



**Project design document form for
CDM project activities
(Version 05.0)**

Complete this form in accordance with the Attachment "Instructions for filling out the project design document form for CDM project activities" at the end of this form.

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	Omnia Fertilizer Limited Nitrous Oxide (N ₂ O) Reduction Project
Version number of the PDD	2
Completion date of the PDD	12/08/2014
Project participant(s)	Omnia Fertilizer Limited
Host Party	South Africa
Sectoral scope and selected methodology(ies), and where applicable, selected standardized baseline(s)	Sectoral Scope: 05 Applied Methodology: ACM0019 Version 02.0.
Estimated amount of annual average GHG emission reductions	421,913 t CO ₂ e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The project activity: “Omnia Fertilizer Limited Nitrous Oxide (N₂O) Reduction Project” was registered under UNFCCC registration number 0752 on 03/05/2007 for the first renewable crediting period of 7 years. The 1st crediting period lasted from 26/02/2008 until 25/02/2015.

This PDD is prepared for the purpose of renewal of the crediting period. The second crediting period will last from 26/02/2015 until 25/02/2022 (7 years).

Omnia Fertilizer Limited has implemented a project activity aimed at reducing the N₂O emissions from its Nitric Acid plant in Sasolburg, South Africa. The project activity is under the category large scale, Sectoral scope 5 “Chemical Industry”.

Registration date: May 3, 2007.

1st Crediting period: February 26, 2008 to February 25, 2015 (Renewable)

The starting date of operation of the project activity is 26/02/2008.

The EnviNox installation was completed and commissioned in January 2008.

Omnia erected and commissioned the Nitric Acid Plant in 1983.

The nitric acid plant was commissioned in 1983, designed by Uhde GmbH with a confirmed production capacity 748t/day 100% concentrated nitric acid corresponding to 273,020 t/year nitric acid. Nitrous Oxide (N₂O) is an undesired by-product of the nitric acid (HNO₃) production process at the synthetic fertilizer production facility. However, N₂O emissions from nitric acid production are not regulated in South Africa. No N₂O abatement system was designed into the plant before start of the CDM project. Without the incentive of the proposed CDM project activity, approx. 488,700 tCO₂e per year¹ would be emitted at Omnia Nitric Acid Plant I. Therefore the baseline scenario without the CDM project would be the operation of the nitric acid plant without N₂O reduction catalyst.

The project activity involves the installation of an N₂O catalytic Destruction Facility, EnviNox™, in the tail gas section of the process downstream of the absorption column at Omnia Fertilizer nitric acid plant in Sasolburg, South Africa. Catalytic reduction of N₂O occurs when the N₂O in the tail gas reacts, in the presence of the iron zeolite catalyst, with the reducing agent in the Destruction Facility. The reaction removes the oxygen from the N₂O molecules and forms one or more compounds. In this case the reducing agent is natural gas, comprised mostly of methane (CH₄).

This project activity will not result in any revenue to Omnia other than the income from the sale of CERs. It is expected to reduce up to 98% of the N₂O emissions that would normally be emitted without the project activity. Calculations of ex ante emissions reduction indicate that the proposed project activity has the capacity to reduce greenhouse gas (GHG) emissions by 2,953,391 tCO₂e over the second 7 year crediting period.

Additionally, the project supports the transfer of greenhouse gas mitigation technology as well as emission monitoring technology to South Africa. The project created construction jobs for the initial erection of the N₂O reduction facility as well as sustainable employment in maintaining the reduction facility as well as monitoring its performance.

¹ An estimated business-as-usual emissions factor of 6.3 kgN₂O/tHNO₃ (Average Baseline Emission factor of the first crediting period) and an annual expected nitric acid production of 261,955 tHNO₃/year was taken into account.

In effect, the project brings not only environmental benefits in the form of substantially reduced N₂O emissions, but social and economic benefits, contributing to the South African government's sustainable development objectives.

The project proponent received approval from South Africa's DNA for voluntary participation, confirming that the project is in total compliance with the country's sustainable development objectives.

A.2. Location of project activity**A.2.1. Host Party**

Republic of South Africa

A.2.2. Region/State/Province etc.

Free State Province, Republic of South Africa

A.2.3. City/Town/Community etc.

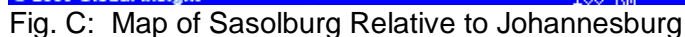
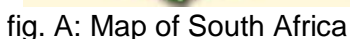
Sasolburg in the municipality of Metsimaholo.

A.2.4. Physical/Geographical location

The project site is located in the industrial town of Sasolburg in Free State Province. This town is located about 80 km south of Johannesburg.

Omnia's plant is located at latitude of approximately 26°48'48" South and a longitude of 27°51'23" East.

Figure A shows the Free State Province in relation to the rest of South Africa. The province is amplified in fig. B with the city of Sasolburg shown thereon. The last map, fig. C, shows the city of Sasolburg in relation to Johannesburg, South Africa's largest city.



The original design and the order for the nitric acid plant did not foresee the installation of a N₂O destruction catalyst systems. When the CDM methodology AM0028 became available it was decided to implement a CDM project with installation of a tertiary N₂O reduction catalyst. Therefore

the baseline scenario without the CDM project would be the operation of the nitric acid plant without N₂O reduction catalyst.

The project activity entails the installation of:

- Tertiary N₂O abatement technology,
- Specialized monitoring equipment that is installed at the tail gas stream after the abatement of N₂O emissions (see Monitoring Plan in this PDD for further information).

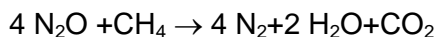
Catalyst Technology

In the production process of nitric acid (HNO₃), NO₂ is produced as an intermediate material from ammonia (NH₃). The associated chemical reactions of oxidizing ammonia and simultaneous unwanted reactions are as follows:

- | | | | |
|---|---|---|--|
| 1. NH ₃ + 2 O ₂ | → | HNO ₃ + H ₂ O | (overall desirable reaction) |
| 2. 4 NH ₃ + 5 O ₂ | → | 4 NO + 6 H ₂ O | (desirable in the NH ₃ oxidization process) |
| 3. 2NO + O ₂ | → | 2 NO ₂ | (desirable in the NO oxidization process) |
| 4. 3 NO ₂ + H ₂ O | → | 2 HNO ₃ + NO | (desirable in the NO ₂ absorption process) |
| 5. 4 NH ₃ + 3 O ₂ | → | 2 N ₂ + 6 H ₂ O | (undesirable) |
| 6. 4 NH ₃ + 4 O ₂ | → | 2 N ₂ O + 6 H ₂ O | (undesirable) |
| 7. 2 NH ₃ + 8 NO | → | 5 N ₂ O + 3 H ₂ O | (undesirable) |

Through the sixth and seventh reactions, some N₂O is generated in the process.

The N₂O abatement technology will be installed in the tail gas downstream after the HNO₃ absorber and before the tail gas turbine. A tertiary catalyst reduces N₂O that is formed in the primary ammonia oxidation reaction. A wide range of metals (e.g. Cu, Fe, Mn, Co and Ni) have been shown to be of varied efficiency in N₂O abatement catalysts. The abatement efficiency of this pelleted catalyst has been shown to be up to 99.9% in the following reaction²:



In the tertiary abatement system N₂O is removed by catalytic reduction with a hydrocarbon, such as methane from natural gas.

The applied technology is chosen because it has negligible risk of decreasing HNO₃ production and a high expected N₂O reduction.

The expected remaining lifetime of the N₂O reduction unit is at least 10 years. It is expected to be in the range of 25 years. However the installed catalyst itself may need to be replaced after a few years, depending on the achieved abatement performance.

In addition NO_x is reduced in a separate catalyst bed by reduction with ammonia.

² While the calculations of estimated emission reductions are based on the conservative estimation of an abatement efficiency of 98 %, it should be noted that from experience from the first crediting period of this project as well as from other similar projects with the same technology even higher abatement efficiencies of up to 99.9 % were observed.

A.4. Parties and project participants

Party involved (host) indicates host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
South Africa (host)	Omnia Fertilizer Limited. Private entity	No
United Kingdom of Great Britain and Northern Ireland	Rabobank International (withdrawn)	No
Netherlands	International Finance Corporation (withdrawn)	No

A.5. Public funding of project activity

No public funds are involved in the financing of the project activity. The project is solely financed by Omnia Fertilizer Limited.

SECTION B. Application of selected approved baseline and monitoring methodology and standardized baseline**B.1. Reference of methodology and standardized baseline**

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Applicable baseline and monitoring methodology:

ACM0019 Version 02.0: "N₂O abatement from nitric acid production"

Methodological tools referred to in ACM0019 as applied in this PDD:

"Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion"

(Version 02)

"Tool to determine the mass flow of a greenhouse gas in a gaseous stream"

(Version 02.0.0)

B.2. Applicability of methodology and standardized baseline

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The chosen baseline methodology ACM0019 is applicable to projects in which tertiary N₂O abatement technology is installed in the tail gas leaving the absorption column in the nitric acid plant. This corresponds with the proposed project activity.

The applicability criteria of the chosen methodology are met by the project:

- Before the start of the first crediting period, no N₂O abatement technology was installed in the plant.

- The plant will be equipped with a complete Automated Monitoring System (AMS). It is used to continuously measure N_2O concentration and total gas volume flow in the stack during the plant's operation throughout the crediting period.
- The host country does not apply any legal requirements to reduce N_2O emissions from nitric acid plants (see B.4 for further information).

The applicability criteria of the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion” (Version 02) are met by the project:

- In the project activity fossil fuel (natural gas) is used in the N_2O destruction facility. The CO_2 emissions are calculated based on the measurement of the fossil fuel amount and based on the fuel properties. Therefore this tool is applicable.

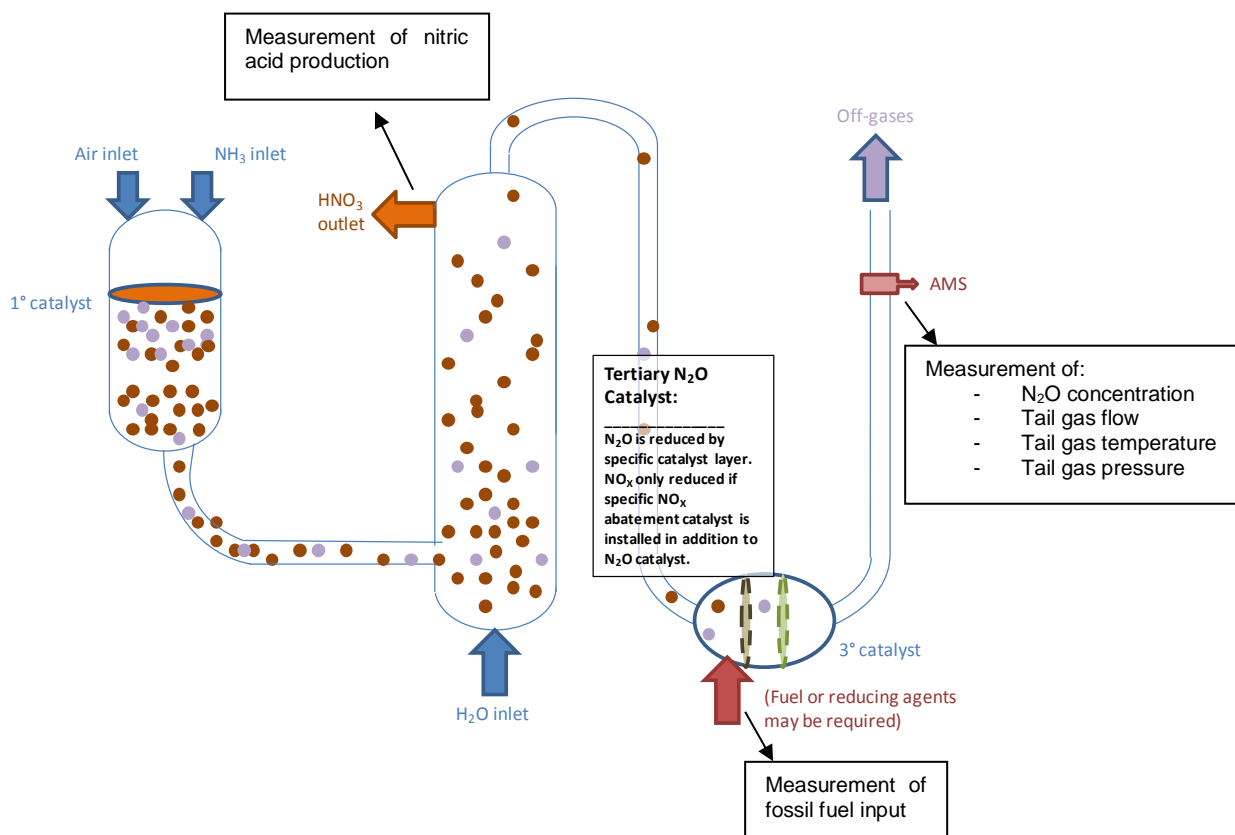
The applicability criteria of the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0) are met by the project:

- In the project activity the flow and composition of exhaust gas is measured for the determination of project emissions. Therefore this tool is applicable.

B.3. Project boundary

The spatial extent of the project boundary encompasses the facility and equipment for the nitric acid production process from the inlet of the ammonia burner to the outlet of the tail gas section.

As the project activity introduces tertiary N_2O abatement, any remaining N_2O emissions from the project plant and CO_2 emissions arising from the operation of the tertiary abatement system are included as project emissions in the project boundary.



The greenhouse gases included in or excluded from the project boundary are shown in the below table:

Source		GHGs	Included?	Justification/Explanation
Baseline scenario	NH ₃ oxidation at the primary catalyst gauze	CO ₂	No	The project activity has no influence on these types of emissions, if present
		CH ₄	No	The project activity has no influence on these types of emissions, if present
		N ₂ O	Yes	Included, main emission source
Project scenario	NH ₃ oxidation at the primary catalyst gauze	CO ₂	No	The project activity has no influence on these types of emissions, if present
		CH ₄	No	The project activity has no influence on these types of emissions, if present
		N ₂ O	Yes	Included, main emission source
	Operation of a tertiary N ₂ O Abatement facility	CO ₂	Yes	In some cases, fossil fuels are used as reducing agent and/or for decomposing the tail gas as part of a tertiary N ₂ O abatement facility. In this case the fossil fuels are mainly converted to CO ₂ . CO ₂ emissions arising from the production of ammonia are assumed to be small and not taken into account
		CH ₄	No	
		N ₂ O	Yes	

B.4. Establishment and description of baseline scenario

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The Department of Environmental Affairs of the government of South Africa is responsible of any national/regional emission regulations. Air Quality legislation has changed recently in South Africa. The 1st of April 2010 marked the full enactment of the National Environmental Management: Air Quality Act (Act No. 39 of 2004). The act itself was preceded by the promulgation of the listed activities and their associated minimum emission standards on 31 March 2010, as contemplated in section 21(1)(a) of the act. An amendment of the listed activities was published in the Government Notice No. 893, Gazette No. 37054 dated 22 November 2013. The table of listed activities describes the processes for which air quality licenses will be required and describes minimum emission standards. The production of nitric acid is a listed activity under this act however there is no minimum emission standard mentioned for the emissions of N₂O. Therefore it can be concluded that there are currently no national regulations in South Africa that limit N₂O emissions from nitric acid production. This has also been confirmed for the specific case of the Omnia nitric acid plant by the operational permit.

In the absence of regulations requiring the abatement of N₂O emissions, the operator of the nitric acid plant has no economic incentives to take any N₂O abatement measures because this entails capital and operating costs but no financial benefits.

Therefore, the CDM project activity is considered additional and the baseline scenario is that the N₂O is emitted to the atmosphere with no N₂O abatement measure being implemented.

B.5. Demonstration of additionality

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According to the baseline methodology procedure of the methodology ACM0019 Version 02.0, the project activity is considered to be additional in the absence of regulations requiring the abatement of N₂O emissions. The operator of the nitric acid plant has no economic incentives to take any N₂O abatement measure because this entails capital and operation costs but no financial benefits. In the absence of any regulation, the baseline scenario is emitting N₂O to the atmosphere with no N₂O abatement measure being implemented.

B.6. Emission reductions

B.6.1. Explanation of methodological choices

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ACM0019, Version 02.0, is the methodology chosen for the implementation of this project activity.

In the following, the explanation of the calculation of baseline and project emissions, as required under the ACM0019, Version 02.0, is presented.

In this case the nitric acid plant used AM0028 during the first crediting period therefore 5.3.1 – Case 1 of the methodology applies.

Case 1: For nitric acid plants that have used AM0028 or AM0034 in the first crediting period

For nitric acid plants that have used AM0028 or AM0034 in the first crediting period and apply this methodology in their second or third crediting period, the baseline emissions are calculated as follows:

$$BE_y = \left(\frac{\min\{P_{production,y}; P_{product,max}\} \times EF_{existing,y}}{\max\{P_{production,y} - P_{product,max}; 0\} \times EF_{new,y}} \right) \times \frac{(h_y - h_{r,y})}{h_y} \times GWP_{N_2O} \times 10^{-3} \quad \text{Equation (1)}$$

Where:

BE_y	=	Baseline emissions in year y (t CO ₂ e)
$P_{product,max}$	=	Design capacity (t HNO ₃)
$P_{production,y}$	=	Production of nitric acid in year y (t HNO ₃)
$EF_{existing,y}$	=	N ₂ O emission factor for nitric acid plants that have used AM0028 or AM0034 in the first crediting period in year y (kg N ₂ O/t HNO ₃)
$EF_{new,y}$	=	Baseline N ₂ O emission factor for nitric acid production in year y (kg N ₂ O/t HNO ₃)
GWP_{N_2O}	=	Global Warming Potential of N ₂ O valid for the commitment period
h_y	=	Number of hours in year y during which the plant was in operation (h)
$h_{r,y}$	=	Number of hours (h) in year y where: <ol style="list-style-type: none"> For secondary N₂O abatement: the abatement system was not installed, underperforming or failed; For tertiary N₂O abatement: the abatement system is bypassed, underperforming or failed

The N₂O emission factor for nitric acid plants that have used AM0028 and AM0034 in the first crediting period ($EF_{existing,y}$) will be calculated as follows:

Equation (2)

$$EF_{existing,y} = \min\{EF_{historical}; EF_{default,y}\}$$

Where:

- $EF_{existing,y}$ = N₂O emission factor for nitric acid plants that have used AM0028 or AM0034 in the first crediting period in year y (kg N₂O/t HNO₃)
- $EF_{historical}$ = Historical baseline emission factor of the nitric acid plant (kg N₂O/t HNO₃)
- $EF_{default,y}$ = Default emission factor according to the operating pressure of the ammonia burner in year y (kg N₂O/t HNO₃)

Calculation of $h_{r,y}$

An abatement system is deemed to be bypassed, not working, underperform or failed in the hour h in year y if:

Case 1: For nitric acid plants that have used AM0028 or AM0034 in the first crediting period

$$F_{N2O,tail\ gas,h} > EF_{existing\ y} \times P_{NA,h} \quad \text{Equation (3)}$$

Where:

- $P_{NA,h}$ = Nitric acid produced in the hour h (t HNO₃)
- $EF_{existing\ y}$ = Default N₂O emission factor for nitric acid plants that have used AM0028 or AM0034 in the first crediting period in year y (kg N₂O/t HNO₃)
- $F_{N2O,tail\ gas,h}$ = Mass flow of N₂O in the gaseous stream of the tail gas in the hour h (kg N₂O/h)

Project Emissions:

Project emissions include emissions of N₂O which have not been destroyed by the project activity and, in case of the installation of a tertiary N₂O abatement facility, CO₂ emissions resulting from the operation of the N₂O abatement facility.

Project emissions are calculated as follows:

$$PE_y = PE_{N2O,y} + PE_{CO2,tertiary,y} \quad \text{Equation (4)}$$

Where:

- PE_y = Project emissions in year y (t CO₂e)
- $PE_{N2O,y}$ = Project emissions of N₂O from the project plant in year y (t CO₂e)
- $PE_{CO2,tertiary,y}$ = Project emissions of CO₂ from the operation of the tertiary N₂O abatement facility in year y (t CO₂)

Project emissions of N₂O from the project plant ($PE_{N_2O,y}$)

The amount of N₂O emissions from the project activity are the emissions from the N₂O contained in the tail gas stream of the plant which is released to the atmosphere.

Accordingly, $PE_{N_2O,y}$ is determined as follows:

$$PE_{N_2O,y} = \sum_{h=1}^{h_y-h_{r,y}} F_{N_2O,tail\ gas,h} \times GWP_{N_2O} \times 10^{-3} \quad \text{Equation (5)}$$

Where:

$PE_{N_2O,y}$	=	Project emissions of N ₂ O from the project plant in year y (t CO ₂ e)
GWP_{N_2O}	=	Global warming potential of N ₂ O valid for the commitment period
$F_{N_2O,tail\ gas,h}$	=	Mass flow of N ₂ O in the gaseous stream of the tail gas in the hour h (kg N ₂ O/h)
h_y	=	Number of hours in year y during which the plant was in operation (h)
$h_{r,y}$	=	Number of hours (h) in year y where: For tertiary N ₂ O abatement. The abatement system is by-passed, underperforming or failed

Determination of $F_{N_2O,tail\ gas,h}$

The amount of N₂O emissions from the tail gas stream of the project plant shall be determined using the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”.

In applying the tool, the following provisions apply:

- Throughout the crediting periods of the project activity, the N₂O concentration and volume or mass flow of the tail gas are to be monitored continuously. The monitoring system is to be installed and maintained throughout the crediting period based on the European Norm 14181 (2004), or any more recent update of that standard;
- The monitoring system should provide separate hourly average values for the N₂O concentration and the volume or mass flow of the tail gas based on two seconds (or shorter) interval readings that are recorded and stored electronically. These N₂O data sets shall be identified by means of a unique time/date key indicating when exactly the values were observed;
- The correction factors derived from the calibration curve of the QAL2 audit for the monitoring components as determined during the QAL2-test in accordance with EN14181 must be applied to both the N₂O concentration and the volume or mass flow of the tail gas. This can either be applied automatically to the raw data recorded by the data storage system at the plant or it can be applied to the calculated hourly averages as part of the calculation of project emissions;
- If data for either the N₂O concentration or the volume or mass flow of the tail gas are not available for more than 1/3 of any hour while the plant was in operation, the value for that hour shall be replaced with the maximum value of N₂O concentration or volume or mass flow of the tail gas observed during the monitoring period. If data for neither the N₂O concentration nor the volume or mass flow of the tail gas are available for more than 1/3 of any hour while the plant was in operation, the maximum value of mass flow of N₂O calculated during the monitoring period shall be applied to any such hour. Values observed during five operating hours before and after a plant start-up and shut-down shall not be used for the determination of the maximum values;

- (e) In the case that the N_2O concentration and the volume or mass flow of the tail gas and by-pass are automatically converted to normal conditions by the AMS during the monitoring process, the parameters P_t and T_t do not need to be monitored except, if applicable, for the purpose of determining the moisture content in the gaseous stream.

According to the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0) the mass flow of greenhouse gas i in the gaseous stream in time interval t ($F_{i,t}$) is calculated based on measurements of

- (a) the total volume flow or mass flow of the gas stream and
- (b) the volumetric fraction of the gas in the gaseous stream and
- (c) the water content and gas composition.

The tool covers possible measurement options, providing six different calculation options to determine the volume or mass flow of a particular greenhouse gas (A-F).

Furthermore, the tool provides several options for the determination of the moisture content of the gaseous stream. As the gaseous stream is assumed to be dry, Option A is applied. In order to apply this option, it shall be demonstrated that the gaseous stream is dry. As described in part (a) of Option A, the moisture content of the gaseous stream ($C_{H_2O,t,db,n}$) will be measured and it shall be demonstrated that it is less or equal to 0.05 kg H_2O/m^3 dry gas.

The moisture measurement shall coincide with the Annual Surveillance Test or the calibration of the flow meter for the gaseous stream.

In accordance with Option A of the tool, the mass flow of greenhouse gas i ($F_{i,t}$) is calculated as follows:

$$F_{i,t} = V_{t,db} * v_{i,t,db} * \rho_{i,t}$$

Equation (6)

With:

$$\rho_{i,t} = \frac{P_t * MM_i}{R_u * T_t}$$

Equation (7)

Where:

$F_{i,t}$ /h)	= mass flow of greenhouse gas N_2O in the gaseous stream in time interval t (kg gas
$V_{t,db}$	= Volumetric flow of the gaseous stream in time interval t on dry basis (m^3 dry gas/h)
$v_{i,t,db}$ a	= Volumetric fraction of greenhouse gas i in the gaseous stream in a time interval t on dry basis (m^3 gas $/m^3$ dry gas)
$\rho_{i,t}$	= Density of greenhouse gas i in the gaseous stream in a time interval t (kg gas $/m^3$ gas i)
P_t	= Absolute pressure of the gaseous stream in time interval t (Pa)
MM_i	= Molecular mass of greenhouse gas i (kg/kmol)
R_u	= Universal ideal gases constant (Pa.m ³ /kmol.K)
T_t	= Temperature of the gaseous stream in time interval t (K)

Project emissions from the operation of the tertiary N₂O abatement facility ($PE_{CO_2,tertiary,y}$)

This emission source only needs to be estimated if a tertiary N₂O abatement facility is installed under the project activity and if fossil fuels are used to operate the facility or re-heat the gas after the facility. Therefore it needs only to be estimated for this nitric acid plant as fossil fuel is used for operation of the tertiary N₂O abatement facility.

The emissions related to the operation of the N₂O destruction facility include only on-site emissions due to the fossil fuel use as input to the N₂O destruction facility:

$$PE_{CO_2,tertiary,y} = PE_{FF,y} \quad \text{Equation (8)}$$

Where:

- $PE_{CO_2,tertiary,y}$ = Project emissions of CO₂ from the operation of the tertiary N₂O abatement facility in year y (t CO₂)
- $PE_{FF,y}$ = Project emissions related to fossil fuel input to the destruction facility and/or re-heater in year y (t CO₂)

The Project proponents shall use the latest version of the “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion” to calculate the project emissions related to fossil fuels used in year y .

Specific guidance on the use of the tool:

- (a) The parameter $PE_{FC,j,y}$ used in the “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion” corresponds to the parameter $PE_{FF,y}$ in this methodology; and
- (b) The element process j in the tool corresponds to the consumption of fossil fuels for the operation of the tertiary N₂O abatement facility and/or the re-heating of the tail gas.

CO₂ emissions from fossil fuel combustion in process j are calculated based on the quantity of fuels combusted and the CO₂ emission coefficient of those fuels, as follows:

$$PE_{FC,j,y} = \sum_i FC_{i,j,y} \times COEF_{i,y} \quad \text{Equation (9)}$$

Where:

- $PE_{FC,j,y}$ = CO₂ emissions from fossil fuel combustion in process j in year y (tCO₂/yr)
- $FC_{i,j,y}$ = Quantity of fuel type i combusted in the process j during year y (mass or volume unit/yr)
- $COEF_{i,y}$ = CO₂ emission coefficient of fuel type i in year y (tCO₂/mass or volume unit)
- i = fuel types combusted in process j during year y

As data about the chemical composition of the fuel type i is available $COEF_{i,y}$ is calculated based on its chemical composition of the fossil fuel type i using Option A of the “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion” (Version 02). As $FC_{i,j,y}$ is measured in a mass unit, the following equation applies:

$$COEF_{i,y} = w_{C,i,y} \times 44/12 \quad \text{Equation (10)}$$

Where:

$COEF_{i,y}$ = CO₂ emission coefficient of fuel type *i* in year *y* (tCO₂/volume unit)

$w_{C,i,y}$ = weighted average mass fraction of carbon in fuel type *i* in year *y* (tC/mass unit of the fuel)

i = fuel types combusted in process *j* during the year *y*

Leakage emissions:

Any leakage emissions sources are deemed to be negligible.

Emission reductions:

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad \text{Equation (11)}$$

Where:

ER_y = Emission reductions in year *y* (t CO₂e)

BE_y = Baseline emissions in year *y* (t CO₂e)

PE_y = Project emissions in year *y* (t CO₂e)

B.6.2. Data and parameters fixed ex ante

Data / Parameter	Operating pressure
Unit	KPa
Description	Operating pressure of the ammonia burner
Source of data	Manufacturer specifications
Value(s) applied	300
Choice of data or Measurement methods and procedures	lowest design operation limit of the ammonia burner
Purpose of data	Calculation of baseline emissions
Additional comment	The design operational range is indicated by the manufacturer as 300 – 450 kPa

Data / Parameter	EF_{historical}
Unit	kg N ₂ O/t HNO ₃
Description	Historical baseline emission factor of the nitric acid plant

Source of data	Historical information from issuance reports of CDM-PDD documents
Value(s) applied	
Choice of data or Measurement methods and procedures	For plants that used AM0028 in the first crediting period: use the lowest baseline emission factor obtained in one calendar year, from 1 January to 31 December, obtained during the first crediting period;
Purpose of data	Calculation of baseline emissions
Additional comment	This value will remain constant over the second and third crediting period

Data / Parameter	EF _{default,y}			
Unit	kg N ₂ O/t HNO ₃			
Description	Default emission factor according to the operating pressure of the ammonia burner in year y (related to 100 per cent pure acid)			
Source of data	This default N ₂ O baseline emission factor will vary every year. In the year 2013 the emission factors will be 5.5; 8.4; and 12.6 kg N ₂ O/t HNO ₃ for low, medium and high pressure ammonia burners. For each subsequent year, the emission factors will decrease by 0.2 kg N ₂ O/t HNO ₃ until they reach a value of 2.5 or 2.4. After reaching the values of 2.5 or 2.4 the emission factor will remain constant over time:			

Purpose of data	Calculation of baseline emissions
Additional comment	The decrease in the value for the baseline emission factor over time is to reflect the technological development

Data / Parameter	EF_{new,y}																																												
Unit	kg N ₂ O/t HNO ₃																																												
Description	Baseline N ₂ O emission factor for nitric acid production in year y (related to 100 per cent pure acid)																																												
Source of data	<p>The baseline N₂O emission factor for nitric acid production will vary every year. In year 2005 the emission factor will be 5.1 and then it will decrease every year until it reaches a final value of 2.5 in the year 2020. The value of 2.5 will remain constant after 2020, as provided in the following table:</p> <table border="1"> <thead> <tr> <th>Year</th><th>Emission factor (kgN₂O/t HNO₃)</th></tr> </thead> <tbody> <tr><td>2005</td><td>5.10</td></tr> <tr><td>2006</td><td>4.90</td></tr> <tr><td>2007</td><td>4.70</td></tr> <tr><td>2008</td><td>4.60</td></tr> <tr><td>2009</td><td>4.40</td></tr> <tr><td>2010</td><td>4.20</td></tr> <tr><td>2011</td><td>4.10</td></tr> <tr><td>2012</td><td>3.90</td></tr> <tr><td>2013</td><td>3.70</td></tr> <tr><td>2014</td><td>3.50</td></tr> <tr><td>2015</td><td>3.40</td></tr> <tr><td>2016</td><td>3.20</td></tr> <tr><td>2017</td><td>3.00</td></tr> <tr><td>2018</td><td>2.80</td></tr> <tr><td>2019</td><td>2.70</td></tr> <tr><td>2020</td><td>2.50</td></tr> <tr><td>2021</td><td>2.50</td></tr> <tr><td>2022</td><td>2.50</td></tr> <tr><td>2023</td><td>2.50</td></tr> <tr><td>...</td><td>...</td></tr> <tr><td>Year n</td><td>2.50</td></tr> </tbody> </table>	Year	Emission factor (kgN ₂ O/t HNO ₃)	2005	5.10	2006	4.90	2007	4.70	2008	4.60	2009	4.40	2010	4.20	2011	4.10	2012	3.90	2013	3.70	2014	3.50	2015	3.40	2016	3.20	2017	3.00	2018	2.80	2019	2.70	2020	2.50	2021	2.50	2022	2.50	2023	2.50	Year n	2.50
Year	Emission factor (kgN ₂ O/t HNO ₃)																																												
2005	5.10																																												
2006	4.90																																												
2007	4.70																																												
2008	4.60																																												
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2022	2.50																																												
2023	2.50																																												
...	...																																												
Year n	2.50																																												
Value(s) applied	-																																												
Choice of data or Measurement methods and procedures	-																																												
Purpose of data	Calculation of baseline emissions																																												
Additional comment	The decrease in the value for the baseline emission factor over time is to reflect the technological development																																												

Data / Parameter	P_{product,max}
Unit	t Product

Description	Design capacity of nitric acid production during the first crediting period
Source of data	Project operator and/or technology provider
Value(s) applied	273,020 t HNO ₃ /year
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	This parameter is only for project activities applying case 1

Parameters from the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0):

Data / Parameter	R_u
Unit	Pa,m ³ /kmol.K
Description	Universal ideal gases constant
Source of data	“Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0)
Value(s) applied	8,314
Choice of data or Measurement methods and procedures	Specified in the above mentioned tool.
Purpose of data	Calculation of project emissions
Additional comment	-

Data / Parameter	MM_i
Unit	kg/mol
Description	Molecular mass of greenhouse gas <i>i</i> (N ₂ O)
Source of data	“Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0)
Value(s) applied	44.02
Choice of data or Measurement methods and procedures	Specified in the above mentioned tool.
Purpose of data	Calculation of project emissions
Additional comment	-

Data / Parameter	P_n
Unit	Pa
Description	Total pressure at normal conditions
Source of data	“Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0)
Value(s) applied	101,325

Choice of data or Measurement methods and procedures	Used for normalization of stack gas measurement as specified in the above mentioned tool.
Purpose of data	Calculation of project emissions
Additional comment	-

Data / Parameter	T_n
Unit	K
Description	Temperature at normal conditions
Source of data	"Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 02.0.0)
Value(s) applied	273.15 K
Choice of data or Measurement methods and procedures	Used for normalization of stack gas measurement as specified in the above mentioned tool.
Purpose of data	Calculation of project emissions
Additional comment	-

B.6.3. Ex ante calculation of emission reductions

For the calculation of the estimated emission reductions it was taken into account:

- The confirmed capacity of 273,020 tHNO₃/year
- Nitric acid production projections based on estimations of market demand plant uptime of 261,955 t HNO₃/year).
- A historical baseline emission factor (EF_{historic}) for calculating baseline emissions of 5.54 kgN₂O/tHNO₃.
- For calculating the mass flow of N₂O in the gaseous stream of the tail gas the average N₂O Baseline emission factors of 6.3 kgN₂O/tHNO₃ as well as an expected reduction efficiency of 98% were taken into account.
- Natural gas consumption for the operation of the tertiary N₂O abatement facility of 0.35 mol CH₄ per mol N₂O as indicated by the technology provider

Baseline emissions:

$$BE_y = \left(\frac{\min\{P_{\text{production},y}; P_{\text{product,max}}\} \times EF_{\text{existing},y}}{\max\{P_{\text{production},y} - P_{\text{product,max}}; 0\} \times EF_{\text{new},y}} \right) \times \frac{(h_y - h_{r,y})}{h_y} \times GWP_{N_2O} \times 10^{-3} \quad \text{Equation (12)}$$

Where:

BE_y	=	Baseline emissions in year y (t CO ₂ e)
$P_{\text{product,max}}$	=	Design capacity (t HNO ₃)
$P_{\text{production},y}$	=	Production of nitric acid in year y (t HNO ₃)
$EF_{\text{existing},y}$	=	N ₂ O emission factor for nitric acid plants that have used AM0028 or AM0034 in the first crediting period in year y (kg N ₂ O/t HNO ₃)
$EF_{\text{new},y}$	=	Baseline N ₂ O emission factor for nitric acid production in year y (kg N ₂ O/t HNO ₃)

GWP_{N_2O}	=	Global Warming Potential of N ₂ O valid for the commitment period
h_y	=	Number of hours in year y during which the plant was in operation (h)
$h_{r,y}$	=	Number of hours (h) in year y where: (c) For secondary N ₂ O abatement: the abatement system was not installed, underperforming or failed; (d) For tertiary N ₂ O abatement: the abatement system is by-passed, underperforming or failed

The N₂O emission factor for nitric acid plants that have used AM0028 and AM0034 in the first crediting period ($EF_{existing,y}$) will be calculated as follows:

$$EF_{existing,y} = \min\{EF_{historical}; EF_{default,y}\} \quad \text{Equation (13)}$$

Where:

$EF_{existing,y}$	=	N ₂ O emission factor for nitric acid plants that have used AM0028 or AM0034 in the first crediting period in year y (kg N ₂ O/t HNO ₃)
$EF_{historical}$	=	Historical baseline emission factor of the nitric acid plant (kg N ₂ O/t HNO ₃)
$EF_{default,y}$	=	Default emission factor according to the operating pressure of the ammonia burner in year y (kg N ₂ O/t HNO ₃)

Calculation of $h_{r,y}$

An abatement system is deemed to be bypassed, not working, underperform or failed in the hour h in year y if:

Case 1: For nitric acid plants that have used AM0028 or AM0034 in the first crediting period

$$F_{N_2O,tail\ gas,h} > EF_{existing\ y} \times P_{NA,h} \quad \text{Equation (14)}$$

Where:

$P_{NA,h}$	=	Nitric acid produced in the hour h (t HNO ₃)
$EF_{existing\ y}$	=	Default N ₂ O emission factor for nitric acid plants that have used AM0028 or AM0034 in the first crediting period in year y (kg N ₂ O/t HNO ₃)
$F_{N_2O,tail\ gas,h}$	=	Mass flow of N ₂ O in the gaseous stream of the tail gas in the hour h (kg N ₂ O/h)

The following table displays the estimated baseline emissions for the project activity over the crediting period of 7 years starting in 26/02/2015.

Year	P _{production,y}	P _{product,max}	EF _{historical}	EF _{default,y}	EF _{existing,y}	EF _{new,y}	GWP _{N2O}	h _y	h _{r,y}	BE _y
	tHNO3	tHNO3	kg N2O/t HNO3	kg N2O/t HNO3	kg N2O/t HNO3	kg N2O/t HNO3	tCO2e/tN2O			t CO2e
2015	221,765	231,132	5.54	8.00	5.54	3.40	298	7,115	0	365,942
2016	261,955	273,020	5.54	7.80	5.54	3.20	298	8,405	0	432,261
2017	261,955	273,020	5.54	7.60	5.54	3.00	298	8,405	0	432,261
2018	261,955	273,020	5.54	7.40	5.54	2.80	298	8,405	0	432,261
2019	261,955	273,020	5.54	7.20	5.54	2.70	298	8,405	0	432,261
2020	261,955	273,020	5.54	7.00	5.54	2.50	298	8,405	0	432,261
2021	261,955	273,020	5.54	6.80	5.54	2.50	298	8,405	0	432,261
2022	40,190	41,888	5.54	6.60	5.54	2.50	298	1,290	0	66,320
Total	1,833,685	1,911,140						58,835	0	3,025,829

Table 1: Estimated baseline emission

Project Emissions:

Project emissions are calculated as follows:

$$PE_y = PE_{N2O,y} + PE_{CO2,tertiary,y} \quad \text{Equation (15)}$$

Where:

- PE_y = Project emissions in year y (t CO₂e)
 $PE_{N2O,y}$ = Project emissions of N₂O from the project plant in year y (t CO₂e)
 $PE_{CO2,tertiary,y}$ = Project emissions of CO₂ from the operation of the tertiary N₂O abatement facility in year y (t CO₂)

Project emissions of CO₂ from the operation of the tertiary N₂O abatement facility will be assessed by using the “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion” (version 2.).

For the purpose of estimating the complete project emissions, an ex-ante calculation was undertaken on the basis of design consumption figures provided by Uhde. The catalyst system will be fed with natural gas providing CH₄, which will be utilized as a reduction agent for the decomposition of N₂O in a quantity of 0.35 mol CH₄/ mol N₂O. Equation (9) is applied for the determination of the parameter $PE_{FC,j,n}$, which is equal to parameter $PE_{CO2,tertiary,n}$ of the applied methodology ACM0019 resulting in estimated emissions from the operation of the tertiary abatement facility of 470 tCO₂/year.

$$PE_{CO2,tertiary,y} = PE_{FF,y} \quad \text{Equation (16)}$$

Where:

- $PE_{CO2,tertiary,y}$ = Project emissions of CO₂ from the operation of the tertiary N₂O abatement facility in year y (t CO₂)
 $PE_{FF,y}$ = Project emissions related to fossil fuel input to the destruction facility and/or re-heater in year y (t CO₂)

The Project proponents shall use the latest version of the “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion” to calculate the project emissions related to fossil fuels used in year *y*.

Specific guidance on the use of the tool:

- (c) The parameter $PE_{FC,j,y}$ used in the “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion” corresponds to the parameter $PE_{FF,y}$ in this methodology; and
- (d) The element process *j* in the tool corresponds to the consumption of fossil fuels for the operation of the tertiary N₂O abatement facility and/or the re-heating of the tail gas.

The following table displays the estimated project emissions for the project activity over the crediting period of 7 years starting in 26/02/2015.

Year	$PE_{N_2O,y}$	$PE_{FC,j,y}$	$PE_{FF,y}$	$PE_{CO_2,tertiary,y}$	PE_y
	t CO ₂ e	t CO ₂ e	t CO ₂ e	t CO ₂ e	t CO ₂ e
2015	8,274	486	486	486	8,761
2016	9,774	574	574	574	10,348
2017	9,774	574	574	574	10,348
2018	9,774	574	574	574	10,348
2019	9,774	574	574	574	10,348
2020	9,774	574	574	574	10,348
2021	9,774	574	574	574	10,348
2022	1,500	88	88	88	1,588
Total	68,418	4,020	4,020	4,020	72,438

Table 2: Estimated project emissions

CO₂ emissions from fossil fuel combustion in process *j* are calculated based on the quantity of fuels combusted and the CO₂ emission coefficient of those fuels, as follows:

$$PE_{FC,j,y} = \sum_i FC_{i,j,y} \times COEF_{i,y} \quad \text{Equation (17)}$$

Where:

- $PE_{FC,j,y}$ = CO₂ emissions from fossil fuel combustion in process *j* in monitoring period *n* (tCO₂/n)
- $FC_{i,j,y}$ = Quantity of fuel type *i* combusted in the process *j* during the monitoring period *n* (mass or volume unit/n)
- $COEF_{i,y}$ = CO₂ emission coefficient of fuel type *i* in monitoring period *n* (tCO₂/mass or volume unit)
- i* = fuel types combusted in process *j* during monitoring period *n*

As data about the chemical composition of the fuel type i is available $COEF_{i,n}$ is calculated based on its chemical composition of the fossil fuel type i using Option A of the “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion” (Version 02):

$$COEF_{i,y} = w_{C,i,y} \times 44/12 \quad \text{Equation (18)}$$

Where:

- $COEF_{i,y}$ = CO₂ emission coefficient of fuel type i in monitoring period n (tCO₂/volume unit)
 $w_{C,i,y}$ = weighted average mass fraction of carbon in fuel type i in monitoring period n (tC/mass unit of the fuel)
 i = fuel types combusted in process j during the year y

The following table displays the estimated project emissions from fossil fuel combustion for the project activity over the crediting period of 7 years starting in 26/02/2015.

Year	$FC_{i,j,y}$	$w_{C,i,y}$	$COEF_{i,y}$	$PE_{FC,j,y}$
	Nm ³	tC/tfuel	tCO ₂ e/Nm ³	t CO ₂ e
2015	177	0.75	2.7456	486
2016	209	0.75	2.7456	574
2017	209	0.75	2.7456	574
2018	209	0.75	2.7456	574
2019	209	0.75	2.7456	574
2020	209	0.75	2.7456	574
2021	209	0.75	2.7456	574
2022	32	0.75	2.7456	88
Total	1,464			4,020

Table 3: Estimated project emissions from fossil fuel combustion

Leakage emissions:

Any leakage emissions sources are deemed to be negligible.

Emission reductions

$$ER_y = BE_y - PE_y \quad \text{Equation (19)}$$

Where:

- ER_y = Emission reductions in year y (t CO₂e)
 BE_y = Baseline emissions in year y (t CO₂e)
 PE_y = Project emissions in year y (t CO₂e)

Year	BE _y	PE _y	Leakage	ER _y
	t CO ₂ e	t CO ₂ e	t CO ₂ e	t CO ₂ e
2015	365,942	8,761	0	357,181
2016	432,261	10,348	0	421,913
2017	432,261	10,348	0	421,913
2018	432,261	10,348	0	421,913
2019	432,261	10,348	0	421,913
2020	432,261	10,348	0	421,913
2021	432,261	10,348	0	421,913
2022	66,320	1,588	0	64,732
Total	3,025,829	72,438	0	2,953,391

Table 2: Overview of estimated emission reductions

B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions (t CO ₂ e)	Project emissions (t CO ₂ e)	Leakage (t CO ₂ e)	Emission reductions (t CO ₂ e)
2015	365,942	8,761	0	357,181
2016	432,261	10,348	0	421,913
2017	432,261	10,348	0	421,913
2018	432,261	10,348	0	421,913
2019	432,261	10,348	0	421,913
2020	432,261	10,348	0	421,913
2021	432,261	10,348	0	421,913
2022	66,320	1,588	0	64,732
Total	3,025,829	72,438	0	2,953,391
Total number of crediting years	7			
Annual average over the crediting period	432,261	10,348		421,913

B.7. Monitoring plan**B.7.1. Data and parameters to be monitored**

Data / Parameter	P _{production,y}
Unit	t HNO ₃
Description	Nitric acid produced in year y
Source of data	Measurements by project participants and production reports
Value(s) applied	261,955 t HNO ₃ at 100% concentration
Measurement methods and procedures	Coriolis mass flow meter Measurement of product mass flow, density and temperature. Calculation of product concentration and conversion of the mass flow to 100% HNO ₃ Accuracy: 0.5% Calibration Frequency: once per year
Monitoring frequency	Every monitoring period,
QA/QC procedures	Periodic calibration
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	h _y
Unit	h

Description	Number of hours of operation in year y
Source of data	Measured
Value(s) applied	8,405
Measurement methods and procedures	The total operating hours are logged continuously in the production log.
Monitoring frequency	Every monitoring period
QA/QC procedures	Operating hours are cross checked against other operational parameters of the plant according to internal QA/QC procedures.
Purpose of data	Calculation of Baseline emissions
Additional comment	Records to be maintained during project's lifetime

Data / Parameter	$h_{r,y}$
Unit	h
Description	Number of hours (h) in year y where the abatement system is by-passed, underperforming or failed
Source of data	Measured
Value(s) applied	0
Measurement methods and procedures	Periods where the abatement system is by-passed are Logged in the production log. Periods where the abatement system is underperforming or failed are calculated continuously based on AMS results
Monitoring frequency	Every monitoring period
QA/QC procedures	-
Purpose of data	Calculation of Baseline emissions
Additional comment	Records to be maintained during project's lifetime

Data / Parameter	$F_{N_2O, \text{ tail gas}, h}$
Unit	kg N ₂ O/h
Description	Mass flow of N ₂ O in the gaseous stream of the tail gas in the hour h
Source of data	N ₂ O concentration: N ₂ O analyser Stack gas volume flow: flow meter
Value(s) applied	32.799

Measurement methods and procedures	<p>(a) Throughout the crediting periods of the project activity, the N₂O concentration and volume or mass flow of the tail gas are to be monitored continuously. The monitoring system is to be installed and maintained throughout the crediting period based on the European Norm 14181 (2004), or any more recent update of that standard;</p> <p>(b) The monitoring system should provide separate hourly average values for the N₂O concentration and the volume or mass flow of the tail gas based on two seconds (or shorter) interval readings that are recorded and stored electronically. These N₂O data sets shall be identified by means of a unique time/date key indicating when exactly the values were observed;</p> <p>(c) The correction factors derived from the calibration curve of the QAL2 audit for the monitoring components as determined during the QAL2-test in accordance with EN14181 must be applied to both the N₂O concentration and the volume or mass flow of the tail gas. This can either be applied automatically to the raw data recorded by the data storage system at the plant or it can be applied to the calculated hourly averages as part of the calculation of project emissions;</p> <p>(d) If data for either the N₂O concentration or the volume or mass flow of the tail gas are not available for more than 1/3 of any hour while the plant was in operation, the value for that hour shall be replaced with the maximum value of N₂O concentration or volume or mass flow of the tail gas observed during the monitoring period. If data for neither the N₂O concentration nor the volume or mass flow of the tail gas are available for more than 1/3 of any hour while the plant was in operation, the maximum value of mass flow of N₂O calculated during the monitoring period shall be applied to any such hour. Values observed during five operating hours before and after a plant start-up and shut-down shall not be used for the determination of the maximum values;</p> <p>(e) In the case that the N₂O concentration and the volume or mass flow of the tail gas and by-pass are automatically converted to normal conditions by the AMS during the monitoring process, the parameters P_t and T_t do not need to be monitored except, if applicable, for the purpose of determining the moisture content in the gaseous stream.</p>
Monitoring frequency	1 h average based on two seconds (or shorter) interval readings
QA/QC procedures	According to EN 14181, the flow meter and the analyzer will be tested and calibrated by an external laboratory with EN ISO IEC 17025 Accreditation. The QAL2 test is conducted once every 5 years; the AST test is conducted once per year. Every 5 years the AST test is part of the QAL2 test.
Purpose of data	Calculation of project emissions
Additional comment	-

Data / Parameter	$PE_{FF,y}$ (corresponding to $PECO2,tertiary,y$)
Unit	tCO ₂ e
Description	Project emissions related to fossil fuel input to the destruction facility and/or re-heater in monitoring period y (tCO ₂)
Source of data	The emissions related to the operation of the N ₂ O destruction facility include only on-site emissions due to fossil fuel use as input to the N ₂ O destruction facility. Natural gas consumption will be measured by a mass flow meter
Value(s) applied	574
Measurement methods and procedures	calculated based on measurement of natural gas consumption and $w_{C,i,y}$
Monitoring frequency	hourly
QA/QC procedures	Maintenance and calibration of the flow meter is applied under the internal QA/QC procedures.
Purpose of data	Calculation of project emissions
Additional comment	NA

Data / Parameter	$w_{C,i,y}$						
Unit	tC/mass unit of the fuel						
Description	Weighted average mass fraction of carbon in fuel type i in year y						
Source of data	<p>The following data sources may be used if the relevant conditions apply:</p> <table border="1"> <thead> <tr> <th>Data source</th><th>Conditions for using the data source</th></tr> </thead> <tbody> <tr> <td>a) Values provided by the fuel supplier in invoices</td><td>This is the preferred source</td></tr> <tr> <td>b) Measurements by the project participants</td><td>If a) is not available</td></tr> </tbody> </table>	Data source	Conditions for using the data source	a) Values provided by the fuel supplier in invoices	This is the preferred source	b) Measurements by the project participants	If a) is not available
Data source	Conditions for using the data source						
a) Values provided by the fuel supplier in invoices	This is the preferred source						
b) Measurements by the project participants	If a) is not available						
Value(s) applied	0.75						
Measurement methods and procedures	Annual value as provided by the fuel supplier						
Monitoring frequency	Once per year						
QA/QC procedures	Verify if the values under a) and b) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in b) should have ISO17025 accreditation or justify that they can comply with similar quality standards.						
Purpose of data	Calculation of project emissions						
Additional comment	NA						

Data / Parameter	$F_{Ci,j,y}$
Unit	Mass unit per year (ton/yr)
Description	Quantity of fuel type i combusted in the process j during year y

Source of data	Measured by mass flow meter
Value(s) applied	209.1
Measurement methods and procedures	Coriolis mass flow meter Accuracy: 0.5% Calibration frequency: 3 years
Monitoring frequency	hourly
QA/QC procedures	Periodic calibrations
Purpose of data	Calculation of project emissions
Additional comment	

Data / Parameter	$V_{t,db}$
Unit	Nm ³ dry gas/h
Description	Volumetric flow of the gaseous stream in time interval t on a dry basis
Source of data	Tail gas volume flow meter
Value(s) applied	Not available for validation. Will be monitored ex-post.
Measurement methods and procedures	Differential Pressure Transmitter Calculation of normalized flow with measurement of temperature (T_t) and pressure (P_t)
Monitoring frequency	1 h average based on two seconds (or shorter) interval readings
QA/QC procedures	According to EN 14181, the flow meter will be tested and calibrated by an external laboratory with EN ISO IEC 17025 Accreditation. The QAL2 test is conducted once every 5 years; the AST test is conducted once per year. Every 5 years the AST test is part of the QAL2 test.
Purpose of data	Calculation of project emissions
Additional comment	

Data / Parameter	$V_{i,t,db}$
Unit	m ³ gas i/m ³ dry gas
Description	Volumetric fraction of greenhouse gas i in a time interval t on a dry basis
Source of data	N ₂ O gas analyzer
Value(s) applied	Not available for validation. Will be monitored ex-post.
Measurement methods and procedures	Non Dispersive Infrared Photometer (NDIR) for N ₂ O Accuracy: 2%
Monitoring frequency	1 h average based on two seconds (or shorter) interval readings
QA/QC procedures	According to EN 14181, the flow meter will be tested and calibrated by an external laboratory with EN ISO IEC 17025 Accreditation. The QAL2 test is conducted once every 5 years; the AST test is conducted once per year. Every 5 years the AST test is part of the QAL2 test.
Purpose of data	Calculation of project emissions
Additional comment	

Data / Parameter	$C_{H_2O,t,db,n}$
Unit	mg H ₂ O/m ³ dry gas

Description	Moisture content of the gaseous stream at normal conditions, in time interval t
Source of data	Measurements according to the USEPA CF42 method 4 – Gravimetric determination of water content
Value(s) applied	Not available for validation. Will be monitored ex-post.
Measurement methods and procedures	Discrete measurement procedure.
Monitoring frequency	The mean value among three consecutive measurements performed in the same day (at least 2 hours each) shall be considered. Measurements should coincide with the Annual Surveillance Test (associated with requirements of the EN 14181 standard) or the calibration of the flow meter for the gaseous stream.
QA/QC procedures	yearly
Purpose of data	According to the USEPA CF42 method 4
Additional comment	Calculation of project emissions

Data / Parameter	T_t
Unit	K
Description	Temperature in the gaseous stream in time interval t
Source of data	Tail gas temperature measurement
Value(s) applied	Not available for validation. Will be monitored ex-post.
Measurement methods and procedures	Instruments with recordable electronic signal (analogical or digital) are required.
Monitoring frequency	1 h average based on two seconds (or shorter) interval readings
QA/QC procedures	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration is according to manufacturer's specifications
Purpose of data	Required for conversion of parameter to normal conditions.
Additional comment	In the case that the N ₂ O concentration and the volume or mass flow of the tail gas and by-pass are automatically converted to normal conditions by the AMS during the monitoring process, the parameters P _t and T _t do not need to be monitored except, if applicable, for the purpose of determining the moisture content in the gaseous stream.

Data / Parameter	P_t
Unit	Pa
Description	Pressure in the gaseous stream in time interval t
Source of data	Tail gas pressure measurement
Value(s) applied	Not available for validation. Will be monitored ex-post.
Measurement methods and procedures	Instruments with recordable electronic signal (analogical or digital) are required.
Monitoring frequency	1 h average based on two seconds (or shorter) interval readings
QA/QC procedures	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration is according to manufacturer's specifications
Purpose of data	Required for conversion of parameter to normal conditions.

Additional comment	In the case that the N ₂ O concentration and the volume or mass flow of the tail gas and by-pass are automatically converted to normal conditions by the AMS during the monitoring process, the parameters P _t and T _t do not need to be monitored except, if applicable, for the purpose of determining the moisture content in the gaseous stream.
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B.7.2. Sampling plan

N/A

B.7.3. Other elements of monitoring plan

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1. Organization Structure with Management & Operation Process

As an operator of nitric acid plants since many years, the plant's staff in general and its instrument department in particular is accustomed to operating technical equipment adhering to high quality standards.

Omnia Fertilizer will train the staff selected for the operation of the relevant monitoring systems and ensures that the operational standards required for the appropriate handling of the equipment will be maintained throughout the crediting period. Measuring instruments will be calibrated by the instrumentation engineer in accordance with the requirements of the instrument suppliers or internal QA procedures. The operations and equipment engineers of the nitric acid plant are responsible for the daily operation and maintenance of the systems.

The monitoring of the N₂O for the project will be the responsibility of the monitoring department. All relevant data will be recorded automatically and stored on electronic media.

Responsibilities:

Eden Jack

Senior Technical Manager

Emission Reduction Calculation

Technical Manager

Focal Point UNFCCC and DOE

Pieter Van Der Merwe

Plant Operation

General Manager Nitrates

Measurement

Focal Point UNFCCC and DOE

Emission Reduction Calculation

Michael Tamakloe

General Manager services
Equipment Calibration
Equipment Maintenance

2. Quality Assurance

ACM0019 requires the use of the European Norm EN14181 (2004) "Stationary source emissions - Quality assurance of automated measuring systems" as a guidance for installing and operating the Automated Monitoring System (AMS) for the monitoring of N₂O emissions in the nitric acid plant. The plant will be equipped with such Automated Monitoring Systems (AMS) to monitor the mass emissions of N₂O in the tail gas of the nitric acid plant.

In the following, it is described how the procedures given in EN14181 for QAL1-3 will be applied at the plant.

QAL 1

In accordance with EN14181, the monitoring system for N₂O concentration measurements shall have been proven suitable for its measuring task (parameter and composition of the flue gas) by use of the QAL1 procedure as specified by EN ISO 15267 or equivalent standards. Monitoring equipment for N₂O concentration measurement and Stack gas flow measurement will be installed at suitable sampling points in the tail gas of the nitric acid plant.

QAL2

QAL2 is a procedure for the determination of the calibration function and its variability. According to EN14181, the QAL2 test needs to be conducted by an independent "testing house" or laboratory which has to be accredited to EN ISO/IEC 17025. The QAL2 tests are performed on suitable AMS that have been correctly installed and commissioned on-site (as opposed to QAL 1 which is conducted off-site).

A calibration function is established from the results of a number of parallel measurements performed with a Standard Reference Method (SRM). The variability of the measured values obtained with the AMS is then evaluated by the independent qualified "testing house". QAL2 tests are to be performed at least every 5 years according to EN 14181.

AST

In addition, Annual Surveillance Tests (AST) should be conducted in accordance with EN 14181; these are a series of measurements with independent measurement equipment in parallel to the existing AMS. The AST tests are performed annually. If a full QAL 2 test is performed (at least every 5 years), an additional AST test is not necessary in that same year.

QAL3

QAL3 describes the on-going quality assurance and maintenance procedures and documentation for the AMS conducted by the plant operator. With this documentation it can be demonstrated that the AMS is in control during its operation so that it continues to function within the required specifications.

In essence, plant staff performs QAL 3 procedures through the established calibration procedures.

Accuracy and calibration of instruments

All meters will be purchased and maintained to ensure a high level of accuracy. The exact specifications of each meter will be determined during the detailed design of the project. Thereafter the meter accuracies will be included in this procedure and steps taken to maintain those levels of accuracy.

All key meters will be subject to a quality control regime that will include regular maintenance and calibration. A record will be maintained showing the location and unique identification number of each meter, the calibration status of that meter (when last calibrated, when next due for calibration) and who performs the calibration service. Calibration certificates will be retained for all meters until two years after the end of the crediting period.

Archiving of data

The monitoring team will periodically archive data to a secure and retrievable storage format on a periodic basis. This step of data archiving can also be implemented as an automated routine within the data collection unit. Calibration records may be archived by scanning and storage in an accessible electronic format. These data will be stored until 2 years after the end of the crediting period or the last issuance of CER's whichever occur later.

Document Control

The Project Manager will implement a document control system that ensures that the current versions of necessary documents are available at the point of use. All documents must be maintained in English with local translations if necessary.

Preparation of monitoring report

The archived / live data will be used to prepare a periodic monitoring report to be submitted to the UNFCCC secretariat for verification and issuance of CERs. An internal technical review process will be conducted and documented before such a report will be submitted for verification.

Data recording system

The CDM Project Manager will implement a data recording system for collection and archiving of the monitoring raw data. The data recording frequency for the continuously monitored parameters is 2 seconds. From these raw data hourly average values are calculated automatically.

Treatment of missing or corrupted data

If data for either the N₂O concentration or the volume or mass flow of the tail gas are not available for more than 1/3 of any hour while the plant was in operation, the value for that hour shall be replaced with the maximum value of N₂O concentration or volume or mass flow of the tail gas observed during the monitoring period. If data for neither the N₂O concentration nor the volume or mass flow of the tail gas are available for more than 1/3 of any hour while the plant was in operation, the maximum value of mass flow of N₂O calculated during the monitoring period shall be applied to any such hour. Values observed during five operating hours before and after a plant start-up and shut-down shall not be used for the determination of the maximum values.

Similar provision may apply for the CH₄ inflow and the nitric acid produced. If data for the CH₄ inflow is not available for more than 1/3 of any hour while the plant was in operation, the value for that hour shall be replaced with the maximum value of CH₄ inflow observed during the monitoring period.

In case of missing hourly data for the nitric acid produced in the monitoring period n ($P_{NA,n}$) the value will be replaced by a nitric acid production value from another source of data e. g. measurements of nitric acid storage tank levels in combination with a production – consumption mass balance. Only in the case that there should be no other reliable data source available the missing value should be replaced with the lowest measured value during plant operations of that monitoring period. Values observed during five operating hours before and after a plant start-up and shut down shall not be used for the determination of the maximum and minimum values.

B.7.4. Date of completion of application of methodology and standardized baseline and contact information of responsible persons/ entities

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12/08/2014

Company	Responsibility	Project Proponent
klimaDock Consulting Martin Stilkenbäumer, Germany	Martin Stilkenbäumer	No
Omnia Fertilizer Limited, South Africa	Pieter Van der Merwe	Yes

SECTION C. Duration and crediting period**C.1. Duration of project activity****C.1.1. Start date of project activity**

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The start date of the project activity is 01/12/2006 as documented in the original PDD for the first crediting period.

The starting date of operation of the project activity is 26/02/2008.

The installation of the abatement unit was completed and commissioned in January 2008.

C.1.2. Expected operational lifetime of project activity

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The existing nitric acid plant, with a design capacity of 650 t/day nitric acid, was commissioned in 1983. Since that time, it has undergone a number of upgrades the last of which occurred in 1999/2000 increased the plant capacity to 748 t/day. Based on the continuous upgrades at the plant, its operational lifetime is 50 years from original commissioning date. Consequently, the existing nitric acid plant has a remaining lifetime of at least 19 years from current date.

According to the Udhe GmbH, the N₂O Reduction technology supplier and equipment manufacturer, the project activity has a life expectancy similar to the nitric acid plant.

C.2. Crediting period of project activity**C.2.1. Type of crediting period**

Renewable crediting period

2nd. Crediting period

C.2.2. Start date of crediting period

26/02/2015

C.2.3. Length of crediting period

7 years

SECTION D. Environmental impacts**D.1. Analysis of environmental impacts**

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The project will reduce gaseous emissions of nitrous oxide (N₂O) from the plant tail gas and will therefore contribute to international efforts to reduce greenhouse gas emissions. The project will have no negative effects on local air quality.

The project will have no impact on water pollution. No additional water is required for the project activity's implementation or operation. Therefore, there is no impact on the sustainable use of water.

The contributions to sustainable development from the project activity are as follows:

- The project will reduce 98% of existing N₂O emissions during the crediting period and thus contributes to reducing the negative impact of global climate change.
- The technology will be introduced to the project, promoting the application of advanced emission reduction technology in South Africa.
- The implementation of the project activity includes the training course for operation of the a tertiary catalyst unit for N₂O abatement. This includes also guidance on accurate monitoring of N₂O emissions and stack gas flow, which will provide the staffs of Omnia Fertilizer with an opportunity to improve skills.
- The implementation of the project activity is likely to create local employment.

D.2. Environmental impact assessment

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Environmental Impact Assessments (EIA) are required by South African legislation for listed activities as published by the regulator. Even though the Nitric Acid process is a listed activity, it is listed specifically for the regulation of NO_x and it is not listed or prescribing any requirements for the regulation of N₂O. Therefore, for the installation of a N₂O-destruction facility, no EIA is required under South African legislation.

SECTION E. Local stakeholder consultation**E.1. Solicitation of comments from local stakeholders**

Not applicable for the second crediting period

E.2. Summary of comments received

Not applicable for the second crediting period

E.3. Report on consideration of comments received

Not applicable for the second crediting period

SECTION F. Approval and authorization

A letter of approval was obtained from the host country before the first renewable crediting period. A new letter of approval for the second renewable crediting period is not required.

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Appendix 1. Contact information of project participants and responsible persons/ entities

Project participant and/or responsible person/ entity	<input checked="" type="checkbox"/> Project participant <input type="checkbox"/> Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Omnia Fertilizer Limited
Street/P.O. Box	Eugene Houdry Street
Building	Northern Industries
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State/Region	Free State Province
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Website	www.omnia.co.za
Contact person	
Title	Business Development Manager
Salutation	Mr.
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Middle name	
First name	Eden
Department	
Mobile	+27 83 655 4617
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Direct tel.	
Personal e-mail	ejack@omnia.co.za

Project participant and/or responsible person/ entity	<input type="checkbox"/> Project participant <input checked="" type="checkbox"/> Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
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Project participant and/or responsible person/ entity	<input type="checkbox"/> Project participant <input checked="" type="checkbox"/> Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
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Direct tel.	
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Appendix 2. Affirmation regarding public funding

No public funds are involved in the financing of the project activity. The project is solely financed by Omnia Fertilizer.

Appendix 3. Applicability of methodology and standardized baseline

N/A

Appendix 4. Further background information on ex ante calculation of emission reductions

N/A

Appendix 5. Further background information on monitoring plan

N/A

Appendix 6. Summary of post registration changes

N/A
