CLEAN DEVELOPMENT MECHANISM
PROPOSED NEW METHODOLOGY: MONITORING (CDM-NMM)
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CONTENTS

SECTION A. Identification of methodology

A.1. Title of the proposed methodology:

Monitoring Methodology for catalytic N_2O destruction in the Reactor gas of Nitric Acid Plants"

A.2. List of category(ies) of project activity to which the methodology may apply:

Abatement of Nitrous Oxide gas (N_2O) in the stack gas from Nitric acid plants; Chemical Industry

A.3. Conditions under which the methodology is applicable to CDM project activities:

This methodology is applicable to existing nitric acid plants that have been operating for at least three years and is limited to the name plate or design capacity measured in tonnes of nitric acid of the existing nitric acid plant).

This methodology is concerned with the abatement of Nitrous Oxide (N_2O) from the stack gas of a nitric acid plant. N_2O is a significant greenhouse gas with a global warming potential of 310 produced as a by product in the production of nitric acid. The result of the installation of a secondary catalyst in the reactor is to destroy the N_2O by converting the N_2O to Nitrogen N_2 and Oxygen O_2. The methodology is applicable to the N_2O waste stream from a nitric acid production plant where:

1. The nitric acid plant has not installed any N_2O destruction or abatement technology that reduces the entire N_2O in the waste gas stream.
2. The project activity does not cause a nitric acid production increase.
3. The project activity in specific to the reduction of N_2O only and will not lead to an increase in any other gases present in the waste gas stream.
4. The N_2O baseline emissions and N_2O emissions related to the project activity are measurable in real time upstream and downstream of the catalytic destruction facility.
5. The project activity will not result in any shutdown of an existing N_2O destruction or abatement facility at the nitric acid plant.
6. Name plate design data of the existing nitric acid plant are available.

A.4. What are the potential strengths and weaknesses of this proposed new methodology?

The methodology is applicable to a wide range of project activities for N_2O destruction. This monitoring methodology prescribes the use of international standard monitoring equipment and practices. Both, baseline and project emissions will be measured real time. The methodology and its use of measured and analysed data for determination of emission reductions, generated by using a reliable metering and monitoring system, has no tendency to overestimate the emission reductions. Another strength of the methodology is that the number of assumptions is very low and those considered are conservative.

The weaknesses of the methodology are the high monitoring effort and the high demand on the measuring devices.

SECTION B. Proposed new monitoring methodology

B.1. Brief description of the new methodology:

The proposed monitoring methodology follows option 1, "monitoring of the emissions in the project scenario and the baseline scenario".
The GHG emission reductions achieved by the project activity are directly related to the quantities of N_2O destroyed in the catalytic N_2O destruction facility. Project and baseline emissions depend on the total amount of nitric acid production, the production conditions and the efficiency of the catalytic N_2O destruction facility. Emissions from the downtime of the N_2O destruction facility are neither claimed for baseline emissions nor for project emissions (outside of the project boundary).
In order to ensure a conservative baseline determination, the following information and data have to be prepared prior to the start of project crediting period and are integrated into the monitoring reports.
The project applicant has the obligation to determine and record:
• The production capacity measured in tonnes of nitric acid (either by the maximum historical production level whenever data are available or the design capacity of the existing nitric acid plant)
• The Pt/Rh gauze operating temperature and pressure range by:
a) firstly data on historical Pt/Rh gauze temperature and pressure ranges or if no data on historical Pt/Rh gauze temperatures and pressures are available
b) secondly by range of Pt/Rh gauze temperatures and pressures stipulated in the operating manual or if no operating manual is available or the operating manual gives insufficient information,
c) thirdly by literature reference (e.g. from Ullmann's Encyclopedia of Industrial Chemistry, Fifth, completely revised edition, Volume A 17, VCH, 1991, P. 298, Table 3. or other standard reference work or literature source).
If no Pt/Rh gauze operating temperature and pressure data are recorded, or if the gauze operating pressure or temperature lie outside the permitted range defined above, conservative IPCC default values will cap the baseline N_2O emissions.

Due to the project specific circumstances, baseline emissions are measured at the inlet of the catalytic N_2O destruction facility (DF). Real time measurement of baseline N_2O emissions upstream of the N_2O destruction facility represents a conservative approach for determination of baseline emission. Baseline parameters to be monitored are the quantity of N_2O at the inlet of the N_2O destruction facility (Q_N_2O_I_DF_m); calculated based on measurements of (a) the flow rate (Q_RG) and (b) the N_2O concentration (N_2O_co_RG_I) in the Reactor gas upstream of the N_2O destruction facility, and in addition the actual and the maximum historical (or design capacity) nitric acid production levels (P_HNO3_p and P_HNO3_hist); the actual average daily operating temperature and pressure at the gauzes (TEMP_GAU and PRES_GAU) and the permitted / historical operating temperature and pressure range at the gauzes (TEMP_GAU_hist AND PRES_GAU_hist).
Furthermore national regulations on N_2O emissions (Reg_1_N_2O_E; Reg_2_N_2O_E; Reg_3_N_2O_E) have to be observed. Limitations on N_2O emissions are taken into account for determination of the baseline emissions. This data will allow computation of the baseline emissions.
Project emissions to be monitored are the project N_2O emissions. Project N_2O emissions are monitored by measuring the tail/Stack gas flow rate and (2) the N_2O concentration at the outlet of the N_2O destruction facility (sample point located in the nitric acid plant stack)
Project parameters to be monitored are the N_2O emissions downstream of the N_2O destructions facility (P_N_2O_p), calculated based on the tail/Stack gas flow rate (Q_TG), the N_2O concentration (N_2O_co_TG_O) and the operating hours in period (M_h).

Other data required, such as emission factors are derived from public sources (e.g. IPCC).

B.2. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario:

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B.2.1. Data to be collected or used in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
A1 TGF	*Q_TG Volume flow tail/stack gas after N_2O destruction facility*	*Tail/Stack Gas Measuring device, data management system*	*Cubic metres / hour*	*Measured continuously*	*Hourly/daily/ weekly/monthly*	*100%*	*electronic*	*Data records will be maintained for a period of 12 years. Flow metering system will automatically record flow adjusted to standard temperature and pressure*
A2 N_2O (Tail/stack)	*N_2O_co_TG_O N_2O concentration in tail/stack gas*	*Gas concentration , measuring device , data management system*	*tN_2O/m_3*	*Measured continuously*	*Hourly/daily/ weekly/monthly*	*100%*	*electronic*	*Data records will be maintained for a period of 12 years.*
A3 Time period	*M_h Operation hours in period*	*Measuring device, data management system*	*h*	*Measured continuously*	*Hourly/daily/ weekly/monthly*	*100%*	*electronic*	*Data records will be maintained for a period of 12 years.*

B.2.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

Calculation of the project N_2O Emissions

The direct emissions from the project activity are equivalent to the N_2O emissions not destroyed plus any emissions related to the operation of the N_2O destruction facility (which in the case of a secondary catalyst unlike a tertiary catalyst are nil).
Total project emissions in period P_E_p [tCO2e] are given by:

Eq 4. $P\_E\_p = P\_N_2O\_b\_p$
where:

P_E_p	Total project emissions in period	[tCO2e]
$P\_N_2O\_b\_p$	N_2O based project emissions (N_2O not destroyed)	[tCO2e]

The **first part** of the project emissions consists of the N_2O not destroyed by the project activity. The N_2O project emissions monitoring equipment will measure the tail/stack gas volume flow (flow rate, temperature and pressure automatically present the volume flow rate of the tail gas at standard temperature and pressure) and (2) the N2O concentration at the outlet of the N_2O destruction facility (DF)(sample point in the stack after any SCR unit installed in the plant for the removal of NOx). The amount of N_2O at the outlet of the N_2O destruction facility can then directly be calculated by multiplying the tail/stack gas volume flow and the N_2O concentration.
The emissions of non destroyed N_2O over a period are given by:
Eq 5 $P\_N_2O\_b\_p = P\_N_2O\_p * GWP\_N_2O = (Q\_TG * N_2O\_co\_TG\_O * M\_h) * GWP\_N_2O$

where:

$P\_N_2O\_b\_p$	N_2O based project emissions (N_2O not destroyed)		[tCO2e]
$P\_N_2O\_p$	Project N_2O emissions		[tN_2O]
GWP_	N_2O Global warming potential of N2O	[-]	
Q_TG	Volume flow rate of tail/stack gas		[m^3/h]
$N_2O\_co\_TG\_O$	N_2O concentration outlet tail/stack gas		[tN_2O/m^3]
M_h	Operating hours in period		[h]

Emission reductions will only be calculated or claimed for periods of time when the plant is running and the N_2O monitor is on line (off line being determined as any time interval in which the N_2O monitor takes no readings)

The global warming potential of N_2O is set at 310 according to the Kyoto Protocol rules.

Please note: generated project emissions are limited to the name plate or design capacity of the existing nitric acid plant. If the actual output of the nitric acid (P_HNO3_p) exceeds the name plate or design capacity (P_HNO3_hist) then subsequent emissions will be claimed neither for the baseline nor for the project scenario. Therefore emission reductions are limited to the name plate or design capacity of the nitric acid plant.

B.2.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of greenhouse gases (GHG) within the project boundary and how such data will be collected and archived:								
ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
B1 RGF	*Q_RG Volume flow Reactor gas before N_2O destruction facility Flow*	*Reactor Gas Flow, data management system*	*Cubic metres/ hour*	*Calculated continuously*	*Hourly/daily /weekly/monthly*	*100%*	*electronic*	*Data records will be maintained for a period of 12 years. Flow metering system will automatically record flow adjusted to standard temperature and pressure.*
B2 N_2O Reactor	*N_2O_co_RG_O N_2O concentration before destruction facility*	*Gas concentration, measuring device , data management system*	*tN_2O/m_3*	*Measured continuously*	*Hourly/daily/ weekly/monthly*	*100%*	*electronic*	*Data records will be maintained for a period of 12 years.*
B3 Nitric acid production	*P_HNO_3_p*	*Production reports*	*tonnes*	*measured*	*Daily*	*100%*	*electronic*	*Data records will be maintained for a period of 12 years.*
B4 RAmGF	*Q_RAmGF Volume flow Reactor ammonia gas flow before N_2O destruction facility*	*Reactor ammonia gas flow, Gas Measuring device, data management system*	*Cubic metres / hour*	*Measured continuously*	*Hourly/daily/ weekly/monthly*	*100%*	*electronic*	*Data records will be maintained for a period of 12 years. Flow metering system will automatically record flow adjusted to standard temperature and pressure.*

B5 RAGF	*Q_RAGF Volume flow Reactor air gas flow before N_2O destruction facility*	*Reactor air gas flow, Gas Measuring device, data management system*	*Cubic metres / hour*	*Measured continuously*	*Hourly/daily/ weekly/monthly*	*100%*	*electronic*	*Data records will be maintained for a period of 12 years. Flow metering system will automatically record flow adjusted to standard temperature and pressure.*
B6 Reg 1	*Reg_1_N_2O_E Regulation 1 absoulute quantity N_2O limited*	*National legislation*	*Tonnes N_2O*	*calculated*	*At date of introduction or change of regulation*	*100%*	*electronic*	*Data records will be maintained for a period of 12 years.*
B7 Reg 2	*Reg_2N_2O_E Regulation 2 N_2O emissions per unit of product limited*	*National legislation*	*Tonnes N_2O per tonne HNO_3*	*calculated*	*At date of introduction or change of regulation*	*100%*	*electronic*	*Data records will be maintained for a period of 12 years.*
B8 Reg3	*Reg_3_N_2O_E Regulation III: N_2O concentration in tail gas limited*	*National legislation*	*Tonnes N_2O per M_3*	*calculated*	*At date of introduction or change of regulation*	*100%*	*electronic*	*Data records will be maintained for a period of 12 years.*
B 9	*P_HNO_3_hist*	*Production reports/ manufacture's specifications*	*tonnes*	*Measured /calculated*	*once*	*100%*	*electronic*	*See chapter B 1*
B 10	*TEMP_GAU_hist*	*Production reports/manufacturers specification*	*°C*	*Measured /calculated*	*once*	*100%*	*electronic*	*See chapter B 1*
B 11	*PRES_GAU_hist*	*Production reports/manufacturers specification*	*Pa*	*Measured /calculated*	*once*	*100%*	*electronic*	*See chapter B 1*
B 12	*TEMP_GAU*	*Measuring device*	*°C*	*Measured continuously*	*daily*	*100%*	*electronic*	*See chapter B 1*

B 13	*PRES_GAU*	*Measuring device*	*Pa*	*Measured continuously*	*daily*	*100%*	*electronic*	*See chapter B 1*

B.2.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

Baseline emissions are calculated based on the quantity of N_2O emitted in the baseline scenario taking national regulations, production levels and operating conditions (temperature and pressure) into consideration
The quantity of N_2O is determined based on the measurement of the N_2O at the inlet of the N_2O destruction facility, which results in a conservative estimation of baseline emissions.
The N_2O baseline emissions monitoring equipment will
(1) calculate the Reactor gas flow being the sum of the measured Reactor air flow and Reactor ammonia gas flow (temperature and pressure are also measured and the volume flow rate automatically corrected to standard temperature and pressure) and
(2) the N_2O concentration at the inlet of the N_2O destruction facility.
(3) the output of nitric acid and
(4) operating temperature and pressure at the gauzes.
The amount of N_2O baseline emissions can then directly be calculated by multiplying the Reactor gas volume flow and the N_2O concentration at the inlet to the destruction facility at stable production conditions with respect to temperature, pressure, catalyst composition and Ammonia (NH_3) input or if the actual operating temperature and pressure are outside the range of permitted operating temperatures and pressures by applying conservative IPCC default values. In order to ensure a conservative baseline determination, baseline emissions are limited to the name plate or design production levels for the existing nitric acid plant.

Total baseline emissions in period (p) BL_E_p [tCO2e] are given by:

Eq 1. $BL\_E\_p = BL\_N_2O\_E\_p * GWP\_N_2O$

where:

BL_E_p	Total baseline emissions in period	[tCO2e]
$BL\_N_2O\_E\_p$	Quantity of baseline N_2O emissions in period	[tN_2O]
GWP_N_2O	Global warming potential of N_2O	[-]

The global warming potential of N_2O is set at 310 according to the Kyoto Protocol rules.
If the actual average daily operating temperature or pressure at the gauzes (TEMP_GAU or PRES_GAU) is outside the permitted range of operating

temperatures and pressures at the gauzes (TEMP_GAU_hist and PRES_GAU_hist) defined as described in chapter B.1., the baseline emissions are calculated based on the conservative IPCC default values (IPCC, Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories; Intergovernmental Panel on Climate Change, 2000) and are limited by the legal regulations.
TEMP_GAU Actual operating temperature gauzes [°C]
PRES_GAU Actual operating pressure gauzes [Pa]
TEMP_GAU_hist Historical operating temperature range gauze [°C]
PRES_GAU_hist Historical operating pressure range gauze [Pa]

Depending on the implementation of regulations for N_2O emissions and the character of the regulation, baseline N_2O emissions ($BL\_N_2O\_E\_p$) are calculated as shown below.

Case 1: No legal regulations for N_2O existing:
The quantity of baseline N_2O emissions in the period ($BL\_N_2O\_E\_p$) are:
$BL\_N_2O\_E\_p = Q\_N_2O\_I\_DF\_m\_p$

where:

$BL\_N_2O\_E\_p$	Quantity of baseline N_2O emissions in period	[tN_2O]
$Q\_N_2O\_I\_DF\_m\_p$	Quantity of N_2O emissions at the inlet DF	[tN_2O]

The quantity of N_2O emissions at the inlet of the N_2O destruction facility (DF) is calculated based on Calculated Rector gas volume flow rate and the N_2O concentration at the inlet of the N_2O destruction facility. Therefore the quantity of N_2O at the inlet is given by:

Eq 2. $Q\_N_2O\_I\_DF\_m\_p = Q\_RG * N_2O\_co\_RG\_I * M\_h$

where:

$Q\_N_2O\_I\_DF\_m\_p$	Quantity of N_2O emissions at the inlet DF	[tN_2O]
Q_RG:	Volume flow rate Reactor gas	DF [m^3/h]
$N_2O\_co\_RG\_I$ N_2O	concentration measured inlet DF	[tN_2O/m^3]
M_h	Operation hours in period	[h]

Case 2: Legal regulations for N_2O are implemented:
In case national regulations concerning the N_2O emissions are implemented during the crediting period, the impact on baseline N_2O emissions is considered without any delay by adjusting the measured N_2O emissions, at the time regulation has to be implemented. Depending on the character of the regulation the

adjustment is done as shown below:

Case 2.1: Regulation setting of a threshold of an absolute quantity of N_2O emissions per nitric acid plant and per time:
Baseline N_2O emissions are limited by the absolute quantity of N_2O emissions given by the regulation. If the measured baseline N_2O emissions are exceeding the regulative limit, then measured baseline N_2O emissions are substituted by the regulative limit.
This leads to the following condition:
If,
$Q\_N_2O\_I\_DF\_m\_p > Reg\_1\_N_2O\_E$
then,
$BL\_N_2O\_E\_p = Reg\_1\_N_2O\_E$
else,
$BL\_N_2O\_E\_p = Q\_N_2O\_I\_DF\_m\_p$

where:

$Q\_N_2O\_I\_DF\_m\_p$	Quantity of N_2O emissions at the inlet DF	[tN_2O]
$Reg\_1\_N_2O\_E$	Regulative limit 1 of N_2O emissions in period	[tN_2O]
$BL\_N_2O\_E\_p$	Quantity of baseline N_2O emissions in period	[tN_2O]

The quantity of N_2O emissions at the inlet of the N_2O destruction facility (DF) is calculated based on measurement of the Calculated Reactor gas volume flow and the N_2O concentration at the inlet of the N_2O destruction facility. Therefore the quantity of N_2O at the inlet of the N_2O destruction facility ($Q\_N_2O\_I\_DF\_m\_p$) is given by:

Eq 2. $Q\_N_2O\_I\_DF\_m\_p = Q\_RG * N_2O\_co\_RG\_I * M\_h$

where:

$Q\_N_2O\_I\_DF\_m\_p$	Quantity of N_2O emissions inlet DF	[tN2O]
Q_RG	Volume flow rate Reactor gas DF	[m^3/h]
$N_2O\_co\_RG\_I$ N_2O	concentration measured inlet DF	[tN_2O/m^3]
M_h	Operation hours in period	[h]

Case 2.2: Regulation setting of a threshold for specific N_2O emissions per unit of product:
This leads to the following condition:
If,

$N_2O\_spec\_m\_output > Reg\_2\_N_2O\_E\_p$
then,

$BL\_N_2O\_E\_p = Reg\_2\_N_2O\_E\_p * P\_HNO_3\_p$
else,

$BL\_N_2O\_E\_p = Q\_N_2O\_I\_DF\_m\_p$

where:

$N_2O\_spec\_m\_output$	Specific N_2O emissions per output nitric acid	$[tN_2O/tHNO_3]$
$Reg\_2\_N_2O\_E\_p$	Regulative limit 2 of N_2O emissions per product	$[tN2O/tHNO_3]$
$BL\_N_2O\_E\_p$	Quantity of baseline N_2O emissions in period	$[tN_2O]$
$Q\_N_2O\_I\_DF\_m\_p$	Quantity of N_2O emissions at inlet DF	$[tN_2O]$

The specific N_2O emissions per unit of output nitric acid defined as:

Eq 3. $N_2O\_spec\_m\_output = Q\_N_2O\_I\_DF\_m\_p / P\_HNO_3\_p$

where:

$N_2O\_spec\_m\_output$	Specific N_2O emissions per output nitric acid	$[tN_2O/tHNO_3]$
$P\_HNO_3\_p$	Nitric acid production in period	$[tHNO_3]$
$Q\_N_2O\_I\_DF\_m\_p$	Quantity of N_2O emissions at inlet DF	$[tN_2O]$

The quantity of N_2O emissions at the inlet of the N_2O destruction facility ($Q\_N_2O\_I\_DF\_m\_p$) is calculated based on the measurement of calculated Reactor gas volume flow rate and the N_2O concentration at the inlet of the N_2O destruction facility. Therefore the quantity of N_2O at the inlet is given by:

Eq 2. $Q\_N_2O\_I\_DF\_m\_p = Q\_RG * N_2O\_co\_RG\_I * M\_h$

where:

$Q\_N_2O\_I\_DF\_m\_p$	Quantity of N_2O emissions inlet DF	$[tN_2O]$
Q_RG	Volume flow rate Reactor gas DF	$[m^3/h]$
$N_2O\_co\_TG\_I$	N_2O concentration measured inlet DF	$[tN_2O/m^3]$

M_h	Operation hours in period	[h]

Case 2.3: Regulation setting of a threshold for specific N_2O concentration flow in the tail/stack gas
This leads to the following condition:

If,
$N_2O\_co\_TG\_I > Reg\_3\_N_2O\_E\_p$

then
$BL\_N_2O\_E\_p = Reg\_3\_N_2O\_E\_p * Q\_RG * M\_h$
else,
$BL\_N_2O\_E\_p = Q\_N_2O\_I\_DF\_m\_p$

where:

$N_2O\_co\_RG\_I$	N_2O concentration measured inlet DF	[tN_2O/m^3]
$Reg\_3\_N_2O\_E\_p$	Regulative limit 3 of specific N_2O concentration	[tN_2O/m^3]
$BL\_N_2O\_E\_p$	Quantity of baseline N_2O emissions in period	[tN_2O]
Q_N2O_I_DF_m_p	Quantity of N2O emissions at inlet DF	[tN_2O]

The quantity of N_2O emissions at the inlet of the N_2O destruction facility ($Q\_N_2O\_I\_DF\_m\_p$) is calculated based on the calculated Reactor gas volume flow rate and the N_2O concentration at the inlet of the N_2O destruction facility. Therefore the quantity of N_2O at the inlet is given by:
Eq 2. $Q\_N_2O\_I\_DF\_m\_p = Q\_RG * N_2O\_co\_RG\_I * M\_h$

where:

$Q\_N_2O\_I\_DF\_m\_p$	Quantity of N_2O emissions inlet DF	[tN_2O]
Q_RG	Volume flow rate Reactor gas	DF [m^3/h]
$N_2O\_co\_RG\_I$	N_2O concentration measured inlet DF	[tN_2O/m^3]
M_h	Operation hours in period	[h]

Please note: generated project emissions are limited to the name plate or design capacity of the existing nitric acid plant. If the actual output

of the nitric acid (P_HNO3_p) exceeds the name plate or design capacity (P_HNO3_hist) then subsequent emissions will be claimed neither for the baseline nor for the project scenario. Therefore emission reductions are limited to the name plate or design capacity of the nitric acid plant.

P_HNO3_hist Name plate / design capacity [$tHNO_3$]
P_HNO3_p Actual production level [$tHNO_3$]

B.3. Option 2: Direct monitoring of emission reductions from the project activity:

Not applicable

B.3.1. Data to be collected or used in order to monitor emissions from the project activity, and how this data will be archived:

B.3.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

Not applicable

B.4. Treatment of leakage in the monitoring plan:

There will no leakage of Nitrous Oxide outside the project boundary. The secondary catalyst installed in the Reactor Basket underneath the noble metal gauzes will result in no measurable increase in utility usage in the plant. The secondary catalyst (DF) unlike a tertiary or tail end N_2O catalyst (NM0111) never needs any form of external heating as the gas temperature in the Nitric acid reactor is well above 800c.

B.4.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity:

ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

B.4.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

In case of the proposed project activity no significant change in anthropogenic emissions by sources of GHG outside the project boundary is identified. Therefore no monitoring mechanism is being suggested.

B.5. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

The greenhouse gas emission reduction (ER_p) achieved by the project activity over a period is the difference between the total baseline emissions over the period (BL_E_p), the total project emissions over the period (P_E_p), the leakage (L_E_p) which in this case is zero, minus any further measured N_2O abatement occurring in the nitric acid plant equipment and piping directly after the secondary catalyst and between the tail end/stack gas sample point (F_A_p)

Eq 6. $ER\_p = BL\_E\_p – P\_E\_p – L\_E\_p – F\_A\_p =$
$= (BL\_N_2O\_E\_p * GWP\_N_2O) – (P\_N_2O\_E\_p * GWP\_N_2O) - (L\_N_2O\_E\_p * GWP\_N_2O) – (F\_N_2O\_A\_p * GWP\_N_2O)$
[tCO2e]

C1 N_2O Reactor	*N_2O_co_RGASC_O N_2O concentration directly after Secondary catalyst destruction installation*	*Gas concentration, measuring device , data management system*	*tN_2O/m_3*	*Measured continuously*	*Hourly/daily/ weekly/monthly*	*100%*	*electronic*	*Data records will be maintained for a period of 12 years.*

Eq 7. $F\_A\_p = Q\_N_2O\_BESC\&T\_m\_p$

where:

F_A_p	Total N_2O abatement between exit secondary catalyst and tail/stack sample point in period	[tCO2e]
$Q\_N_2O\_BESC\&T\_m\_p$	Quantity of N_2O abatement between exit secondary catalyst and tail/stack sample point	[tN_2O]

The quantity of any N_2O abatement Q_N_2O_BESC&T_m_p occurring directly after the secondary catalyst installation in the nitric acid reactor in the process equipment and piping between the secondary catalyst and the tail/stack gas sample point is calculated based on the measurement of calculated Reactor gas volume flow rate and the N_2O concentration directly after the secondary catalyst (C1N_2O reactor) minus the measured tail gas volume flow rate and the N_2O concentration in the tail gas (A2 N_2O (Tail/stack)
Therefore the quantity of any further N_2O abatement occurring directly after the secondary catalyst installation in the nitric acid reactor in the process equipment and piping between the secondary catalyst and the tail/stack gas sample point is given by:

Eq 8. $Q\_N_2O\_BESC\&T\_m\_p = Q\_RG * N_2O\_co\_RGDASC\_O * M\_h - Q\_TG * N_2O\_co\_TG\_O * M\_h$

where:

Q_N_2O_BESC&T_m_p	Quantity of N_2O abatement between exit secondary catalyst and tail/stack sample point	[tN_2O]
Q_RG	Volume flow rate Reactor gas DF	[m^3/h]
N_2O_co_RGDASC_O	N_2O concentration measured outlet Secondary catalyst installation	[tN_2O/m^3]
M_h	Operation hours in period	[h]
Q_TG	Volume flow rate tail/stack gas flow	[m^3/h]
N2O_co_TG_O	N_2O concentration outlet tail/stack gas	[tN_2O/m^3]

The daily monitoring of GHG emission reductions takes the (1) production level, (2) national regulations and (3) the operation conditions at the gauzes into Account and are subject to ensuring stable production conditions such as temperature, pressure, catalyst composition and HN3 input.

B.6. Assumptions used in elaborating the new methodology:

CO2 emission factors could either be obtained from certificated supplier information or from IPCC default value information. All other information used in the calculation of emissions are measured or calculated.

B.7. Please indicate whether quality control (QC) and quality assurance (QA) procedures are being undertaken for the items monitored:		
Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
A1 TGF	*low*	*Calibration procedure to be developed for routine calibration of gas flow meter to internationally recognised standards and in compliance with manufacturer's specification.*
A2 N_2O	*low*	*Calibration procedure to be developed for routine calibration of Nitrous Oxide monitor to internationally recognised standards and in compliance with manufacturer's specification.*
B1 RGF (Calculated)	*low*	*Calibration procedure to be developed for routine calibration of Reactor Ammonia gas flow meter and Reactor Air flow meter to internationally recognised standards and in compliance with manufacturer's specification.*
B2 N_2O	*low*	*Calibration procedure to be developed for routine calibration of Nitrous Oxide monitor to internationally recognised standards and in compliance with manufacturer's specification.*
B4 RAmGF	*low*	*Calibration procedure to be developed for routine calibration of gas flow meter to internationally recognised standards and in compliance with manufacturer's specification.*
B5 RAGF	*low*	*Calibration procedure to be developed for routine calibration of gas flow meter to internationally recognised standards and in compliance with manufacturer's specification.*
B12, B13	*low*	*Calibration procedure to be developed for Regular calibration, maintenance and testing regime to internationally recognized standards and in compliance with manufacturers specification.*
A3 Time Period	*low*	*Meters for measuring operations hours will be subject to regular calibration, maintenance and testing regime to ensure accuracy is maintained*
C1 N_2O	*low*	*Calibration procedure to be developed for routine calibration of Nitrous Oxide monitor to internationally recognised standards and in compliance with manufacturer's specification.*

The type of instrument to be used in the measurement of N_2O concentrations from the project is a multicomponent FT-IR gas analyzer. The sampling intervals can be adjusted from 1 minute intervals.
GASMET ON-LINE SERIES includes industrial multicomponent gas analyzers for continuous monitoring applications. The GASMET Cx-4000 incorporates a Fourier Transform Infrared spectrometer, a temperature controlled sample cell, and signal processing electronics. The analyzer is fully equipped for fixed installations and it offers versatility and high performance for all industrial users. The GASMET Cx-4000 is designed for continuous emission monitoring (CEM).It is an ideal tool to analyze trace concentrations of pollutants in wet, corrosive gas mixtures. The sample cell can be heated up to 180 °C. Sample cell absorption path length is selected according to the application. The GASMET Cx-4000 allows simple calibration using only single component calibration gases. The user can easily configure the analyzer for a new set of compounds
We have already used the GASMET Dx-4000 portable version for determining plant specific N2O emission factors. The GASMET Dx-4000 incorporates an FT-IR spectrometer, a temperature controlled sample cell, and signal processing electronics. It is a cost effective, truly portable FT-IR gas analyzer that offers versatility and performance for all industrial users. The GASMET Dx-4000 includes a large reference spectrum library. The user can easily configure the analyzer for a new set of components by just activating new calibration spectra from the library.

B.8. Has the methodology been applied successfully elsewhere and, if so, in which circumstances?

Yes, a similar methodology was validated by a Designated Operational Entity for a JI project submitted to Senter Erupt 4 tender in 2004.
The JI projects where in the United Kingdom. The measurement of N_2O has been successfully carried out and reported by the largest nitric acid producer in the UK (Terra Industries for over 3 years using a gas analyser similar to the instrument described above. The accurate measurement of N_2O has also been carried out at "AMI Agrolinz Melamine International" in the Republic of Austria refer new proposed methodology NM0111. This system which has been in operation in the Ludwigshafen 03-85 nitric acid plant since 11/3/1999 has proven to give consistent accurate measurements of N_2O concentrations.

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