 5. Quarterly cylinder gas audit conducted 15 December, 2010.³⁶
V _{SG}		

***CEMS Installation and Quality Assurance and Control (QA/QC)***

In 2008 and prior to the adoption of the NAPPP 1.0, the Yazoo Project installed and began operating an ABB Gas Analyzer AO2000 Series CEMS. At the time of installation, the QA/QC requirements and installation requirements for N₂O abatement projects within NAPs had not been established by the CAR. Therefore, the Yazoo Project installed and operated the CEMS in accordance with European Norm (EN) 14181 requirements, which were the generally accepted industry practice for monitoring Clean Development Mechanism (CDM) N₂O abatement projects.

Chapter 6 of the NAPPP 1.0 requires CEMS monitoring N₂O concentration and flow in the flue gas to operate QA/QC provisions and activities in accordance with the United States Code of Federal Regulations Title 40 (40 CFR), Part 60 and Part 75. On 28 May, 2010 Terra filed a Request for Project Variance,³⁷ petitioning the CAR to allow the Yazoo Project to substitute EN 14181 CEMS QA/QC provisions and activities for these requirements. The CAR granted a Variance Approval (2010 Variance Approval) allowing the Yazoo facility to operate the CEMS in accordance with EN 14181 requirements for the period of 22 October, 2008 to 15 December, 2010. Additionally, the CAR approval allows for the Yazoo facility to employ a third party to conduct annual emission stack testing using the EN 14181 norm requirements or the standard RATA test requirements of 40 CFR Part 60.³⁸

The CAR 2010 Variance Approval requires that the verifier:

- Confirm that a sound installation, monitoring and QA/QC process was followed and was in conformance with the requirements of EN 14181.
- Confirm that the party conducting the RATA has the appropriate accreditation/certification and that the RATA was performed in accordance with the applicable standard.

The verification period consisted of two campaign periods, with the second campaign period (Campaign 5) falling outside the allowable time period for the CAR Variance Approval. Therefore, during the verification period Terra was subject to two separate QA/QC requirements, those of EN 14181 and 40 CFR Parts 60 and 75.

The 2010 CAR Variance Approval allowed Terra to operate the CEMS in accordance with the requirements of EN 14181 until 15 December, 2010. After this date, Terra was required to align its CEMS QA/QC procedures with the requirements of the NAPP 1.0 (40 CFR Parts 60 and 75).

Terra scheduled transition of the CEMS QA/QC requirements to 40 CFR Parts 60 and 75 was 29 October, 2010, which corresponds to a gauge change but does not correspond to the final date of the 2010 CAR Variance Approval. Due to programming issues with the



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system employed for implementing the daily QA/QC requirements of 40 CFR Part 75, Terra's transition to these requirements was delayed past the 15 December, 2010 date of the 2010 Variance Approval. This resulted in Terra filing a Variance Request on 7 September, 2011, which was approved by the CAR on 15 September, 2011 (2011 Variance Approval).^{39,40} Therefore, DNV's evaluation of the CEMS conformance with the requirements of the CAR's 2010 Variance Approval, 2011 Variance Approval and the NAPP 1.0 requirements does not correspond to the campaign periods. In an effort to streamline verification findings for this report, DNV has delineated the CEMS operating periods into two distinct periods:

- CEMS operating period 1: 22 June, 2010 – 31 January, 2011.
- CEMS operating period 2: 1 February, 2011 to 1 March, 2011.

Relevant background information and DNV's verification findings for each period can be found below.

CEMS Operating Period 1: Terra's September, 2011 Variance Request requested that the CAR allow Terra to substitute the weekly calibration error testing (as written in EN 14181) for the daily assessments required by 40 CFR Part 75. In DNV's opinion, Terra's 2011 Variance Request is simply an extension of the provision related to ongoing QA/QC requirements contained in the 2010 Variance Request, with one additional verification requirement. DNV must verify that the N₂O analyzer did not require nor undergo a calibration adjustment during the period of 15 November, 2010 to 31 January, 2011 (period of 2011 Variance Approval).

Therefore, in accordance with the 2010 and 2011 Variance Approvals, DNV reviewed ongoing QA/QC procedures to determine if the CEMS was monitored and maintained in accordance with EN 14181 requirements and to determine if the CEMS was required to undergo a calibration adjustment. The results of this review are as follows:

- DNV can verify for the period of 24 June, 2010 – 31 January, 2011 the CEMS installed to monitor N₂O at the Yazoo Project followed the QA/QC process requirements of EN 14181. Specifically, this included weekly calibration and span checks of the calibration gas, which are referred to as QAL 3 procedures under the EN 14181 requirements.^{33,34}
- DNV reviewed the Yazoo City maintenance logs for the CEMS system and confirmed that the N₂O analyzer did not require nor undergo a calibration adjustment during the period of 15 November, 2010 to 31 January, 2011.^{33,34}
- The CAR Variance Approval allowed Terra during the verification period to either employ a third party to conduct a stack gas accuracy audit using the procedures of EN 14181 (QAL 2) or the RATA procedures of 40 CFR Part 60. For the verification period, Terra elected to use the RATA procedures of 40 CFR Part 60. DNV can verify that on 16 December, 2010, Environmental Monitoring



Laboratories, a third-party stack gas testing company, conducted a RATA in accordance with the procedures of 40 CFR Part 60. DNV reviewed the RATA results and can confirm that the results indicate the CEMS operates within the design limits for stack gas flow and N₂O concentration.³² The State of Mississippi does not require accreditation of third-party stack gas testing companies. However, DNV was able to confirm that Environmental Monitoring Laboratories is accredited by the State of Louisiana.⁴¹

CEMS Operating Period 2: In accordance with the 2011 Variance Approval, the date that DNV must begin verifying that the QA/QC procedures conform to the requirements of 40 CFR Parts 75 is 1 February, 2011. Additionally, in accordance with the requirements of the NAPP 1.0, DNV must verify that the Yazoo facility contracted with a third party for an annual emissions stack test. The results of DNV's review are as follows:

- DNV reviewed the results of the daily CEMS calibration and can confirm that the system was successfully calibrated on a daily basis for the period of 1 February, 2011 to 1 March, 2011.³⁴ Additionally, DNV reviewed a sample cylinder gas certification result provided by the cylinder gas retailer and can confirm that the reference gas values listed in the daily calibration tracking file match those found on the cylinder gas certificates.⁴²
- DNV reviewed the results of the first quarter 2011 cylinder gas audit and can confirm that the CEMS system was operating in the allowable range.³⁶
- DNV reviewed the results of the quarterly stack flow meter linearity check (calibrations) and can confirm the device was operating correctly.⁴³
- DNV can verify that on 16 December, 2010 an accredited third party conducted a RATA in accordance with the procedures of 40 CFR Part 60. DNV reviewed the RATA results and can confirm that the results indicate that the CEMS operates within the design limits stack gas flow and N₂O concentration.³²

QA/QC for non-CEMS Related Equipment

All of the QA/QC procedures to ensure the correct measurement, calculation and reporting of emissions reductions are properly defined for each parameter and have been clearly documented in the Monitoring Plan. These include:

- Organization and responsibility.
- Data management and record keeping.
- Operations and maintenance.
- Regulatory compliance and violation.

4.4.2 The GHG Assessment Boundary

The GHG assessment boundary for the Yazoo Project is limited to N₂O released as a reaction by-product. DNV confirms that N₂O released as a by-product in the project campaigns has been accurately accounted for in the monitoring plan and emission reduction files.^{11,12,13}

4.4.3 GHG Emission Reduction Calculations

Emission Reduction Calculation Equations

Equation 5.1 of the NAPPP 1.0 is properly applied for the GHG emission reduction calculations of the Yazoo Project, as shown in Table 4 below.^{12,13}

Table 4: Application of Equation 5.1 with Properly Selected Parameters

Parameter	Project Campaign		Unit
	4	5	
ER	102 990	115 079	t CO ₂ e
EF _{BL}	0.00643	0.00643	t N ₂ O/t HNO ₃
EF _P	0.00184	0.00135	t N ₂ O/t HNO ₃
HNO _{3ER}	72 380	73 075	t HNO ₃
GWP _{N2O}	310	310	t CO ₂ e/tN ₂ O

Baseline Equations

Equations 5.2 and 5.3 of the NAPPP 1.0 are properly applied for the GHG emission reduction calculations of the Yazoo Project, as shown in Tables 5 and 6 below.⁴⁴

Table 5: Application of Equation 5.2 with Properly Selected Parameter Values

Parameter	Value	Unit
EF _{BL}	0.00643	t N ₂ O/t HNO ₃
BE _{BC}	508.15	t N ₂ O
HNO _{3BC}	78 959	t HNO ₃

Table 6: Application of Equation 5.3 with Properly Selected Parameter Values

Parameter	Value	Unit
BE _{BC}	508.15	t N ₂ O
V _{SG BC}	79 972	m ³ /hour
NC _{SG BC}	2 080	mgN ₂ O/ m ³
OH _{BC}	3 055	hours

Campaign Equations

Equations 5.4 and 5.5 of the NAPPP 1.0 are properly applied for the GHG emission reduction calculations of the Yazoo Project, as shown in Tables 7 and 8 below.^{12,13}

Table 7: Application of Equation 5.4 with Properly Selected Parameter Values

Parameter	Project Campaign		Unit
	4	5	
PE _n	132.96	100.40	t N ₂ O
V _{SGn}	78 291	72 257	m ³ /hour
NC _{SGn}	563	475	mgN ₂ O/ m ³
OH _n	3 016	2 923	hours

Table 8: Application of Equation 5.5 with Properly Selected Parameter Values

Parameter	Project Campaign		Unit
	4	5	
EF _n	0.00184	0.00135	t N ₂ O/t HNO ₃
PE _n	132.96	100.40	t N ₂ O
HNO _{3n}	72 380	74 187	t HNO ₃

4.4.4 Other Calculations***HNO_{3MAX} and HNO_{3MAXSCALED}***

For calculating *HNO_{3MAX}* and *HNO_{3MAXSCALED}*, the Yazoo Project has calculated and properly applied the requirements of the Nitric Acid Production Project Protocol Errata and Clarifications, specifically Clarification 3.² Campaign 5 HNO₃ production totalled 74 187 t HNO₃, which exceeded the *HNO_{3MAXSCALED}* value of 73 075 t. These data are shown in Table 9.

Table 9: HNO₃MAXSCALED Values for Project Emissions

Parameter	Project Campaign		Unit
	4	5	
HNO ₃ MAXSCALED	75 400	73 075	t HNO ₃

Campaign 5 HNO₃ production totaled 74 187 t HNO₃ which exceeded the HNO₃MAXSCALED value of 73 075 t HNO₃. DNV reviewed the emission reduction calculations and confirmed that Terra calculated the total CRTs by using the HNO₃MAXSCALED value, which conforms to the Nitric Acid Production Project Protocol Errata and Clarifications, specifically Clarification 3.^{2,13}

Statistical Comparison of Permitted Operating Conditions (POCs)

In accordance with Section 5.1.2.1 of the NAPPP 1.0 and the Nitric Acid Production Project Protocol Errata and Clarifications, specifically Clarification 4, Terra conducted a statistical comparison of the average historical mean POCs with the mean values developed from the baseline campaign and project campaigns for the following operating parameters:

- Oxidation temperature (OT).
- Oxidation pressure (OP).
- Ammonia to air ratio (AIFR).

DNV reviewed the statistical comparison and confirmed that the mean values for operating parameters for the baseline campaign and project campaigns fall within the upper and lower bound of the 95% confidence interval (CI) for POCs that were developed from the Historical Operating Period data. Additionally, DNV reviewed the emission reduction files and can confirm that the periods that the NAP operated outside of the POCs for both campaigns 4 and 5 were less than 50% of the duration for each campaign.^{12,13}

Table 10 lists the descriptive statistics for POCs in the historical period.

Table 10: Descriptive Statistics for Historical Operating Period POCs

POCs	Statistical Parameters			
	Mean	Standard Deviation	95% CI Upper Bound	95% CI Lower Bound
T (°C)	870	112	1 090	650
P (Bar)	6.6	0.9	8.4	4.8
AIFR (%)	10.4	1.4	13.1	7.7



Table 11 lists operating parameter means for the baseline campaign and project campaigns. DNV confirms all values listed fall within the upper and lower bound of the 95% confidence interval for the mean POCs developed from the Historical Operating Period.

Table 11: Mean Values of Operating Parameters

Operating Parameter	Project Campaigns	
	4	5
T (°C)	923	697
P (Bar)	7.0	7.0
AIFR (%)	10.7	10.7

4.5 Data Collection, Aggregation and Calculation

The data collection, aggregation and GHG emission reduction calculations have been planned properly and implemented effectively, as detailed below.

CEMS and Operating Conditions Data

N₂O concentration in the flue gas, flue gas flow rate, operating conditions and HNO₃ production data are continuously monitored and logged within the Yazoo City nitrogen plant management system. Data is pulled from this system and forwarded to a contractor who incorporates the data into the Yazoo Project emission reduction calculation spreadsheet.

GHG Emission Reductions for the Period of 22 June, 2010 to 1 March, 2011

- The emissions reductions were calculated based on Equations 5.1., 5.2., 5.3, 5.4 and 5.5.
- The calculations were checked by a complete review of the project campaigns emission reduction files.^{12,13} The calculations were determined to be accurate in accordance with the NAPPP 1.0 requirements. Additionally, DNV conducted a review of a two-month sampling period and found no material or immaterial errors.
- The verified GHG emission reductions are shown in Table 12.
- The verified GHG emission reductions for each vintage year are shown in Table 13.



Table 12: GHG Emission Reductions for the Period of 22 June, 2010 to 01 March, 2011

Emission Parameters	Project Campaign	
	4	5
Baseline emissions (tCO ₂ e)	144 209	146 204
Project emissions (tCO ₂ e)	41 219	31 125
Emission reductions (tCO ₂ e)	102 990	115 079

Table 13: GHG Emission Reductions for the Period of 22 June, 2010 to 01 March, 2011--Amount by Vintage Year

Vintage Year	Emission Reductions (t CO ₂ e)
2010	163 262
2011	54 807
Total	218 069



5. VERIFICATION OPINION STATEMENT

Det Norske Veritas (U.S.A.), Inc (DNV) has performed a verification of GHG emission reductions reported for the “Terra Yazoo City # 9, Nitrous Oxide Abatement Project” managed by Terra Mississippi Nitrogen, Inc. for the period of 22 June, 2010 to 1 March, 2011.

In DNV’s opinion, the GHG emission reductions reported for the project are fairly stated and the project meets all the verification criteria of the Climate Action Reserve.

The GHG emission reductions were calculated correctly, using methods and data contained in the Nitric Acid Production Project Protocol: Reducing Nitrous Oxide from Process Gas Emissions, Version 1.0, and the Monitoring Plan provided.

DNV was able to verify that the emission reductions from the “Terra Yazoo City # 9 Nitrous Oxide Abatement Project” managed by Terra Mississippi Nitrogen, Inc. for the period from 22 June, 2010 to 1 March, 2011 amount to 218 069 tCO_{2e}.

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REFERENCES

- 1 Climate Action Reserve, Nitric Acid Production Project Protocol: Reducing Nitrous Oxide from Process Gas Emissions, Version 1.0, 02 December, 2009.
- 2 Climate Action Reserve, Nitric Acid Production Project Protocol, Version 1.0 Errata and Clarifications, 19 August, 2010.
- 3 Climate Action Reserve, Verification Program Manual, 17 June, 2009.
- 4 Climate Action Reserve, Program Manual, 26 October, 2011.
- 5 ISO 14064-3:2006 – Greenhouse gases, Part 3. Specification with guidance for the validation and verification of greenhouse gas assertions.
- 6 ABB Inc, Purchase Order and Installation Service Report for CEMS, February and November, 2008.
- 7 W.C. Hareus GmbH, Secondary Catalyst Installation Report, 15 April, 2009.
- 8 State of Mississippi, Water Pollution Control Permit (Permit No. MS0000574), 15 July, 2008.
- 9 State of Mississippi, Title V Permit (Permit No. 3020-00010), 20 January, 2009.
- 10 Terra Mississippi Nitrogen, Inc., Project Developer's Attestation of Title, 21 July, 2011.
- 11 Terra Mississippi Nitrogen, Inc., Yazoo City AOP # 9 Nitrous Oxide Abatement Project Monitoring Plan Version 2.0, Submitted to DNV July, 2011.
- 12 Terra Mississippi Nitrogen, Inc., Emission Reduction Calculations File for the Campaign Period of 06/24/2010 – 10/28/2010 Version 1.0, 07 July, 2011.
- 13 Terra Mississippi Nitrogen, Inc., Emission Reduction Calculations File for the Campaign Period of 10/29/2010 – 3/12/2011 Version 1.0, 07 July, 2011.
- 14 Terra Mississippi Nitrogen, Inc., Purchase Order for CEMS, 10 July, 2008.
- 15 Terra Mississippi Nitrogen, Inc., Yazoo City AOP # 9 Nitrous Oxide Abatement Project Monitoring Plan Version 1.0, 2010.
- 16 Climate Action Reserve, Nitric Acid N₂O Project Submittal Form for Terra Industries Inc., City AOP # 9 Nitrous Oxide Abatement Project, 09 February, 2010.
- 17 W.C. Hareus GmbH, Secondary Catalyst Installation Report, 15 April, 2009.
- 18 Discussion with Terra EH&S Director, 02 August, 2011.
- 19 Terra Nitrogen, Limited Partnership, Project Developer's Attestation of Voluntary Implementation, 21 July, 2011.
- 20 Terra Mississippi Nitrogen, Inc., Project Developer's Attestation of Regulatory Compliance, 21 July, 2011.
- 21 Terra Industries, Yazoo City Historical Environmental and Safety Tracking Sheet, Undated – Submitted to DNV August, 2011.
- 22 U.S. Department of Labor, OSHA Form 300 for Terra Mississippi Nitrogen, 2010.
- 23 U.S. Department of Labor, OSHA Form 300 for Terra Mississippi Nitrogen, 2011.
- 24 Terra Industries, EHS Incident Tracking File for 2010, Submitted to DNV 04 August, 2011.
- 25 Terra Industries, Critical Equipment Tracking and QA/QC Procedures for N₂O Emission Reduction Project, Submitted to DNV 26 August, 2010.
- 26 Emerson Process Management, Meter Verification Structural Integrity Method, 10 February, 2010.
- 27 Thompson Equipment Company, Accuracy Verification Check Results for # 9 Flow Meter, 15 March, 2011.
- 28 Terra Industries, Work Order for Gauze Change, 26 October, 2010.
- 29 Terra Industries, Work Order for Gauze Change, 02 March, 2011.
- 30 Terra Industries, No. 9 AOP Process Alarms and Trips, 02 February, 2010-22 June, 2010.
- 31 Terra Industries, No. 9 AOP Process Alarms and Trips, 1 March 2011-21 July, 2011.
- 32 Environmental Monitoring Laboratories, Inc., Relative Accuracy Test Audit, 16 December, 2010.
- 33 Terra Industries, Excel File of QAL 3 Charts for Campaign 4, Submitted to DNV July, 2011.
- 34 Terra Industries, Excel File of CEMS Calibration Results, Version 1.1., 30 August, 2011.



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- 35 Terra Industries, Instrument Repair Report for Annubar Flow Meter, 01 March, 2011.
- 36 Terra Industries, CGA Audit Results, Undated – Submitted to DNV August, 2011.
- 37 Climate Action Reserve, Request for Project Variance for the Terra Mississippi Nitrogen Inc. Yazoo City AOP # 9 Nitrous Oxide Abatement Project, 28 May, 2010.
- 38 Climate Action Reserve, Variance Approval for the Terra Industries Inc., Terra Yazoo Nitrous Oxide Abatement Project, Yazoo City AOP # 9, 14 September, 2010.
- 39 Climate Action Reserve, Request for Project Variance for the Terra Mississippi Nitrogen Inc. Yazoo City AOP # 9 Nitrous Oxide Abatement Project, 07 September, 2011.
- 40 Climate Action Reserve, Variance Approval for the Terra Industries Inc., Terra Yazoo Nitrous Oxide Abatement Project, Yazoo City AOP # 9, 13 September, 2010.
- 41 State of Louisiana Department of Environmental Quality Environmental Services, Scope of Accreditation Letter to Environmental Monitoring Laboratories, Inc., 01 July, 2011.
- 42 Airgas, Certificate of Analysis for Part # X03NI99P15A59BO, 13 September, 2010.
- 43 Terra Industries, Instrument Repair Report, 01 March, 2011.
- 44 Terra Industries, Baseline Emission Factor Data File Version 1.1, 27 September, 2010.