

MONITORING REPORT FOR PROJECT MONITORING PERIOD #2 (CAMPAIGN #2)

Document prepared by Shanghai BASF Polyurethane Co., Ltd. (SBPC)

Project Title	Catalytic Reduction of N ₂ O inside the Ammonia Burners of the Nitric Acid Plant at Caojing, Shanghai
Version	Version 2.1
Date of Issue	02-03-2012
Project ID	575
Monitoring Period	01-07-2010 to 23-05-2011 (both dates included)
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1 PROJECT DETAILS

1.1 Summary Description of Project

The nitric acid plant at Caojing is licensed by Tecnicas Reunidas (Espindesa) from Spain. The production capacity of the plant as per name plate information in the manual is 335.8 kt HNO₃ per year (as 100% concentration equivalent). Generally, this product is used as raw material for TDI and crude MDI production.¹

The project at hand intends a substantial emission reduction from the nitric acid production process at Caojing by installation of a N₂O decomposition catalyst right below the platinum gauze in the ammonia oxidation reactor as a secondary abatement measure.

The N₂O decomposition catalyst was installed in late 2009 (exact date: 23 November 2009), following a six months baseline measurement period. The emission reductions to amount to 4,929,000 tCO₂e over the whole crediting period or 492,900 tCO₂e p.a. according to PD estimation.

With no economic benefit from N₂O abatement and the absence of any legal obligation, the emission reductions will only be realized if the investment and the on-going costs for the secondary abatement can be financed by a VCS project.

1.2 Sectoral Scope and Project Type

The respective sectoral scope is scope 5: chemical industry. The project is not a grouped project.

1.3 Project Proponent

Shanghai BASF Polyurethane Co., Ltd. (SBPC)
No. 25 Chu Jua Road
Caojing, Shanghai
Zip code 201508
People's Republic of China

1.4 Other Entities Involved in the Project

Not applicable.

1.5 Project Start Date

The project start date is identical with the start of the first project campaign (28 November 2009).

1.6 Project Crediting Period

A crediting period over 10 years applies, starting with the achievement of first verifiable emission reductions in November 2009. Thus the crediting period shall last from 28 November 2009 until 27 November 2019.

¹ TDI (Toluene diisocyanate), MDI (Diphenylmethane diisocyanate). Plants for production of these materials and thus the main consumers of the produce are located on the SBPC site as well.

1.7 Project Location

The nitric acid plant of Shanghai BASF Polyurethane Co., Ltd. (SBPC), and all connected facilities are located at the production site at Shanghai Chemical Industry Park (SCIP) in Caojing, Municipality of Shanghai. The nitric acid production is housed in buildings block A615 of SBPC.

Exact address:

No. 25 Chu Hua Road

Caojing, Shanghai

zip code 201507

People's Republic of China

Coordinates of the plant:

Lat: 30° 47' 13" N

Lon: 121° 27' 51" E

1.8 Title and Reference of Methodology

The project utilizes the following CDM EB-approved methodologies:

- AM0034, VER 3.2 "Catalytic reduction of N₂O inside the ammonia burner of nitric acid plants"
- AM0028 VER 4.1 "Catalytic N₂O destruction in the tail gas of Nitric Acid Plants"

The report has been prepared for verification of the achieved emission reductions during the second project campaign at Caojing plant. As basic documentation for verification it refers to:

- Approved baseline and monitoring methodology AM0034: "Catalytic reduction of N₂O inside the ammonia burner of nitric acid plants", v3.2, which is used in the PD.
- Project documentation (PD) to Caojing project in its validated version: "Catalytic Reduction of N₂O inside the Ammonia Burners of the Nitric Acid Plant at Caojing, Shanghai", version 3, 24 June 2010, validated.
- VCS 2007.1 Validation Report from TÜV Nord: "CATALYTIC REDUCTION OF N₂O INSIDE THE AMMONIA BURNERS OF THE NITRIC ACID PLANT IN CAOJING, SHANGHAI", Report No: 8000372692 - 09/208, revision 1, 2010-11-22.
- Monitoring plan as an up-to-date documentation to the monitoring procedures and their implementation: "VER Handbook", v2.2, March 2012.
- Extracted Durag AMS data and project calculation tools where relevant calculations are presented in a transparent way.

2 IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

Table 1 below illustrates the project implementation as of November 2011.

Table 1: Status of implementation

Activity	Date
Baseline measurement period	13-03-2009 – 22-11-2009
Onsite validation	08-07-2009 – 09-07-2009
First monitoring period	23-11-2009 – 30-06-2010
First project campaign (PC1)	28-11-2009 – 30-06-2010
Second monitoring period	01-07-2010 – 23-05-2011
Second project campaign (PC2)	12-07-2010 – 23-05-2011
Onsite first verification	22-11-2010 – 24-11-2010
Third monitoring period	24-05-2011 – tbd.
Onsite second verification	08-11-2011 – 10-11-2011

Table 2 below shows all significant events during the campaign and their treatment.

Table 2: Significant events during campaign

Campaign	Date	Explanation	Treatment
PC2	12-07-2010 (3h) – 19-08-2010 (9h)	Drift of the N ₂ O analyser occurred and has to be taken into account for the indicated timeframe.	Values have been replaced by the statistical NCTG maximum (95% standard deviation) of all correct NCTG values from the project campaign.
PC2	07-10-2010 (15h) – 21-10-2010 (12h)	Drift of the N ₂ O analyser occurred and has to be taken into account for the indicated timeframe.	Values have been replaced by the statistical NCTG maximum (95% standard deviation) of all correct NCTG values from the project campaign.
PC2	27/28-10-2010	AST: hourly NCTG and VTG values have to be corrected.	Affected hourly values are considered as downtime hours.

During the second project campaign there were 6 start-ups. In total the plant was out of operation for 162 hours.

2.2 Deviations from the Monitoring Plan

Due to periodical requirements of the DNT plant (downstream nitric acid recipient) for higher concentrated nitric acid (70% instead of 68%) parts of the NAP production have been transferred to the DNT plant via a second product pipeline. These amounts of nitric acid have been measured by the entry flow meter of the DNT plant (recipient) and have been considered in the calculations.

The flowmeter for secondary flow is technically the same as the one for primary NAP (both produced by Emerson). The measurement range of the secondary NAP flowmeter is half the size of the flowmeter while the measurement accuracy is generally the same.

For the secondary NAP flowmeter a two times higher frequency of lab concentration analyses applies (four times vis-à-vis twice a day) – defining an even higher degree of accuracy. This internal requirement reflects higher downstream product quality standards.

2.3 Grouped Project

Not applicable.

3 DATA AND PARAMETERS

3.1 Data and Parameters Available at Validation

Parameters for baseline determination are not subject to this monitoring report. They were discussed and verified during first verification and may be found in the verification documentation to the first monitoring report.

3.2 Data and Parameters Monitored

Baseline parameters have been monitored, calculated and evaluated during first verification. In general they are not subject to this monitoring report. Still for evaluation and calculation of project emissions the following baseline parameters have been considered and shall be reported in this monitoring report.

Data Unit / Parameter:	B.4 NAP _{BC}
Data unit:	t HNO ₃
Description:	Baseline campaign length, measured in nitric acid production volume of the baseline campaign
Source of data:	Monitored
Frequency of monitoring/recording:	Every 2 seconds
Value applied:	180,988
Monitoring equipment:	Mass Flow meter Instrument No.: 3751549; Measurement range: 0~70000 kg/h
Purpose of the data:	Serving as cap to production for NCTG data integration (calculation of project campaign EF).
Calculation method:	Measured
Any comment:	

Data Unit / Parameter:	B.12 GS _{normal}
Data unit:	

Description:	Normal gauze supplier for historical campaigns
Source of data:	Delivery notes
Value applied:	-
Purpose of the data:	This information is only available at the plant for determination and verification.
Any comment:	This information is confidential.

Data Unit / Parameter:	B.13 GC _{normal}
Data unit:	
Description:	Gauze composition during historical campaigns
Source of data:	Delivery notes/data provided by supplier
Value applied:	-
Purpose of the data:	This information is only available at the plant for determination and verification.
Any comment:	This information is confidential.

The following project parameters are all directly relevant for the evaluation of the second project campaign.

Data Unit / Parameter:	P.1 NCTG _{PC2}
Data unit:	mgN ₂ O/Nm ³ (converted from ppmv)
Description:	N ₂ O concentration in tail gas during project campaign n
Source of data:	Durag
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every 2 seconds
Value monitored:	275.78
Monitoring equipment:	N ₂ O analyser; Infrared Photometer URAS26; instrument no: 3,356554.8, Measurement range: 0~500/2000 ppm
QA/QC procedures to be applied:	Regular calibrations according to vendor specifications and recognized industry standards (EN 14181). Staff trained in monitoring procedures and reliable technical support infrastructure set up.
Calculation method:	Measured
Any comment:	

Data Unit / Parameter:	P.2 VTG _{PC2}
Data unit:	Nm ³ /h

Description:	Volume flow rate of tail gas during project campaign n
Source of data:	Durag
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every 2 seconds
Value monitored:	118,545
Monitoring equipment:	FMD99, instrument no: B3-08111, Measurement range: 0~200,000 Nm3/h
QA/QC procedures to be applied:	Regular calibrations according to vendor specifications and recognized industry standards (EN 14181). Staff trained in monitoring procedures and reliable technical support infrastructure set up.
Calculation method:	Measured
Any comment:	

Data Unit / Parameter:	P.3 OH _{PC2}
Data unit:	Hours
Description:	Operating hours during project campaign n
Source of data:	Limit switch of control valve: Control valve for Ammonia feed in, open means plant start-up/ close means shut-down.
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Daily, compiled for entire campaign
Value monitored:	5,457
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	Measured
Any comment:	

Data Unit / Parameter:	P.4 NAP _{PC2}
Data unit:	tHNO ₃
Description:	Nitric acid production (100% concentrate) during project campaign n
Source of data:	Durag and DCS
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	282,233
Monitoring equipment:	Mass Flow meter Instrument No.: 3751549; Measurement

	range: 0~70000 kg/h Mass Flow meter Instrument No.: 417668 ; Measurement range: 0-35000 kg/h:
QA/QC procedures to be applied:	
Calculation method:	Measured
Any comment:	

Data Unit / Parameter:	P.5 TTG _{PC2}
Data unit:	°C
Description:	Temperature of tail gas during project campaign n
Source of data:	Durag
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every 2 seconds
Value monitored:	-
Monitoring equipment:	Thermometer instrument no:B3-08111, Measurement range: 0~300 °C
QA/QC procedures to be applied:	
Calculation method:	Measured
Any comment:	

Data Unit / Parameter:	P.6 PTG _{PC2}
Data unit:	Pa
Description:	Pressure of tail gas during project campaign n
Source of data:	Durag
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every 2 seconds
Value monitored:	-
Monitoring equipment:	Pressure Transmitter instrument no: 267184 800~1200 mbar abs.
QA/QC procedures to be applied:	
Calculation method:	Measured
Any comment:	

Data Unit / Parameter:	P.7 GS _{project}
Data unit:	

Description:	Gauze supplier for project campaign
Source of data:	Delivery notes
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	-
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	This information is only available at the plant for determination and verification. This information is confidential.

Data Unit / Parameter:	P.8 GC _{project}
Data unit:	
Description:	Gauze composition during project campaign
Source of data:	Delivery notes/data provided by supplier
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	-
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	This information is only available at the plant for determination and verification. This information is confidential.

Data Unit / Parameter:	P.9 EF _{reg}
Data unit:	
Description:	Changed emission level set by changed policies or regulations.
Source of data:	Monitored for verification
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value monitored:	-
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	

Any comment:	Updated when new regulations come into force.
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The following parameters are furthermore monitored.

Project campaign

Parameter	Comments
OT	Monitored, protocolled in Durag and included in listed data of excel calculation sheet.
AFR	Monitored, protocolled in Durag and included in listed data of excel calculation sheet.
AIFR	Monitored, protocolled in Durag and included in listed data of excel calculation sheet.

Baseline campaign

Parameter	Value	Comment
OH _{BC} (h)	5,511	Operating hours of baseline campaign.
NCSG _{BC} (mg/m ³)	2071.09	Percentile mean of N ₂ O concentration, used for calculations of baseline EF.
VTG _{BC} (m ³ /h)	120,135	Percentile mean of volume flow, used for calculations of baseline EF.
UNC (%)	4.59	Combined uncertainty (UNC) as per QAL2 report, used for calculation of baseline EF.

3.3 Description of the Monitoring Plan

The procedure for the proposed project follows the official methodology AM0034, VERSION 3.2, which contains both a baseline and a monitoring methodology.

An automated measuring system (AMS) has been installed using European norm EN 14181 as guidance for its selection, installation, and operation. Thus three different levels of quality assurance tests and one annual functional test for the AMS are applied; The AMS together with the procedures for its uncertainty determination fulfil DIN EN ISO 14956 requirements.

The AMS provides separate readings for N₂O concentration and gas volume flow continuously, generating average values for every 60 minutes of operation. Error readings (e.g. downtime or malfunction) and extreme values are automatically eliminated from the output data series by the monitoring system.

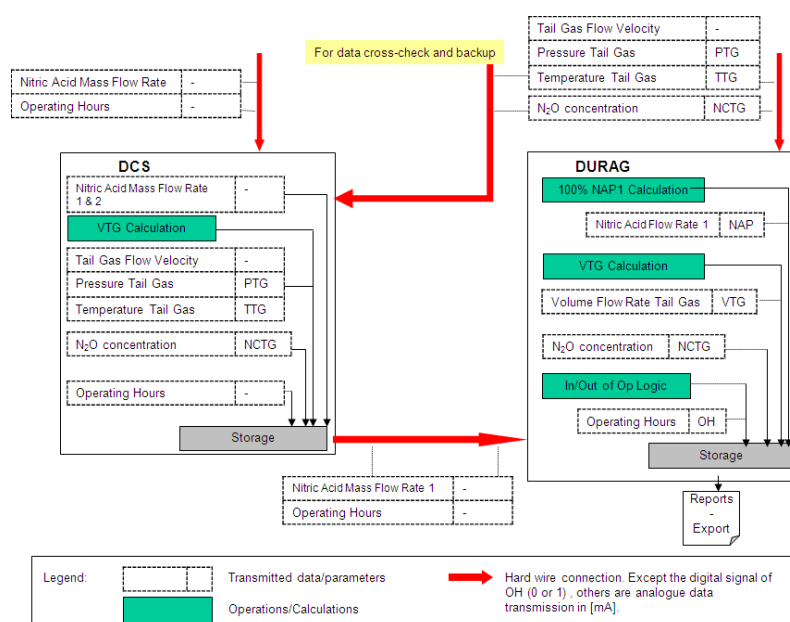
For data integration statistical evaluation is applied to the project data series for N₂O concentration and gas volume flow in order to eliminate mavericks from downtime or malfunction of the monitoring system.

Data Collecting, processing and storage

The first level of data control is provided by a Distributed Control System (DCS). This Emerson Delta V system is operated around the clock by staff in the control room.

The second level of data control operates via an AspenTech PIMS (Plant Information Management System) system. Data from this system is accessible to the plant manager via computer software. On a regular basis data exports from the system in excel are conducted.

For the project implementation an automated monitoring system (AMS) has been installed using the guidance document EN 14181 (see also section 9 below). Parameter information from the analysers and flow meters are fed into this system. Here calculations are performed and hourly averages or the parameters are generated.



The AMS provides separate readings for N₂O concentration and gas volume flow continuously, generating average values for every 60 minutes of operation. Apart from these two parameters, temperature and pressure of the tail gas are recorded in the AMS. The data transfer via DCS to the AMS is described in Figure 1. Maintenance procedures to the AMS are described in an → AMS Manual.

Figure 1: Data transfer between DCS and system

The responsibilities for the project management

DURAG is responsible for the supervision of the Automated Measurement System (AMS). Regarding maintenance and troubleshooting procedures, it is the SBPC E&I engineer who commissions necessary calibrations, which are implemented by SBPC E&I technician. For prompting such measures, SBPC E&I supervisor checks drift reports every week. He is also responsible for the weekly documentation of these measures.

The calculation of the emission reductions is done after each campaign by the Nitric Acid Plant Technologist or Technology Specialist, based on the campaign data, and validated by the Nitric Acid Plant Manager. The Nitric Acid Plant Manager analyses the data and prepares the report according to requirements outlined in the procedures of the VER handbook. A Task Group for the N₂O emission reduction project implementation has been installed to support SBPC E&I engineer the implementation of proper monitoring procedures at any time.

A clear allocation of responsibilities has been established at the plant in regards to the monitoring of the VER project. Figure 2 below illustrates the management structure inside the nitric acid production plant.

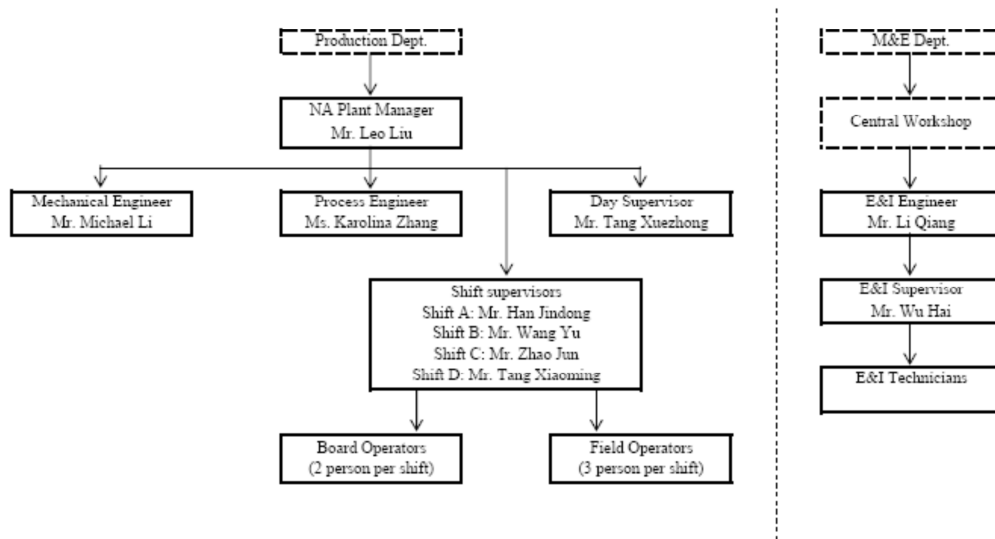


Figure 2: Plant management structure

Data handling and troubleshooting procedures

Concrete troubleshooting procedures have been defined. These specific measures are integrated into a comprehensive data handling manual which serves as the guidebook for documentation and monitoring procedures. Adequate templates for documentation on the maintenance and data control measures are compiled at weekly data control and documentation meetings.

Table 3: Troubleshooting procedures for NCTG/VTG

		N ₂ O Analyser (NCTG/P.1)	Volume flow meter (VTG/ P.2)
1	On-going quality procedures: What regular quality assurance measures are performed (calibration, QAL 3, controls etc.) when and by whom?	Complete EN 14181 QA requirements, AST (annually, by maintenance contractor); QAL 3 is carried out (every week, by SBPC E&I technicians), results are entered into QAL 3 module in DURAG system.	Regular calibrations according to vendor specifications and recognised industry standards (EN 14181).
2	What happens in case drifts or faults are determined during quality checks (e.g. replacement of device, adjustment of calibration/regression data in DURAG system)?	1. Checking hardware problems on daily basis, zero drift and linear deviation can be fixed within standardized normal calibration. 2. Partially changing the hardware in case of a definite problem. 3. Changing the whole analyser.	1. Checking hardware problems on daily basis, zero drift can be fixed within standardized normal zero calibration 2. Partially changing the hardware in case of a definite problem. 3. Changing the whole flow meter.
3	What malfunctions can occur? How are those malfunctions identified (what signal does device send in case of malfunctions)?	Zero drift, can be identified within the regular calibration procedure; Span drift, can be identified within the regular calibration procedure; Besides, hardware problems can be identified because of the message on the device itself and maintenance message, sent to DCS.	Zero drift, can be identified within the regular calibration procedure; Besides, hardware problems can be identified because of the message on the device itself and maintenance message, sent to DCS.
4	What happens in case of a malfunction? Who notices when and how? What does the person who notices do? What steps are taken to solve the problem? How are the necessary tasks documented?	In case of a malfunction, Zero or Span drift, for example, the patrolling technician will inform his supervisor, who will identify further according to the manuals and specification, calibration will be carried out to fix the problems. After that the relevant work record will be noted down accordingly. The same procedure applies if a hardware problem would occur.	In case of a malfunction, Zero drift, for example, the patrolling technician will inform his supervisor, who will identify further according to the manuals and specification, calibration will be carried out to fix the problems. After that the relevant work record will be noted down accordingly. The same procedure if a hardware problem would occur.
5	What data are recorded during malfunctions? How and where are default values generated (in metering device or DURAG system)? Are default values accordingly marked in the data base?	Malfunction of the analyser is to be considered in the data analysis (calculation tool). The value is to be replaced by a conservative default value which is defined by application of the 95% confidence interval (1.96 times the standard deviation). The second source of data is the PIMS system	Malfunction of the flow meter is to be considered in the data analysis (calculation tool). The value is to be replaced by a conservative default value which is defined by application of the 95% confidence interval (1.96 times the standard deviation). The second source of data is the PIMS system

Table 4: Troubleshooting procedures for NAP/NAP concentration

		Nitric acid production measurement: mass flow (NAP/P.4)	Nitric acid production measurement: concentration
1	Ongoing quality procedures: What regular quality assurance measures are performed (calibration, QAL 3, controls etc.) when and by whom?	Regular calibrations according to vendor specification and national standard.	Laboratory analysis of the nitric acid concentration twice a day in regular case by lab technician.
2	What happens in case drifts or faults are determined during quality checks (e.g. replacement of device, adjustment of calibration/regression data in DURAG system)?	1. Checking hardware problems on AMS system using HART protocol System at least one time each year. 2. partially changing the hardware in case of a definite problem. 3. Changing the whole flow meter in case of necessity.	Spec of nitric acid 68% produced by SBPC is $\geq 67.5\%$. Re-sampling by plant operator will be done if result deviates to much. Finally a non-conformity report (NCR) will be issued by lab manager if Nitric acid concentration lower than 67.5%
3	What malfunctions can occur? How are those malfunctions identified (what signal does device send in case of malfunctions)?	Transmitter hardware problem or sensor worn out problem, both can be identified promptly by the maintenance signal automatically to DCS.	As the sampling and analysis are all done by manpower, here this block is not applicable.
4	What happens in case of a malfunction? Who notices when and how? What does the person who notices do? What steps are taken to solve the problem? How are the necessary tasks documented?	In case of malfunction, the DCS operator will be informed immediately by the error alarm signal, the instrument technician will identify the problem afterwards via AMS system and site access, in case of transmitter or sensor problem, the instrument will ask the permit to change the hardware in question. After work done, the relevant work record will be noted down formally.	As the sampling and analysis are all done by manpower, here this block is not applicable.
5	What data are recorded during malfunctions? How and where are default values generated (in metering device or DURAG system)? Are default values accordingly marked in the data base?	During malfunction of the NAP flow meter the value is to be replaced by a conservative default value which is defined by application of the 95% confidence interval (1.96 times the standard deviation). The second source of data is the PIMS system.	

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

All calculations are carried out in an appropriate Excel file where all relevant values from the AMS and the process control system are listed.

4.1 Baseline Emissions

Baseline emissions have been determined for and verified during first verification. The following data had been calculated:

Campaign	EF _{BC} [kgN ₂ O/tHNO ₃]	CL _{BC} [tN ₂ O]
BC	7.25	169,958

On the basis of real campaign length of project campaign 2 (CL_{PC2}/ see 4.2 below) baseline emissions of 634,203 tCO₂e have been calculated.

4.2 Project Emissions

For calculation of project emissions, the following formulae have been applied:

In order to determine project emissions:

$$PE_n = VTG \times NCTG \times OH \times 10^{-9} \quad PD \text{ Formula } 3$$

Where:

PE_n	Total N ₂ O emissions for the nth project campaign (tN ₂ O)
VTG	Mean tail gas volume flow rate for the project campaign (m ³ /h)
$NCTG$	Mean concentration of N ₂ O in the tail gas for the project campaign (mgN ₂ O/m ³)
OH	Number of hours of operation in the specific project campaign (h)

From the project emissions and the accordant nitric acid production in the monitored campaign, the specific campaign emission factor is calculated:

$$EF_n = PE_n / CL_n \quad PD \text{ Formula } 4$$

Where:

EF_n	Project N ₂ O emission factor (tN ₂ O/tHNO ₃)
CL_n	Volume of nitric acid production during the project period (tHNO ₃) (=NAP)

For taking into account the moving average:

$$EF_{ma,n} = (EF_1 + EF_2 + \dots + EF_n) / n \quad PD \text{ Formula } 5$$

$$\begin{aligned} \text{If } EF_{ma,n} > EF_n \text{ then } EF_p &= EF_{ma,n} \\ \text{If } EF_{ma,n} < EF_n \text{ then } EF_p &= EF_n \end{aligned} \quad PD \text{ Formula } 6$$

Where:

EF_n	Emission factor calculated for a specific project campaign n (tN ₂ O /HNO ₃)
$EF_{ma,n}$	Moving average emission factor after nth period, incl. the current period (tN ₂ O /HNO ₃)

n Number of periods to date
 EF_p Emission factor that will be applied to calculate the emission reductions (tN_2O / HNO_3)

For second project campaign, the following data has been calculated:

Campaign	NCTG _{PC2} [mg N ₂ O/Nm ³]	VTG _{PC2} [Nm ³ /h]	OH _{PC2}
PC2	275.78	118,545	5,457

Campaign	EF _{PC2} [kgN ₂ O/tHNO ₃]	PE _{PC2} [tN ₂ O]	PE _{PC2} [tCO ₂]	CL _{PC2} [tHNO ₃] (=NAP _{PC2})
PC2	0.63(203)	178.41	55,306	282,233

For consideration of the moving average, the following data have been calculated/apply:

Campaign	EF _{PC1} [kgN ₂ O/tHNO ₃]	Campaign	EF _{ma,PC2} [kgN ₂ O/tHNO ₃]
PC1	0.62(370)	PC2	0.62(786)

As EF_{ma,PC2} is smaller than the campaign specific EF_{PC2}, the latter (higher) value is applied in the calculation of emission reductions.

4.3 Leakage

Not applicable.

4.4 Summary of GHG Emission Reductions and Removals

For calculation of emission reductions, the following formulae have been applied:

$$ER_n = (EF_{BC} - EF_p) * CL_n * GWP_{N_2O} \quad (tCO_2e) \quad PD \text{ Formula 7}$$

Where:

ER_n Emission reductions of the project for the specific campaign n (tCO₂e)
 EF_{BC} Baseline emission factor
 GWP_{N_2O} Global Warming Potential of N₂O: 310

For second project campaign, the following emission reductions have been calculated:

Campaign	ER _{PC2} [tN ₂ O]	ER _{PC2} [tCO ₂ e]	ER _{PC2} in 2010 [tCO ₂ e]	ER _{PC2} in 2011 [tCO ₂ e]
PC2	1,867	578,897	313,907	264,990

Emission reductions over the 10.5 months of second project campaign are higher than estimated in PD (578,899 against ~431,287 t CO₂e over 10.5 months (PDD: 492,900 t CO₂e p.a.)). This increase is due to a substantially higher mitigation catalyst performance rate than anticipated (> 92% against 80%) as well

as a substantially increased NAP production load (282,233 against ~231,875 tHNO₃ over 10.5 months on average (PDD: 265,000t HNO₃ p.a.)).

5 ADDITIONAL INFORMATION

Further information is given in the VER project handbook.