Draft revision to the approved baseline and monitoring methodology AM0051

"Secondary catalytic N_2O destruction in nitric acid plants"

I. SOURCE AND APPLICABILITY

Source

This methodology is based on the project activity "Soluciones Nitrous Oxide Abatement Project", whose baseline and monitoring methodology and project design document were prepared by Sindicatum Carbon Capital Ltd.

For more information regarding the proposal and its consideration by the Executive Board please refer to case NM0176-rev: "Methodology for secondary catalytic N_2O destruction in nitric acid plants" on http://cdm.unfccc.int/goto/MPappmeth

This methodology also refers to the latest approved versions of the following baseline and monitoring methodologies:

AM0028 "Catalytic N_2O destruction in the tail gas of Nitric Acid or Caprolactam Production Plants";
AM0034 "Catalytic reduction of N_2O inside the ammonia burner of nitric acid plants".

Selected approach from paragraph 48 of the CDM modalities and procedures

"Actual or historical emissions, as applicable"

Applicability

The methodology is applicable to project activities that destroy N_2O emissions by either catalytic decomposition or catalytic reduction of N_2O within the reactor chamber of nitric acid plants (i.e. secondary destruction). The applicability is limited to existing plants that have been in operation since 31 December 2005. Note further that emission reductions can only be claimed for the existing production capacity measured in tonnes of nitric acid. Existing production capacity is defined as the designed capacity, measured in tonnes of nitric acid per year, installed no later than 31 December 2005.

The following conditions apply to the methodology:

- The project activity shall not affect the level of nitric acid production;
- At the start of the project activity, there are no regulatory requirements or incentives to reduce levels of N_2O emissions from nitric acid plants in the host country;
- No N_2O abatement technology is currently installed or has been installed in the past in the plant;
- The project activity will not cause an increase in NO_X emissions;
- If any NO_X abatement catalyst is installed prior to the start of the project activity, it is not a Non-Selective Catalytic Reduction (NSCR) $DeNO_X$ unit;
- Operation of the secondary N_2O abatement catalyst, installed under the project activity, does not lead to any process emissions of greenhouse gases, directly or indirectly;

- The N_2O concentration in the flow before and after the secondary catalyst is measurable in real time.

II. BASELINE METHODOLOGY

Project boundary

The spatial extent of the project boundary shall cover the facility and equipment for the complete nitric acid production process from the inlet of the ammonia burner to the stack. This includes all compressors, tail gas expander turbines and any NO_X abatement equipment installed. The only greenhouse gas to be included in the project boundary is the N_2O contained in the waste stream exiting the stack.

Flow diagrams of different types of nitric acid plants (high, medium and low pressure; mono and dual pressure; plant constructor) differ substantially. Therefore, a plant specific flow diagram should be provided in the CDM-PDD, including the project boundary of the particular nitric acid plant involved in the project activity.

Table 1: Overview of emission sources included or excluded from the project boundary.

Source		Gas	Included?	Justification / Explanation
Baseline	Nitric acid plant tail gas	CO_2	No	The project does not lead to any change in CO_2 or CH_4 emissions.
		CH_4	No	
		N_2O	Yes	Main emission source
Project Activity	Nitric acid plant tail gas	CO_2	No	The project does not lead to any change in CO_2 or CH_4 emissions.
		CH_4	No	
		N_2O	Yes	Main emission source

Identification of the baseline scenario

The baseline scenario shall be identified using the procedure for identification of the baseline scenario described in the latest approved version of methodology AM0028 “Catalytic N_2O destruction in the tail gas of Nitric Acid or Caprolactam Production Plants”.

This methodology is only applicable if this procedure results in that the most plausible baseline scenario is that no N_2O abatement technology would be installed in the absence of the project and the N_2O would continue to be emitted to the atmosphere.

Additionality

The additionality of the project activity shall be demonstrated and assessed using the latest version of the *“Tool for demonstration and assessment of additionality”* agreed by the Executive Board, taking into account similarity of approaches used to determine baseline scenario and additionality.

Consistency shall be ensured between the baseline scenario determination and additionality demonstration. The baseline scenario alternative selected in the previous section shall be used when applying the tool for demonstration and assessment of additionality.

In case of a re-assessment of the baseline scenario as a consequence of new NO_X regulations over the course of the crediting period of the proposed project activity, the re-assessment of baseline scenario shall be undertaken using the same procedure indicated above. In such a case, the additionality of the project must also be re-demonstrated.

Baseline emissions

This methodology calculates baseline emissions for projects where the baseline scenario is the continuation of release of untreated N_2O to the atmosphere. This methodology requires the determination of a N_2O decomposition factor (NDF_c) for each secondary catalyst ~~nitric acid production~~ campaign *c*. The NDF represents the amount of N_2O that would have been decomposed within the reactor chamber and downstream of the reactor in the absence of the secondary catalyst. N_2O emissions after the primary catalyst are measured *ex-post*, which are then adjusted by the NDFc. The methodology makes ~~takes~~ provisions for *ex-post* adjustment of the baseline emissions in cases where legislation and regulations are implemented after the project activity has commenced. It also provides a conservative approach to estimate baseline emissions *ex-ante*, for the purposes of preparing the CDM-PDD.

Baseline and project emissions should be calculated separately for each secondary catalyst campaign '*c'* and for all or part of each primary catalyst campaign '*d'*. The duration of each production campaign T_c corresponds to the lifetime of the secondary catalyst installed as part of the project activity, i.e. it starts with the installations of the secondary catalyst and ends at the decommissioning of the catalyst

~~Baseline and project emissions should be calculated separately for each nitric acid production campaign *c*. The duration of each production campaign T_c corresponds to the lifetime of the secondary catalyst installed as part of the project activity, i.e. it starts with the installations of the catalyst and ends of the decommissioning of the catalyst.~~

The following steps are described below:

1. Determination of the permitted operating conditions of the nitric acid plant
2. Determination of the N_2O decomposition factor
3. *Ex-post* determination of baseline emissions

1. Determination of the permitted operating conditions of the nitric acid plant

Prior to the implementation of the project activity, project participants shall define and document in the CDM-PDD the permitted operating conditions of the nitric acid production plant where the N_2O abatement technology is installed. The permitted operating conditions shall be determined for the following parameters: (i) oxidation temperature; (ii) oxidation pressure; (iii) ammonia gas flow rate, (iv) air input flow rates, and (v) composition of catalyst. The permitted range shall be established using the procedures provided in the latest approved version of methodology AM0034, over five production campaigns. Note that data for these parameters is routinely logged in the process control systems of the plant. Document the permitted operating conditions for each parameter transparently in the CDM-PDD.

Changes to the existing equipment, e.g. replacement of worn components of the production train, may be undertaken as long they do not alter the nameplate capacity or the operating conditions defined above

2. Determination of the N_2O decomposition factor

The N_2O decomposition factor (NDF) is defined as the relation of the N_2O concentration in the tail gas in relation to the N_2O concentration directly after the primary catalyst without a secondary catalyst. The NDF is determined, prior to the installation of the secondary catalyst, in a measurement campaign, which shall be carried out over 24 hours of continuous measurement (after the exclusion of any periods when the plant is operating outside the operating parameters identified in the procedure provided below).

The NDF shall be calculated by dividing the N_2O concentration in the tail gas ($w_{N2O,TG,NDF}$), adjusted by the lower range of the uncertainty at a 95% confidence level, by the of N_2O concentration immediately after the primary catalyst ($w_{N2O,PC,NDF}$), adjusted by the upper range of the uncertainty at a 95% confidence interval, as follows:

~~$NDF_c = \frac{w_{N2O,TG,NDF} - UNC\left(w_{N2O,TG}\right)}{w_{N2O,PC,NDF} + UNC\left(w_{N2O,PC}\right)}$ (1)~~

$$NDF_c = \frac{w_{N2O,TG,NDF} - UNC\left(w_{N2O,TG,NDF}\right)}{w_{N2O,PC,NDF} + UNC\left(w_{N2O,PC,NDF}\right)} \qquad \textbf{(1)}$$

Where:

NDF_c	N_2O decomposition factor for the nitric acid production campaign *c*
$w_{N2O,PC,NDF}$	Average N_2O concentration in the process gas immediately after the primary catalyst during the measurement to determine the N_2O decomposition factor for the nitric acid production campaign *c* (ppm or tonnes N_2O/m^3)
$w_{N2O,TG,NDF}$	Average N_2O concentration in the tail gas during the measurement to determine the N_2O decomposition factor for the nitric acid production campaign *c* (ppm or tonnes N_2O/m^3)
$UNC\ (w_{N2O,PC,NDF})$	Upper range of the uncertainty of the estimated $w_{N2O,PC,NDF}$ value at a 95% confidence level
$UNC\ (w_{N2O,TG,NDF})$	Lower range of the uncertainty of the estimated $w_{N2O,TG,NDF}$ value at a 95% confidence level

The NDF shall be re-measured in the same manner each time the secondary catalyst is replaced. If the new value of NDF is lower than the current value, the new value will be applied to future calculations. If the new value is higher, the current value will continue to be used. The results of each measurement campaign should be recorded and presented in an annex to the monitoring report. Continuous measurements shall be taken with readings, recorded every two minutes or more frequently. For the actual measurement methods, refer to the following section and the monitoring section.

3. *Ex-post* determination of baseline emissions

Baseline emissions are calculated *ex-post* by measuring the N_2O concentration immediately after the primary catalyst, which is multiplied by the flow rate and the N_2O decomposition factor (NDF) in order to estimate the baseline emission of N_2O in the tail gas.

Measurement of N_2O concentration immediately after the primary catalyst

To provide a representative sample of the N_2O concentration in the process gas immediately after the primary catalyst during measurement of $w_{N2O,PC,NDF}$ and $w_{N2O,PC,c,d,p}$, a probe (spanning the diameter of the reactor chamber) will be inserted perpendicular to the gas flow. For a reactor whose diameter is less than 600 mm, the probe should have five equidistant holes, on the downstream side, with no holes in the first and last 50 mm (to avoid any side wall effects). For reactors with a diameter of 600 mm or more, the holes will be placed equidistantly (avoiding the first and last 50 mm) and the number of holes is to be determined as follows:

$$NH = \frac{(D_{RC} - 100)}{100} \qquad (2)$$

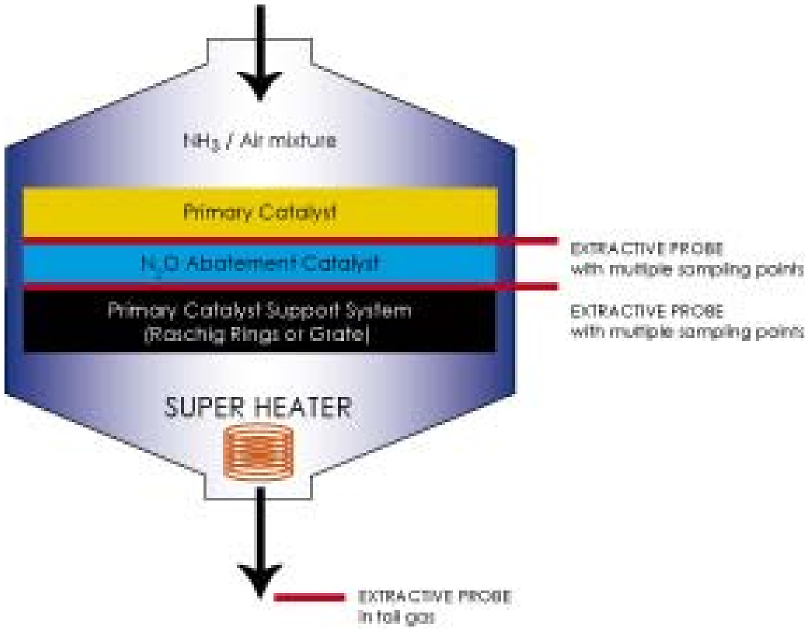
Where:

NH	Number of holes for the sampling probes to test N_2O concentration after the primary catalyst (rounded down, where necessary, to the upper value)
D_{RC}	Diameter of reactor chamber (mm)

The N_2O concentration in the tail gases will be sampled using an industry standard extractive probe before the introduction of any new gases that would alter the composition or flow of the tail gases (i.e. before the de-NO_X unit).

Figure 1

Reactor chamber showing the relative locations of the primary and secondary catalysts and the extractive probes.



Baseline emissions are calculated for discrete time periods *'p'* of the duration T_p. The duration of T_p of each time period *'p'* should be consistent throughout campaign 'd' ~~the same~~ and should be 1 hour or less. Baseline emissions in year *y* are calculated by summing up the baseline emission of each time period *'p'*, taking into account that the baseline emissions should be calculated separately for each secondary catalyst campaign '*c'* and for all or part of each primary catalyst campaign '*d'* ~~measurement campaign *c*~~, as follows:

$$BE_y = GWP_{N2O} \cdot \sum_{c} \sum_{d=1}^{N_{cd}} \sum_{p=1}^{N_{dp}} BE_{N2O,c,d,p} \tag{3}$$

Where:

BE_y	Total baseline emissions in year *y* (tonnes CO_2eq)
$BE_{N2O,c,d,p}$	Baseline N_2O emissions for period '*p*' during primary catalyst campaign '*d*' in secondary catalyst campaign '*c*' ~~in period *p*~~ (tonnes N_2O)
GWP_{N2O}	Global warming potential of N_2O valid for the commitment period
c	Index for secondary catalyst campaign
p	Time periods during the production campaign 'd' ~~measurement campaign *c*~~ where the nitric acid reactor was operating and where all operating parameters (oxidation temperature, oxidation pressure, ammonia gas flow rate, air input flow rates, and composition of catalyst) and all applicable monitoring parameters have been measured
d	Index for primary catalyst campaign
N_{cd}~~$_p$~~	Number of 'd' periods ~~period 'p'~~ in campaign 'c'
N_{dp}	Number of 'p' periods in campaign 'd'

The methodology provides three different approaches to determine $BE_{N2O,p}$. Project participants shall determine during monitoring for each period *'p'* which procedure has to be applied to calculate $BE_{N2O,p}$, according to the following guidance:

- If all operation parameters defined above (oxidation temperature, oxidation pressure, ammonia gas flow rate, air input flow rates, and composition of catalyst) are within the permitted operating conditions and if no legal regulations concerning N_2O emissions are in place, use procedure A below.
- If one of the ~~operation~~ operational parameters defined above (oxidation temperature, oxidation pressure, ammonia gas flow rate, air input flow rates, and composition of catalyst) is not within the permitted operating conditions and if no legal regulations concerning N_2O emissions are in place, use procedure B below.
- If legal regulations concerning N_2O emissions are in place, apply procedure C and procedure A or, if applicable, procedure B and use the lowest resulting value for $BE_{N2O,p}$.

Procedure A: All operation parameters are within the permitted operating conditions and no legal regulations concerning N_2O emissions are in place

Baseline N_2O emissions for the period *p* are calculated as follows:

$$BE_{N2O,c,d,p} = Q_{N2O,PC,c,d,p} \cdot NDF_c \tag{4}$$

Where:

$BE_{N2O,c,d,p}$	Baseline N_2O emissions for period '*p*' during primary catalyst campaign '*d*' in secondary catalyst campaign '*c'* (tonnes N_2O) ~~campaign '*c*' in period *p* (tonnes N_2O)~~
$Q_{N2O,PC,c,d,p}$	Quantity of N_2O flowing through the reactor during period '*p*' during primary catalyst campaign '*d*' in secondary catalyst campaign '*c'* (tonnes N_2O) ~~the period *p*, measured immediately after the primary catalyst (tonnes N_2O) for campaign '*c*'~~
NDF_c	N_2O decomposition factor for the nitric acid production campaign *c*

The N_2O flow immediately after the primary catalyst is determined as follows:

$$Q_{N2O,PC,c,d,p} = (Q_{RG,c,d,p} - UNC(Q_{RG,c,p}))\cdot(w_{N2O,PC,c,d,p}\cdot(1-UNC(W_{N20,PC}))\cdot T_p \qquad \mathbf{(5)}$$

Where:

$Q_{N2O,PC,c,d,p}$	Quantity of N_2O flowing through the reactor during the period '*p*' during primary catalyst campaign '*d*' in secondary catalyst campaign '*c'* (tonnes N_2O) ~~period *p*, measured immediately after the primary catalyst (tonnes N_2O) for campaign '*c*'~~
$Q_{RG,c,d,p}$	Volume flow rate of reactor gas in period '*p*' during primary catalyst campaign '*d*' in secondary catalyst campaign '*c'* (m^3/h) ~~period *p* (m^3/h) for campaign '*c*'~~
$UNC\ (Q_{RG,c,p})$	Range of the uncertainty of the determination of $Q_{RG,y}$ at a 95% confidence level
$w_{N2O,PC,c,d,p}$	Average N_2O concentration in the process gas immediately after the primary catalyst during period '*p*' during primary catalyst campaign '*d*' in secondary catalyst campaign '*c'* (tonnes N_2O/m^3) ~~period *p* (tonnes N_2O/m^3) for campaign '*c*'~~
$UNC(W_{N2O,PC})$	Range of the uncertainty of the determination of $Q_{N2O,pc}$ at a 95% confidence level
T_p	Length of period *p* (hours)

The volume flow rate of the reactor gas ($Q_{RG,p}$) is established by one of the following methods:

(i) By direct measurement of the flow rate of reactor gas using flow meters installed at appropriate locations; or

(ii) Calculated on the basis of the ammonia gas flow and the ratio of air to ammonia entering the reactor as follows:

$$\mathrm{Q_{RG,p}} = \mathrm{Q_{NH3,p}} \times \left(1 + \mathrm{r_{AIR,NH3,p}}\right) \qquad \mathbf{(6)}$$

Where:

$Q_{RG,p}$	Volume flow rate of reactor gas in period *p* (m^3/hour)
$Q_{NH3,p}$	Ammonia input to the oxidation reactor in period *p* (m^3/hour)
$r_{AIR,NH3,p}$	Ratio of air to ammonia entering the oxidation reactor in period *p*

Procedure B: One of the operating parameters is not within the permitted operating conditions

Baseline N_2O emissions for the period *p* are calculated based on the quantity of nitric acid produced during the period *p* and an emissions factor, as follows:

$$BE_{N2O,c,d,p} = P_{HNO3,c,d,p} \times EF_{N2O,BL,c,d,p} \tag{7}$$

Where:

$BE_{N2O,c,d,p}$	Baseline N_2O emissions in period '*p*' during primary catalyst campaign '*d*' in secondary catalyst campaign '*c'* (tonnes N_2O) ~~period *p* (tonnes N_2O) for campaign '*c*'~~
$P_{HNO3,c,d,p}$	Nitric acid production in period '*p*' during primary catalyst campaign '*d*' in secondary catalyst campaign '*c'* (tonnes HNO_3) ~~period *p* (tonnes HNO_3) for campaign '*c*'~~
$EF_{N2O,BL,,c,d,p}$	Baseline emission factor applied in period '*p*' during primary catalyst campaign '*d*' in secondary catalyst campaign '*c'* (tonnes N_2O/ tonnes HNO_3) ~~period *p* (tonnes N_2O/ tonnes HNO_3) for campaign '*c*'~~

As a conservative approach, the baseline emission factor for the period *p* ($EF_{N2O,BL,p}$) should be chosen as the lowest value among the following:

- A default value of 0.0045 tonnes of N_2O generated per tonne of nitric acid produced ($EF_{N2O,BL,p} =$ 0.0045 t N_2O/t HNO_3), based on the lower range of the default values provided in the 2006 IPCC Guidelines;
- The baseline N_2O emission factor of the plant for the production campaign ($EF_{N2O,BL,p} = EF_{N2O,BL,plant,c}$), i.e. the average baseline N_2O emissions of the plant per ton of nitric acid produced during the production campaign 'd'~~c~~, calculated based on those periods *p* during the length of the production campaign ~~T_c~~ where all operating parameters were within the permitted operating conditions.

The baseline N_2O emission factor of the plant ($EF_{N2O,BL,plant,c,d}$) is calculated separately for each production campaign 'd'~~'c'~~, by dividing the baseline N_2O emissions by the quantity of nitric acid produced during the whole nitric acid production campaign, excluding time intervals where the operating parameters were not within the permitted operating conditions, as follows:

$$EF_{N2O,BL,plant,c,d} = \frac{NDF_c x \sum_{s=1}^{N_{ds}} Q_{N2O,PC,c,d,s}}{\sum_{s=1}^{N_{ds}} P_{HNO3,c,d,s}} \tag{8}$$

Where:

$EF_{N2O,BL,plant,c,d,}$	Baseline N_2O emission factor of the plant for the nitric acid primary catalyst production campaign *'d'* during secondary catalyst campaign *'c'* ~~c~~ (tonnes N_2O/ tonnes HNO_3)
$Q_{N2O,PC,c,d,s}$	Quantity of N_2O flowing through the reactor during the period 's'~~*sp*~~, measured immediately after the primary catalyst (tonnes N_2O) during primary catalyst campaign '*d*' in secondary catalyst campaign '*c'* ~~for campaign '*c*'~~
NDF_c	N_2O decomposition factor for the nitric acid production campaign *c*
$P_{HNO3,c,d,s}$	Nitric acid production in period *'s'* (tonnes HNO_3)for campaign 'd'~~'*c*'~~
N_{ds}	Number of period 's' in campaign 'd'~~'c'~~. NOTE: $N_{ds} < N_{dp}$ ~~$N_{es} < N_{ep}$~~
s	Is set of all time periods '*p*' of length T_p during the total measurement campaign *c* where all operating parameters defined above (oxidation temperature, oxidation

pressure, ammonia gas flow rate, air input flow rates, and composition of catalyst) were within the permitted operating conditions

Procedure C: Legal regulations concerning N_2O emissions are in place

In case regulations concerning N_2O emissions are implemented during the crediting period, the impact on baseline N_2O emissions shall be considered by adjusting the baseline N_2O emissions respectively from the time on when the regulation must be implemented, taking into account relevant EB decisions on the considerations of such regulations.

Project participants should document in a transparent manner how the level of baseline emissions resulting from the regulation is to be calculated; taking into account the type of legal regulation that is required. All assumptions and calculation steps should be explained and substantiated and their appropriateness should be verified by the DOE.

For example, where the regulation is setting a threshold for specific N_2O emissions per unit output of nitric acid, baseline emissions should be calculated as follows:

$$BE_{N2O,c,d,p} = Reg_{N2O} \cdot P_{HNO3,c,d,p} \qquad \textbf{(9)}$$

Where:

$BE_{N2,c,d,p}$	Baseline N_2O emissions in period '*p*' during primary catalyst campaign '*d*' in secondary catalyst campaign '*c'* (tonnes N_2O) ~~period *p* (tonnes N_2O) for campaign '*c*'~~
Reg_{N2O}	Threshold limit of N_2O emissions per output of nitric acid, imposed by the regulation (tonnes N_2O/ tonnes HNO_3)
$P_{HNO3,c,d,p}$	Nitric acid production in period '*p*' during primary catalyst campaign '*d*' in secondary catalyst campaign '*c'* (tonnes HNO_3) ~~period *p* (tonnes HNO_3) for campaign '*c*'~~

Project emissions

The emissions attributable to the project activity consist of the non-destroyed N_2O in the tail gas of the reactor that is emitted to the atmosphere. The procedure to determine the project N_2O emissions is similar to the one applied to determine baseline emissions, whereby the N_2O concentration can be measured directly after the secondary catalyst or in the tail-gas where the NDF tail gas measurement was taken.

The N_2O emissions that are not destroyed by the project activity are determined *ex-post* by continuous measurement of the N_2O concentration after the secondary catalyst and the volume flow rate of the reactor gas stream.

Project emissions are calculated as follows:

$$PE_y = GWP_{N2O} \cdot \sum_{c} \sum_{d=1}^{N_{cd}} \sum_{p=1}^{N_{dp}} PE_{N2O,c,d,p} \qquad \textbf{(10)}$$

Where:

$PE_{,y}$	Total project emissions in year y (tonnes CO_2eq)
$PE_{N2O,c,d,p}$	Project N_2O emissions in period 'p' during primary catalyst campaign 'd' in secondary catalyst campaign 'c' (tonnes N_2O) period p (tonnes N_2O) for campaign c
GWP_{N2O}	Global warming potential of N_2O valid for the commitment period

If all operation parameters (oxidation temperature, oxidation pressure, ammonia gas flow rate, air input flow rates, and composition of catalyst) are within the permitted operating conditions in period p, the project N_2O emissions in period p ($PE_{N2O,p}$) are calculated as follows:

$$PE_{N2O,c,d,p} = Q_{N2O,SC,c,d,p} + UNC\left(Q_{N2O,SC,c,d,p}\right) \tag{11}$$

with

$$Q_{N2O,SC,c,d,p} = Q_{RG,c,d,p} \cdot w_{N2O,SC,c,d,p} \cdot T_p \tag{12}$$

Where:

$PE_{N2O,c,d,p}$	Project N_2O emissions in period 'p' during primary catalyst campaign 'd' in secondary catalyst campaign 'c' (tonnes N_2O) ~~period p (tonnes N_2O) for campaign 'c'~~
$Q_{N2O,SC,c,d,p}$	Quantity of N_2O that is not destroyed and emitted through the tail gas during the period 'p' during primary catalyst campaign 'd' in secondary catalyst campaign 'c' (tonnes N_2O) ~~period p, measured immediately after the secondary catalyst (tonnes N_2O) for campaign 'c'~~
$UNC (Q_{N2O,SC,c,d,p})$	Upper range of the uncertainty of the determination of $Q_{N2O,SC,c,d,p}$ at a 95% confidence level for campaign 'c'
$Q_{RG,c,d,p}$	Volume flow rate of reactor gas in period 'p' during primary catalyst campaign 'd' in secondary catalyst campaign 'c' (m^3/h) ~~period p (m^3/h) for campaign 'c'~~
$w_{N2O,SC,c,d,p}$	N_2O concentration after the secondary catalyst during period 'p' during primary catalyst campaign 'd' in secondary catalyst campaign 'c' (tonnes N_2O/m^3) ~~period p (tonnes N_2O/m^3) for campaign 'c'~~
T_p	Length of period p (hours)

If one of the operation parameters (oxidation temperature, oxidation pressure, ammonia gas flow rate, air input flow rates, and composition of catalyst) is not within the permitted operating conditions in period p, the project N_2O emissions in period p ($PE_{N2O,e,d,p}$) are calculated based on the baseline emissions in the period p ($BE_{N2O,e,d,p}$) and the destruction efficiency of the secondary catalyst ($DE_{SC,c}$), as follows:

$$PE_{N2O,d,p} = BE_{N2O,d,p} * DE_{SC,c} \tag{13}$$

with

$$DE_{SC,d} = \frac{\sum_{s=1}^{N_{ds}} Q_{N2O,SC,d,s}}{\sum_{s=1}^{N_{ds}} Q_{N2O,PC,d,s}} \cancel{DE_{SC,c}} = \frac{\sum_{s=1}^{N_{cs}} Q_{N2O,SC,s}}{\sum_{s=1}^{N_{cs}} Q_{N2O,PC,s}} \qquad \textbf{(14)}$$

Where:

$PE_{N2O,\cancel{c,p},d,p}$	Project N_2O emissions in period *p* (tonnes N_2O) for campaign *'d'* ~~*'c'*~~
$BE_{N2O,\cancel{c,p},d,p}$	Baseline N_2O emissions in period *p* (tonnes N_2O) for campaign *'d'* ~~*'c'*~~
$DE_{SC,c}$	Average destruction efficiency of the secondary catalyst during the nitric acid production campaign *c*
$Q_{N2O,SC,d,s}$	Quantity of N_2O flowing through the reactor during the period *p*, measured ~~immediately~~ after the secondary catalyst (tonnes N_2O) for campaign *'d'* ~~*'c'*~~
$Q_{N2O,PC,d,s}$	Quantity of N_2O flowing through the reactor during the period *p*, measured immediately after the primary catalyst (tonnes N_2O) for campaign *'d'* ~~*'c'*~~
N_{ds}	Number of period 's' in campaign *'d'* ~~*'c'*~~. NOTE: $N_{ds} < N_{cp}$
s	Set of time periods 'p' of length T_p during the total measurement campaign *'d'* ~~*'c'*~~ where all operating parameters defined above (oxidation temperature, oxidation pressure, ammonia gas flow rate, air input flow rates, and composition of catalyst) were within the permitted operating conditions

The calculation of DE_{SC} does not need consider the NDF or subsequent changes in N_2O concentration because DE_{SC} is applied to a conservative baseline value, which is based on end of pipe emissions that already take these factors into account.

Leakage

There will not be any significant leakage of nitrous oxide or other green house gases outside the project boundaries. The secondary catalyst installed in the reactor underneath the precious metal gauzes will result in no measurable increase in resource use in the nitric acid plant.

Ex-post determination of emission reductions

Emission reductions are only calculated for those periods where the reactor is operating and where all operating parameters (oxidation temperature, oxidation pressure, ammonia gas flow rate, air input flow rates, and composition of catalyst) and all applicable monitoring parameters are measured. This corresponds to all periods *p*.

If the nitric acid production in year *y* ($P_{HNO3,y}$) is equal to or lower than the existing production capacity ($P_{HNO3,cap}$), emission reductions are calculated as follows:

$$ERy = BEy - PEy \qquad \textbf{(15)}$$

If the nitric acid production in year *y* ($P_{HNO3,y}$) is larger than the existing production capacity ($P_{HNO3,cap}$), emission reductions are calculated as follows:

$$ER_y = \frac{P_{HNO3,cap}}{P_{HNO3,y}} \times \left(BE_y - PE_y\right)$$

~~$ER_y = \frac{P_{HNO3,y}}{P_{HNO3,cap}} \times (BE_y - PE_y)$~~ **(16)**

Where:

ER_y	Emission reductions in year y (tonnes CO_2 eq)
$P_{HNO3,y}$	Nitric acid production in year y (tonnes HNO_3/yr)
$P_{HNO3,cap}$	Existing production capacity, defined according to the applicability conditions (tons HNO3/yr)
BE_y	Total baseline emissions in year y (tonnes CO_2 eq)
PE_y	Total project emissions in year y (tonnes CO_2 eq)

Ex-ante estimation of emission reductions

For the purposes of preparing the CDM-PDD, the *ex-ante* estimation of emission reductions should use the IPCC default factors contained in Table 3.3, page 3.23, Volume 3 in the 2006 IPCC Guidelines in combination with the projected annual production of nitric acid to calculate both baseline and project emissions, as follows:

$$BE_y = P_{HNO3,y,pred} \cdot EF_{N2O/HNO3} \cdot GWP_{N2O} \tag{17}$$

$$PE_y = P_{HNO3,y,pred} \cdot EF_{N2O/HNO3} \cdot (DE_{SCpred}) \cdot GWP_{N2O} \tag{18}$$

Where:

BE_y	Total baseline emissions in year y (tonnes CO_2 eq)
PE_y	Total project emissions in year y (tonnes CO_2 eq)
$P_{HNO3,y,pred}$	Predicted annual production of nitric acid (tonnes HNO_3)
$EF_{N2O/HNO3}$	*Ex-ante* emission factor (tonnes of N_2O/tonnes HNO_3)
DE_{SCpred}	Predicted destruction efficiency (ratio) of the secondary catalyst
GWP_{N2O}	Global warming potential of N_2O valid for the commitment period

Changes required for methodology implementation in 2nd and 3rd crediting periods

No changes are required as the baseline methodology takes provision for the implementation of regulations the date on which they become active.

Data and parameters not monitored

Use the following table for each data/parameter

ID Number:	P1
Parameter:	D_{RC}
Data unit:	mm
Description:	Diameter of reactor chamber
Source of data:	Plant specification
Measurement procedures (if any):	
Any comment:	This is to calculate the number of holes for the sampling probes.

ID Number:	P2
Parameter:	$TEMP_{hist}$
Data unit:	°C
Description:	Historical operating temperature range of the ammonia oxidation reactor
Source of data:	Historic plant operating data
Measurement procedures (if any):	Use data from most recent 5 campaigns, screening to remove outliers – remove any data collected when ammonia flow was zero, sort in ascending order and trim off the upper and lower 2.5% of the data
Any comment:	This parameter is determined from historic data over which there is no particular way to improve data quality. In absence of historical records operations Manual from the plant manufacturer can be used to determine the parameter value.

ID Number:	P3
Parameter:	$PRES_{hist}$
Data unit:	Pa or bar
Description:	Historical operating pressure range of ammonia oxidation reactor
Source of data:	Historic plant operating data
Measurement procedures (if any):	Use data from most recent 5 campaigns, screening to remove outliers – remove any data collected when ammonia flow was zero, sort in ascending order and trim off the upper and lower 2.5% of the data
Any comment:	This parameter is determined from historic data over which there is no particular way to improve data quality. In absence of historical records operations Manual from the plant manufacturer can be used to determine the parameter value.

ID Number:	P4
Parameter:	$CAT_{specifications,hist}$
Data unit:	Various
Description:	Historic catalyst specifications including: • Supplier • Type of metal alloy (e.g., Pt/Rh ratio) • Diameter of wire (usually, 90, 76 or 60 microns) • Mesh number per cm • Number of gauzes • Relevant details of the catalyst system (e.g., flat or corrugated)

Source of data:	Catalyst supplier
Measurement procedures (if any):	This parameter is determined from historic data over which there is no particular way to improve data quality.
Any comment:	-

ID Number:	P5
Parameter:	$Q_{NH3,hist}$
Data unit:	m^3/h
Description:	Historical ammonia input to oxidation reactor
Source of data:	Historic plant operating data
Measurement procedures (if any):	Use data from most recent 5 campaigns, screening to remove outliers – remove any data collected when ammonia flow was zero, sort in ascending order and trim off the upper and lower 2.5% of the data.
Any comment:	This parameter is determined from historic data over which there is no particular way to improve data quality. In absence of historical records operations Manual from the plant manufacturer can be used to determine the parameter value.

ID Number:	P6
Parameter:	$r_{AIR,NH3,hist}$
Data unit:	-
Description:	Historical ratio of ammonia to air entering the oxidation reactor
Source of data:	Historic plant operating data
Measurement procedures (if any):	Use data from most recent 5 campaigns, screening to remove outliers – remove any data collected when ammonia flow was zero, sort in ascending order and trim off the upper and lower 2.5% of the data.
Any comment:	This parameter is determined from historic data over which there is no particular way to improve data quality. In absence of historical records operations Manual from the plant manufacturer can be used to determine the parameter value.

ID Number:	P7
Parameter:	$EF_{N2O/HNO3}$
Data unit:	tonnes N_2O /tonnes HNO_3
Description:	Default emissions factor
Source of data:	Choose the most appropriate value from 2006 IPCC Guidelines, Volume 3, page 3.23, Table 3.3
Measurement procedures (if any):	
Any comment:	

ID Number:	P8
Parameter:	$\mathbf{T_p}$
Data unit:	Hours
Description:	Length of the timer period *p*
Source of data:	Choose 1 hour or a shorter time interval
Measurement procedures (if any):	
Any comment:	

ID Number:	P9
Parameter:	$\mathbf{P_{HNO3,cap}}$
Data unit:	Tonnes HNO_3 per annum
Description:	Design capacity installed before 31 December 2005
Source of data:	Design specifications, operation manual, insurance documentation, permits
Measurement procedures (if any):	
Any comment:	If design capacity is not representative because of subsequent modifications to the plant, then the 10-year average production from the most recent ten years may be used instead.

III. MONITORING METHODOLOGY

Monitoring procedures

Project participants must provide details in the CDM-PDD of how each of the relevant parameters will be measured. These details must address the following specifications:

Monitoring procedures

Baseline and project emissions will be measured on an hourly basis or more frequently (i.e. defined as period *'p'*). Each of the necessary parameters will be calculated as the average for period 'p' using the sampling frequencies, monitoring and QA/QC procedures specified in the tables below.

Treatment of missing and abnormal data

Abnormal readings that arise during start-up and shut-down operations should be excluded from the baseline emission calculations.

Where one parameter is missing due to either an equipment malfunction or a data collection or handling error, and where other data is available to support the fact that plant is continuing to operate correctly (for example, production of HNO_3), missing data may be interpolated by taking the lower or upper value – whichever is more conservative - of the average reading over 12 hours (a) before the reading was lost or (b) after the reading was re-gained. Anomalous data immediately prior to loss or immediately after re-starting may be excluded from the baseline emission calculations. Missing data can only be interpolated for a maximum of 24 hours, during which time the fault must be rectified.

Monitoring regulations

Project participants should monitor continuously whether any regulation concerning N_2O emissions from nitric acid production is in place and applicable for the project plant. If regulation is in place, the type of regulation should be described and appropriate procedures to calculate baseline emissions, following the guidance in procedure C above, should be developed, documented, justified and be evaluated by the DOE.

Determination of NDF:

NDF may be checked by the verifying DOE and reported in the monitoring report. Recalculated values of NDF (prior to renewal of the secondary catalyst) will also be reported in the monitoring reports and will therefore be checked by the verifying DOE.

Data and parameters monitored

ID Number:	P10
Data / Parameter:	$Q_{RG,c,d,p}$
Data unit:	m^3 / h
Description:	Volume flow rate of reactor gas in period *p*
Source of data:	Measurement or calculation
Measurement procedures (if any):	Measurement: Either from a totalizing meter or an average of at least 60 * 1 minute readings of flow rate of gases. Calculation: see equation (6)
Monitoring frequency:	Hourly
QA/QC procedures:	Use calibrated equipment which will ideally demonstrate traceability to national standards or, failing that, defined standards. Metering equipment should meet best practice standards, typically more accurate than 1% to 5%. Lower accuracies must be justified. Monitoring equipment must be commissioned, maintained and calibrated accordingly. Procedures to ensure the QA and QC of this parameter will be documented, either in the monitoring plan or if they already exist in plant operating procedures, then they shall be referenced.
Any comment:	Monitoring of this parameter is only necessary if it is not calculated based on $Q_{NH3,p}$ and $r_{AIR,NH3,p}$. NH_3 and air flow rates are operating parameters normally measured at a plant.

ID Number:	P11
Data / Parameter:	$w_{N2O,TG,NDF}$
Data unit:	ppm or tonnes N_2O/m^3
Description:	Average N_2O concentration in the tail gas during the measurement to determine the N_2O decomposition factor for the secondary catalyst ~~nitric acid production~~ campaign c
Source of data:	Measurements using an extractive probe
Measurement procedures (if any):	The probe should be placed in the tail gas, before any other gases are introduced that would alter the composition or flow of the tail gases (i.e. before any de-NO_X unit).
Monitoring frequency:	During a 24 hour measurement campaign at two second intervals. Before installation a new secondary catalyst

QA/QC procedures:	The accuracy of the N_2O emissions monitoring results is to be ensured by installing a monitoring system that has been certified to meet (or exceed) the requirements of the prevailing best industry practice or monitoring standards in terms of operation, maintenance and calibration. The latest applicable European standards and norms (EN 14181) shall be used as the basis for selecting and operating the monitoring system. The following guidance documents are recommended as references for the Quality Assurance and Control procedures: a) European Standard, Technical Committee Air Quality: Working Document, Air quality – Certification of automated measuring systems (AMS). Part 3: Performance specifications and test procedures for AMS for monitoring emissions from stationery sources, prEN 264022, CEN/TC 264:2005/1. b) European Norm EN 14181: Quality assurance of automated measuring systems, 2004; c) Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU), German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety: Bundeseinheitliche Praxis bei der Überwachung der Emissionen. RdSchr. d. BMU v. 13.06.2005 – IG 12 – 45053/5.
Any comment:	The 24 hours of data must be when the plant is running within its defined operational range.

ID Number:	P12
Data / Parameter:	$w_{N2O,PC,NDF}$
Data unit:	ppm or tonnes N_2O/m_3
Description:	Average N_2O concentration in the process gas immediately after the primary catalyst during the measurement to determine the N_2O decomposition factor for the secondary catalyst ~~nitric acid production~~ campaign *c*
Source of data:	Measurements with an extractive probe placed after the primary catalyst, with a minimum of five collection points or 1 per 100mm of reactor diameter (avoiding sidewall effects) merged into one sample
Measurement procedures (if any):	To provide a representative sample of the processed gas ($w_{N2OPC,ndf}$) a probe (spanning the diameter of the reactor chamber) will be inserted perpendicular to the gas flow.
Monitoring frequency:	During a 24 hour measurement campaign at two second intervals. Before installation a new secondary catalyst
QA/QC procedures:	The accuracy of the N_2O emissions monitoring results is to be ensured by installing a monitoring system that has been certified to meet (or exceed) the requirements of the prevailing best industry practice or monitoring standards in terms of operation, maintenance and calibration. The latest applicable European standards and norms (EN 14181) shall be used as the basis for selecting and operating the monitoring system. The following guidance documents are recommended as references for the Quality Assurance and Control procedures: a) European Standard, Technical Committee Air Quality: Working Document,

	Air quality – Certification of automated measuring systems (AMS). Part 3: Performance specifications and test procedures for AMS for monitoring emissions from stationery sources, prEN 264022, CEN/TC 264:2005/1. b) European Norm EN 14181: Quality assurance of automated measuring systems, 2004; c) Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU), German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety: Bundeseinheitliche Praxis bei der Überwachung der Emissionen. RdSchr. d. BMU v. 13.06.2005 – IG 12 – 45053/5.
Any comment:	The 24 hours of data must be when the plant is running within its defined operational range. See P24 above.

ID Number:	P13
Data / Parameter:	$w_{N2O,SC,c,d,p}$
Data unit:	Tonnes N_2O/m^3
Description:	Average N_2O concentration in the process gas ~~immediately~~ after the secondary catalyst during period *p*
Source of data:	Measurement using an extractive probe placed after the secondary catalyst
Measurement procedures (if any):	Calculated as the average of readings taken at 2 second intervals. At least 8 minutes (13.3%) worth of data must be recorded per 60 minutes. If measurements are not taken throughout the whole period, justification must be provided. The N_2O concentration below the secondary catalyst will be measured using an extractive probe: (a) Spanning the diameter of the reactor chamber, inserted perpendicular to the gas flow. For a reactor diameter of less than 599 mm, the probe will have equidistant 5 holes, on the downstream side, with no holes in the first or last 50 mm (to avoid any side wall effects). For reactors with a diameter of more than 599 mm, the holes will be placed equidistantly, with the number of holes determined according to equation (2) above, avoiding the first and last 50 mm of the probe; or (b) In the tail gas, at the location where the tail gas measurement is taken to determine NDF and prior to any de-NOx unit where other gases may be introduced.
Monitoring frequency:	Hourly
QA/QC procedures:	This parameter is to be measured by using an on-line analyser that measures gas concentrations continuously. The accuracy of the N_2O emissions monitoring results is to be ensured by installing a monitoring system that has been certified to meet (or exceed) the requirements of the prevailing best industry practice or monitoring standards in terms of operation, maintenance and calibration. The latest applicable European standards and norms (EN 14181) shall be used as the basis for selecting and operating the monitoring system. The following guidance documents are recommended as references for the Quality Assurance and Control procedures: a) European Standard, Technical Committee Air Quality: Working Document,

	Air quality – Certification of automated measuring systems (AMS). Part 3: Performance specifications and test procedures for AMS for monitoring emissions from stationery sources, prEN 264022, CEN/TC 264:2005/1. b) European Norm EN 14181: Quality assurance of automated measuring systems, 2004. c) Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU), German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety: Bundeseinheitliche Praxis bei der Überwachung der Emissionen. RdSchr. d. BMU v. 13.06.2005 – IG 12 – 45053/5.
Any comment:	

ID Number:	P14
Data / Parameter:	$\mathbf{P_{HNO3,c,d,p}}$
Data unit:	Tonnes HNO_3
Description:	Nitric acid production during period *p*
Source of data:	Production meters checked against periodic mass balance calculations
Measurement procedures (if any):	Direct measurement.
Monitoring frequency:	Hourly – from a totalizing meter or average of 30 * 2 minute readings from a flow meter. If hourly data is not available, production can be estimated from shift or daily records, pro rata, with justification.
QA/QC procedures:	This parameter will be measured on site using calibrated equipment which will ideally demonstrate traceability to national standards or, failing that, defined standards. Metering equipment should meet best practice standards, typically more accurate than 1% to 5%. Lower accuracies must be justified. Monitoring equipment must be commissioned, maintained and calibrated accordingly. Sampling frequency is hourly. Procedures to ensure the QA and QC of this parameter will be documented, either in the monitoring plan or if they already exist in plant operating procedures, then they shall be referenced. Cross-check the measured quantities with purchase invoices. A mass balance approach shall be used for periodic check of the measured values.
Any comment:	Concentration of HNO_3 must be consistent throughout the reporting period.

ID Number:	P15
Data / Parameter:	$\mathbf{w_{N2O,PC,c,d,p}}$
Data unit:	Tonnes N_2O/m^3
Description:	Average N_2O concentration in the process gas immediately after the primary catalyst during period *p* (its maximum value is denoted as $w_{N2O,max,,p)}$
Source of data:	Measurement using an extractive probe placed after the primary catalyst.
Measurement procedures (if any):	Calculated as the average of readings taken at 2 second intervals. At least 8 minutes (13.3%) worth of data must be recorded per 60 minutes. If measurements are not taken throughout the whole period, justification must be provided. N_2O concentration underneath the primary catalyst will be measured using an extractive probe, spanning the diameter of the reactor chamber, inserted perpendicular to the gas flow. For a reactor diameter of less than 599 mm, the

	probe will have equidistant 5 holes, on the downstream side, with no holes in the first or last 50 mm (to avoid any side wall effects). For reactors with a diameter of more than 599 mm, the holes will be placed equidistantly, with the number of holes determined according to equation (2) above and avoiding the first and last 50 mm of probe.
Monitoring frequency:	Hourly
QA/QC procedures:	This parameter is to be measured by using an on-line analyser that measures gas concentrations continuously. In order to allow one sampling system to serve several production lines (by rotating samples through the sampling system, after purging), the proportion of N_2O concentration data sampled may be reduced as long as statistical results from a measurement campaign are presented to show that there is no significant difference (at 95% confidence level) between the means calculated at the different proportions of monitoring. The accuracy of the N_2O emissions monitoring results is to be ensured by installing a monitoring system that has been certified to meet (or exceed) the requirements of the prevailing best industry practice or monitoring standards in terms of operation, maintenance and calibration. The latest applicable European standards and norms (EN 14181) shall be used as the basis for selecting and operating the monitoring system. The following guidance documents are recommended as references for the Quality Assurance and Control procedures: a) European Standard, Technical Committee Air Quality: Working Document, Air quality – Certification of automated measuring systems (AMS). Part 3: Performance specifications and test procedures for AMS for monitoring emissions from stationery sources, prEN 264022, CEN/TC 264:2005/1. b) European Norm EN 14181: Quality assurance of automated measuring systems, 2004. c) Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU), German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety: Bundeseinheitliche Praxis bei der Überwachung der Emissionen. RdSchr. d. BMU v. 13.06.2005 – IG 12 – 45053/5.
Any comment:	

ID Number:	P16
Data / Parameter:	**$TEMP_p$**
Data unit:	°C
Description:	Actual operating temperature at primary catalyst of the ammonia oxidation reactor during period *p*
Source of data:	Thermocouple within reactor chamber
Measurement procedures (if any):	Measured as the average of at least 30 readings at 2 minute intervals
Monitoring frequency:	Hourly
QA/QC procedures:	This parameter will be measured on site using calibrated equipment which will ideally demonstrate traceability to national standards or, failing that, defined standards. Metering equipment should meet best practice standards, typically more accurate than 1% to 5%. Lower accuracies must be justified. Monitoring equipment must be commissioned, maintained and calibrated accordingly. Sampling frequency is hourly. Procedures to ensure the QA and QC of this parameter will be documented, either in the monitoring plan or if they already exist in plant operating procedures, then they shall be referenced.
Any comment:	

ID Number:	P17
Data / Parameter:	**$PRES_p$**
Data unit:	Pa or bar
Description:	Actual operating pressure of the ammonia oxidation reactor during period *p*
Source of data:	Pressure sensor within reactor chamber
Measurement procedures (if any):	Measured as the average of at least 30 readings at two minute intervals
Monitoring frequency:	Hourly
QA/QC procedures:	This parameter will be measured on site using calibrated equipment which will ideally demonstrate traceability to national standards or, failing that, defined standards. Metering equipment should meet best practice standards, typically more accurate than 1% to 5%. Lower accuracies must be justified. Monitoring equipment must be commissioned, maintained and calibrated accordingly. Sampling frequency is hourly. Procedures to ensure the QA and QC of this parameter will be documented, either in the monitoring plan or if they already exist in plant operating procedures, then they shall be referenced.
Any comment:	

ID Number:	P18
Data / Parameter:	$\mathbf{Q_{NH3,p}}$
Data unit:	m^3/hour
Description:	Ammonia input to the oxidation reactor in period *p*
Source of data:	Measurements from the NH_3 compressor
Measurement procedures (if any):	Measured as the average of at least 60 readings at one minute intervals
Monitoring frequency:	Hourly
QA/QC procedures:	This parameter will be measured on site using calibrated equipment which will ideally demonstrate traceability to national standards or, failing that, defined standards. Metering equipment should meet best practice standards, typically more accurate than 1% to 5%. Lower accuracies must be justified. Monitoring equipment must be commissioned, maintained and calibrated accordingly. Sampling frequency is hourly. Procedures to ensure the QA and QC of this parameter will be documented, either in the monitoring plan or if they already exist in plant operating procedures, then they shall be referenced.
Any comment:	NH_3 feed rate can be corroborated by reviewing NH_3 production rates.

ID Number:	P19
Data / Parameter:	$\mathbf{r_{AIR,NH3,p}}$
Data unit:	-
Description:	Ratio of air to ammonia entering the oxidation reactor during period *p*
Source of data:	Calculated from compressor data or directly measured
Measurement procedures (if any):	Measured as the average of at least 60 at one minute intervals
Monitoring frequency:	Hourly
QA/QC procedures:	This parameter will be measured on site using calibrated equipment which will ideally demonstrate traceability to national standards or, failing that, defined standards. Metering equipment should meet best practice standards, typically more accurate than 1% to 5%. Lower accuracies must be justified. Monitoring equipment must be commissioned, maintained and calibrated accordingly. Sampling frequency is hourly. Procedures to ensure the QA and QC of this parameter will be documented, either in the monitoring plan or if they already exist in plant operating procedures, then they shall be referenced.
Any comment:	

ID Number:	P20
Data / Parameter:	$\mathbf{CAT_{specifications}}$
Data unit:	Various
Description:	Catalyst specifications for each production campaign • Supplier • Type of metal alloy • Diameter of wire (usually, 90, 76 or 60 microns) • Mesh number per cm • Number of gauzes • Details of the catalyst system (flat or corrugated)
Source of data:	Catalyst suppliers
Measurement procedures (if any):	-
Monitoring frequency:	At the start of each new nitric acid production campaign *c*
QA/QC procedures:	
Any comment:	

References and any other information

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