CLEAN DEVELOPMENT MECHANISM

**CDM-MP59-A03**

# Draft Large-scale Consolidated Methodology

# ACM0019: $N_2O$ abatement from nitric acid production

Version 02.0

Sectoral scope(s): 05

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United Nations
Framework Convention on
Climate Change

# COVER NOTE

## 1. Procedural background

1. The Executive Board (hereinafter referred to as the Board) of the clean development mechanism (CDM), at its sixty-sixth meeting (paragraph 92 of the meeting report) requested the Methodologies Panel (Meth Panel) to assess methodologies for $N_20$ abatement from nitric acid production, taking into account the potential issue brought to the attention of the Board by the secretariat, including:

   (a) Clear identification of perverse incentives;

   (b) Providing analysis of the impact of the incentives in terms of emission reductions;

   (c) Providing a recommendation to the Board on how to address the issues.

2. The Board, at its sixty-ninth meeting (paragraph 82 of the meeting report) considered all the recommendations from the Meth Panel related to the methodologies for $N_2O$ emission reduction and, based on the further information provided during the meeting, the Board agreed not to approve the recommendations by the Meth Panel. The Board requested the Meth Panel to work further on these methodologies and report back for the consideration of the Board at a future meeting.

3. The draft revision of the approved methodology "ACM0019: $N_2O$ abatement from nitric acid production" also takes into consideration issues in response to the submission AM_REV_0245: request for revision of project emission calculation of "ACM0019: $N_2O$ abatement from nitric acid production".

4. The submission AM_REV_0245 was considered by the Meth Panel at its 58$^{th}$ meeting in accordance with the "Procedure for the submission and consideration of requests for revision of approved baseline and monitoring methodologies and tools for large scale CDM project activities" (EB 54, annex 2).

5. The Board at its seventieth meeting considered the Meth Panel recommendation to revise the consolidated methodology "ACM0019: $N_2O$ abatement from nitric acid production", to withdraw the methodologies "AM0034: Catalytic reduction of $N_2O$ inside the ammonia burner of nitric acid plants" and "AM0051: Secondary catalytic $N_2O$ destruction in nitric acid plants", and to revise "AM0028: $N_2O$ destruction in the tail gas of Caprolactam Production Plants". The Board agreed to request the Meth Panel to review all these methodologies in order to assess how their baselines impact incentives for project participants to implement and continue a CDM project activity.

## 2. Purpose

6. The purpose of the proposed revision is to improve existing regulations.

## 3. Key issues and proposed solutions

7. The draft revision:

   (a) Provides default emission factors that can be adopted at the renewal of the crediting period for project activities associated with currently using AM0028 and AM0034 for nitric acid production project activities;

   (b) Allows project participants to assume reductions as zero whenever the project emissions exceed the baseline emission benchmark;

   (c) Incorporates provisions from “AM0034: Catalytic reduction of $N_2O$ inside the ammonia burner of nitric acid plants” and “AM0051: Secondary catalytic $N_2O$ destruction”.

## 4. Impacts

8. The revision of the methodology, if approved, will help project proponents to accurately calculate the emission reductions.

9. The methodology was approved at EB 61 in June 2011 and no revision has been done so far. So far seven projects and no PoA have been registered applying this methodology. Twenty one projects and no PoAs are currently listed as under validation applying this methodology.

## 5. Proposed work and timelines

10. The proposed draft revision of the methodology is recommended by the Meth Panel to be considered by the Board at its seventy-third meeting. No further work is envisaged.

## 6. Recommendations to the Board

11. The Meth Panel recommends that the Board adopts the draft revised methodology.

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# 1. Introduction

1. The following table describes the key elements of the methodology:

**Table 1. Methodology key elements**

| | |
|---|---|
| **Typical projects** | Project activities that introduce $N_2O$ abatement measures in nitric acid plants can use this methodology |
| **Type of GHG emissions mitigation action** | Destruction of GHG.<br>Destruction of $N_2O$ emissions through abatement measures |

# 2. Scope, applicability, and entry into force

## 2.1. Scope

2. This methodology applies to project activities that introduce $N_2O$ abatement measures in nitric acid plants.

## 2.2. Selected approach from paragraph 48 of the CDM modalities and procedures

3. "Existing actual or historical emissions, as applicable".

## 2.3. Applicability

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4. The methodology is applicable under the following conditions:

(a) In the case that the nitric acid plant started commercial operation before the implementation of the CDM project activity, the project participants shall demonstrate that there was no secondary or tertiary $N_2O$ abatement technology installed in the respective nitric acid plant;

(b) Continuous real-time measurements of the $N_2O$ concentration and the total gas volume flow can be carried out in the tail gas stream after the abatement of $N_2O$ emissions throughout the crediting period of the project activity;

(c) No law or regulation which mandates the complete or partial destruction of $N_2O$ from nitric acid plants exists in the host country where the CDM project activity is implemented.

5. In addition, the applicability conditions included in the tools referred to above apply.

## 2.4. Entry into force

6. The date of entry into force of the revision is the date of the publication of the EB 73 meeting report on 31 May 2013.

# 3. References and any other information

7. This consolidated baseline and monitoring methodology is based on elements from the following approved baseline and monitoring methodologies and proposed new methodologies:

   (a) "NM0339: $N_2O$ abatement in New Capacity nitric acid plants" prepared by N.serve Environmental Services GmbH;

   (b) "NM0340: $N_2O$ abatement in New Nitric Acid Plants" prepared by Carbon Climate Protection GmbH and Enaex S.A.;

   (c) "AM0028: Catalytic $N_2O$ destruction in the tail gas of Nitric Acid or Caprolactam Production Plants, Version 05";

   (d) "AM0034: Catalytic reduction of $N_2O$ inside the ammonia burner of nitric acid plants, Version 04".

8. This methodology also refers to the latest approved versions of the following tools:

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

   (b) "Tool to calculate project or leakage $CO_2$ emissions from fossil fuel combustion".

9. For more information regarding the proposed new methodologies and the tools as well as their consideration by the Executive Board (hereinafter referred to as the Board) of the clean development mechanism (CDM)~~Executive Board~~ please refer to <http://cdm.unfccc.int/goto/MPappmeth>.

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# 4. Definitions

10. The definitions contained in the Glossary of CDM terms shall apply.

11. For the purpose of this methodology, the following definitions apply:

   (a) **Secondary $N_2O$ abatement** - Refers to the installation of a catalyst inside the ammonia burner unit with the sole purpose of removing $N_2O$ emissions from the stream;

   (b) **Tertiary $N_2O$ abatement** - Refers to the installation of an abatement system in the tail-gas leaving the absorption column of a nitric acid plant to destroy the $N_2O$ generated in the ammonia burner unit.

# 5. Baseline methodology

## 5.1. Identification of the baseline scenario and demonstration of additionality

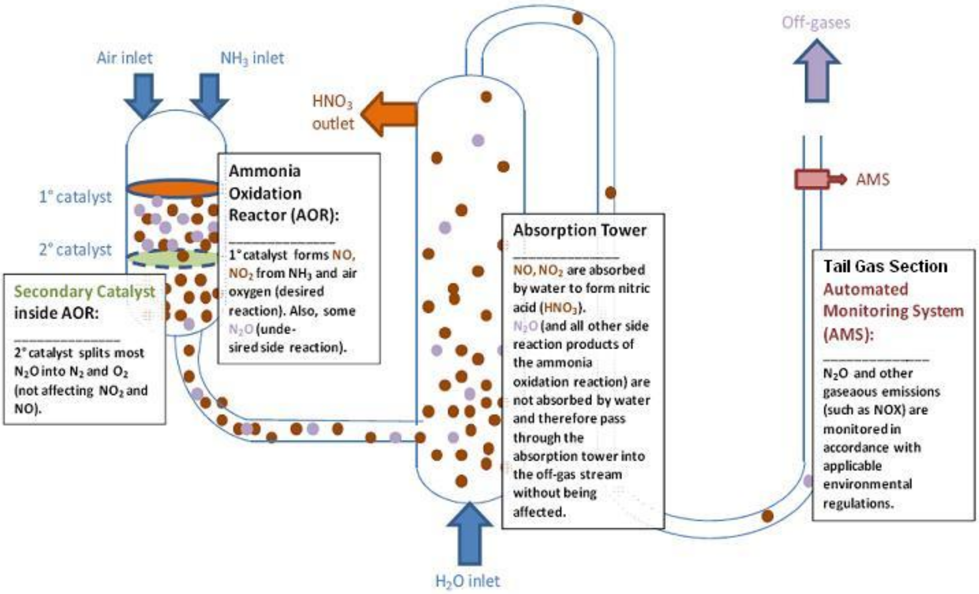
12. In the absence of regulations requiring the abatement of $N_2O$ emissions, the operator of the nitric acid plant has no economic incentives to take any $N_2O$ abatement measures because this entails capital and operating costs but no financial benefits. Therefore, the CDM project activity is considered additional and the baseline scenario is that the $N_2O$ is emitted to the atmosphere with no $N_2O$ abatement measure being implemented.

## 5.2. Project boundary

13. 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.

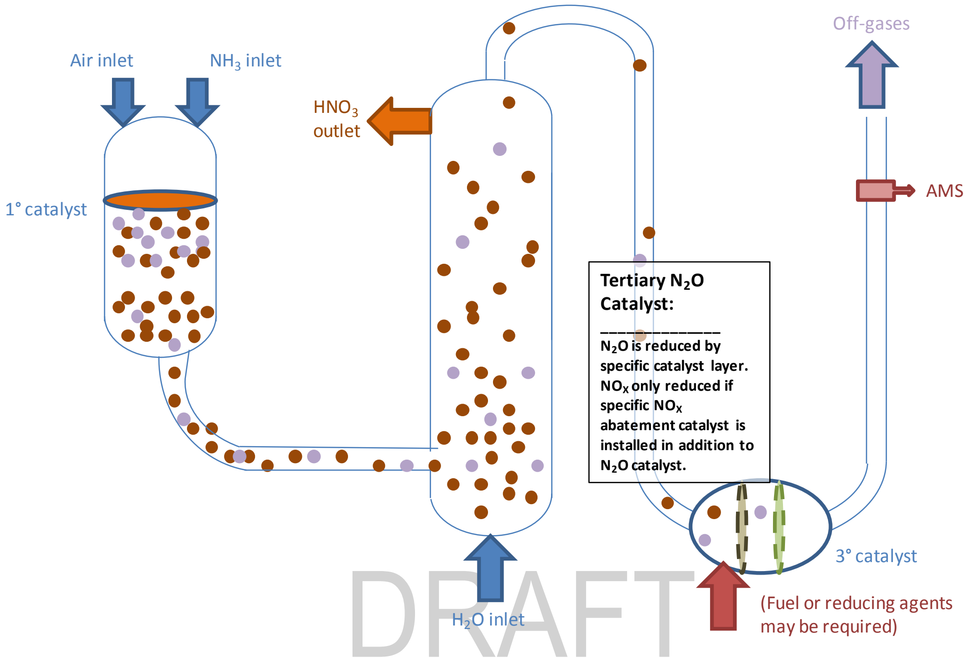
14. If the project activity introduces only secondary and no tertiary $N_2O$ abatement, then the only gas to be included as project emissions is the $N_2O$ that is not destroyed and is still present in the tail gas stream of the plant. The situation using a secondary abatement technology is illustrated below in Figure 1.

**Figure 1. Project boundary if the project activity includes ~~consists of~~ the introduction of a secondary $N_2O$ abatement measure (simplified standard nitric plant layout displaying the location of the $N_2O$ abatement catalyst, process sources of $N_2O$ and the sampling point location for the Automated Monitoring System (AMS))**




15. If the project activity introduces tertiary $N_2O$ abatement, then any remaining $N_2O$ emissions from the project plant and $CO_2$ emissions arising from the operation of the tertiary $N_2O$ abatement system are included as project emissions in the project boundary. The situation using a tertiary $N_2O$ abatement technology is illustrated below in Figure 2.

**Figure 2. Project boundary if the project activity includes ~~consists of~~ the introduction of a tertiary $N_2O$ abatement measure (simplified standard nitric plant layout displaying the location of the $N_2O$ abatement catalyst, process sources of $N_2O$ and the sampling point location for the Automated Monitoring System (AMS))**




16. The greenhouse gases included in or excluded from the project boundary are shown in Table 2.

**Table 2. Emission sources included in or excluded from the project boundary**

| Source | | Gas | Included | Justification/Explanation |
|---|---|---|---|---|
| Baseline | $NH_3$ 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 | |
| | | $N_2O$ | Yes | Included, main emission source |
| Project activity | $NH_3$ 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 | |
| | | $N_2O$ | Yes | Included, main emission source |
| | Operation of a tertiary $N_2O$ 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 $N_2O$ 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 | |
| | | $N_2O$ | Yes | Included |

## 5.3. Baseline emissions

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17. Baseline emissions are calculated as follows:

~~$$BE_n = P_{NA,n} \times EF_{BL,N2O,n} \times GWP_{N2O} \times 10^{-3} \quad (1)$$~~

~~Where:~~

| | | |
|---|---|---|
| ~~$BE_n$~~ | ~~=~~ | ~~Baseline emissions in monitoring period *n* (t $CO_2$e)~~ |
| ~~$P_{NA,n}$~~ | ~~=~~ | ~~Nitric acid produced in the monitoring period *n* (t $HNO_3$)~~ |
| ~~$EF_{BL,N2O,n}$~~ | ~~=~~ | ~~Baseline $N_2O$ emission factor for nitric acid production in the monitoring period *n* (kg N2O / t $HNO_3$)~~ |
| ~~$GWP_{N2O}$~~ | ~~=~~ | ~~Global Warming Potential of $N_2O$ valid for the commitment period~~ |

~~*Determination of the baseline $N_2O$ emission factor ($EF_{BL,N2O,n}$)*~~

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

18. 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:

$$BE_y = \begin{pmatrix} min\{P_{production,y};P_{product,max}\} \times EF_{existing,y} + \\ max\{P_{production,y} - P_{product,max};0\} \times EF_{new,y} \end{pmatrix} \times \frac{(h_y - h_{r,y})}{h_y} \times GWP_{N2O} \times 10^{-3}$$ 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 $HNO_3$) |
| $EF_{existing,y}$ | = | Default $N_2O$ emission factor for nitric acid plants that have used AM0028 or AM0034 in the first crediting period in year *y* (kg $N_2O$/t $HNO_3$) |
| $EF_{new,y}$ | = | Baseline $N_2O$ emission factor for nitric acid production in year *y* (kg $N_2O$/t $HNO_3$) |
| $GWP_{N2O}$ | = | Global Warming Potential of $N_2O$ 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:<br>(a) For secondary $N_2O$ abatement. Abatement system was not installed, underperforming or failed;<br>(b) For tertiary $N_2O$ abatement. The abatement system is by-passed, underperforming or failed |

### 5.3.2. Case 2: For other nitric acid plants

19. Baseline emissions are calculated as follows:

$$BE_y = P_{production,y} \times EF_{new,y} \times \frac{(h_y - h_{r,y})}{h_y} \times GWP_{N2O} \times 10^{-3}$$ Equation (2)

Where:

| | | |
|---|---|---|
| $BE_y$ | = | Baseline emissions in year *y* (t $CO_2$e) |
| $P_{production,y}$ | = | Production of nitric acid in year *y* (t $HNO_3$) |
| $EF_{new,y}$ | = | Baseline $N_2O$ emission factor for nitric acid production in year *y* (kg $N_2O$/t $HNO_3$) |
| $GWP_{N2O}$ | = | Global Warming Potential of $N_2O$ 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:<br>(a) For secondary $N_2O$ abatement. Abatement system was not installed, underperforming or failed;<br>(b) For tertiary $N_2O$ abatement. The abatement system is by-passed, underperforming or failed |

### 5.3.3. Calculation of $h_{r,y}$

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

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

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

Where:

| | | |
|---|---|---|
| $P_{NA,h}$ | = | Nitric acid produced in the hour *h* (t $HNO_3$) |
| $EF_{existing\ y}$ | = | Default $N_2O$ emission factor for nitric acid plants that have used AM0028 or AM0034 in the first crediting period in year *y* (kg $N_2O$/t $HNO_3$) |
| $F_{N2O,tail\ gas,h}$ | = | Mass flow of $N_2O$ in the gaseous stream of the tail gas in the hour *h* (kg $N_2O$/h) |

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#### 5.3.3.2. Case 2: For other nitric acid plants

$$F_{N2O,tail\ gas,h} > EF_{New,y} \times P_{NA,h} \qquad \text{Equation (4)}$$

Where:

| | | |
|---|---|---|
| $P_{NA,h}$ | = | Nitric acid produced in the hour *h* (t $HNO_3$) |
| $EF_{new,y}$ | = | Baseline $N_2O$ emission factor for nitric acid production in year *y* (kg $N_2O$/t $HNO_3$) |
| $F_{N2O,tail\ gas,h}$ | = | Mass flow of $N_2O$ in the gaseous stream of the tail gas in the hour h (kg $N_2O$/h) |

## 5.4. Project emissions

21. Project emissions include emissions of $N_2O$ which have not been destroyed by the project activity and, in case of the installation of a tertiary $N_2O$ abatement facility, $CO_2$ emissions resulting from the operation of the $N_2O$ abatement facility.

22. Project emissions are calculated as follows:

$$PE_y = PE_{N2O,y} + PE_{CO2,tertiary,y} \qquad \text{Equation (5)}$$

Where:

| | | |
|---|---|---|
| $PE_y$ | = | Project emissions in year *y* (t $CO_2$e) |
| $PE_{N2O,y}$ | = | Project emissions of $N_2O$ from the project plant in year *y* (t $CO_2$e) |
| $PE_{CO2,tertiary,y}$ | = | Project emissions of $CO_2$ from the operation of the tertiary $N_2O$ abatement facility in year *y* (t $CO_2$) |

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

23. The amount of $N_2O$ emissions from the project activity include two emission sources are the emissions from the $N_2O$ contained in the tail gas stream of the plant which is released to the atmosphere. and

(a) The $N_2O$ released to the atmosphere due to unusual reasons:

(i) In the case of secondary $N_2O$ abatement: the $N_2O$ contained in the tail gas stream of the plant when a secondary abatement facility underperforms or it is not installed inside the ammonia burner;

(ii) In the case of tertiary $N_2O$ abatement: the $N_2O$ contained in any by-pass streams to the tertiary $N_2O$ abatement facility. In some situations, the gas stream from the nitric acid plant may not be sent to the tertiary $N_2O$ abatement facility but may be directly vented to the atmosphere through a by-pass.

24. Accordingly, $PE_{N2O,y}$ is determined as follows:

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$$PE_{N2O,n} = (Q_{N2O,tail\ gas,n} + Q_{N2O,by-pass,n}) \times GWP_{N2O}$$ Equation (6)

$$PE_{N2O,y} = \sum_{1}^{h_y - h_{r,y}} F_{N2O,tail\ gas,h} \times GWP_{N2O} \times 10^{-3}$$

Where:

| | | |
|---|---|---|
| $PE_{N2O,y}$ | = | Project emissions of $N_2O$ from the project plant in year *y* (t $CO_2$e) |
| $Q_{N2O,tail\ gas,n}$ | = | Amount of $N_2O$ released through the tail gas of the project plant to the atmosphere in monitoring period *n* (t $N_2O$) |
| $Q_{N2O,by-pass,n}$ $Q_{N2O,released,n}$ | = | Amount of $N_2O$ released to the atmosphere due to unusual reasons in monitoring period *n* (t $N_2O$) |
| $GWP_{N2O}$ | = | Global warming potential of $N_2O$ valid for the commitment period |
| $F_{N2O,tail\ gas,h}$ | = | Mass flow of $N_2O$ in the gaseous stream of the tail gas in the hour *h* (kg $N_2O$/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:<br>(a) For secondary $N_2O$ abatement. Abatement system was not installed, underperforming or failed;<br>(b) For tertiary $N_2O$ abatement. The abatement system is by-passed, underperforming or failed |
| ~~$P_{production,y}$~~ | = | ~~Production of nitric acid in year y (t $HNO_3$)~~ |
| ~~$EF_{project,y}$~~ | = | ~~Project N2O emission factor for nitric acid production in the year y (kg $N_2O$ / t HNO3)~~ |

### 5.4.2. Determination of $F_{N2O,tail\ gas,h}$

25. The amount of $N_2O$ 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”.

26. In applying the tool, the following provisions apply:

(a) Throughout the crediting periods of the project activity, the $N_2O$ 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;

(b) The monitoring system should provide separate hourly average values for the $N_2O$ 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 $N_2O$ data sets shall be identified by means of a unique time/date key indicating when exactly the values were observed;

(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 $N_2O$ 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;

(d) If data for either the $N_2O$ 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 $N_2O$ concentration or volume or mass flow of the tail gas observed during the monitoring period. If data for neither the $N_2O$ 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 $N_2O$ 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

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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.

### 5.4.3. Project emissions from the operation of the tertiary $N_2O$ abatement facility ($PE_{CO2,tertiary,y}$)

27. This emission source only needs to be estimated if a tertiary $N_2O$ 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.

28. The emissions related to the operation of the $N_2O$ destruction facility include only on-site emissions due to the fossil fuel use as input to the $N_2O$ destruction facility:

$$PE_{CO2,tertiary,y} = PE_{FF,y} \quad \text{Equation (7)}$$

Where:

| | | |
|---|---|---|
| $PE_{CO2,tertiary,y}$ | = | Project emissions of $CO_2$ from the operation of the tertiary $N_2O$ abatement facility in year *y* (t $CO_2$) |
| $PE_{FF,y}$ | = | Project emissions related to fossil fuel input to the destruction facility and/or re-heater in year *y* (t $CO_2$) |

29. Project proponents shall use the latest version of the "Tool to calculate project or leakage $CO_2$ emissions from fossil fuel combustion" to calculate the project emissions related to fossil fuels used in year *y*.

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30. Specific guidance on the use of the tool:

(a) The parameter $PE_{FC,j,y}$ used in the "Tool to calculate project or leakage $CO_2$ 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 $N_2O$ abatement facility and/or the re-heating of the tail gas.

## 5.5. Leakage

31. Any leakage emissions sources are deemed to be negligible.

## 5.6. Emission reductions

32. Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad \text{Equation (8)}$$

Where:

| | | |
|---|---|---|
| $ER_y$ | = | Emission reductions in year *y* (t $CO_2$e) |
| $BE_y$ | = | Baseline emissions in year *y* (t $CO_2$e) |
| $PE_y$ | = | Project emissions in year *y* (t $CO_2$e) |

## 5.7. Data and parameters not monitored

33. In addition to the parameters listed in section 5.7, the provisions on data and parameters not monitored in the tools referred to in this methodology apply.

**Data / Parameter table 1.**

| **Data / Parameter:** | **Operating pressure** |
|---|---|
| Data unit: | KPa |
| Description: | Operating pressure of the ammonia burner |
| Source of data: | Manufacturer specifications |
| Measurement procedures (if any): | None |
| Monitoring frequency: | - |
| QA/QC procedures: | The parameter is used to determine whether the nitric acid plant operates at a low, medium or high pressure |
| Any comment: | - |

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**Option 1**

**Data / Parameter table 2.**

| **Data / Parameter:** | $EF_{existing, y}$ |
|---|---|
| Data unit: | kg $N_2O$/t $HNO_3$ |
| Description: | Default $N_2O$ emission factor (for nitric acid plants that have used AM0028 or AM0034 in the first crediting period) in the calendar year *y* of the monitoring period *y* (related to 100 per cent pure acid) |

| | |
|---|---|
| Source of data: | This default $N_2O$ baseline emission factor will vary every year. In year 2012 the emission factors will be 4.4; 5.9; and 8.2 kg $N_2O$/t $HNO_3$ for low, medium and high pressure ammonia burners and they will decrease every year by 0.2 kg $N_2O$/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: |

| Year | Low pressure (0 – 200 kPa) | Medium pressure (200 – 600kPa) | High pressure (Over 600 kPa) |
|---|---|---|---|
| 2012 | 4.4 | 5.9 | 8.2 |
| 2013 | 4.2 | 5.7 | 8,0 |
| 2014 | 4.0 | 5.5 | 7.8 |
| 2015 | 3.8 | 5.3 | 7.6 |
| 2016 | 3.6 | 5.1 | 7.4 |
| 2017 | 3.4 | 4.9 | 7.2 |
| 2018 | 3.2 | 4.7 | 7.0 |
| 2019 | 3.0 | 4.5 | 6.8 |
| 2020 | 2.8 | 4.3 | 6.6 |
| 2021 | 2.6 | 4.1 | 6.4 |
| 2022 | 2.4 | 3.9 | 6.2 |
| 2023 | 2.4 | 3.7 | 6.0 |
| 2024 | 2.4 | 3.5 | 5.8 |
| 2025 | 2.4 | 3.3 | 5.6 |
| 2026 | 2.4 | 3.1 | 5.4 |
| 2027 | 2.4 | 2.9 | 5.2 |
| 2028 | 2.4 | 2.7 | 5.0 |
| 2029 | 2.4 | 2.5 | 4.8 |
| 2030 | 2.4 | 2.5 | 4.6 |

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| | |
|---|---|
| Measurement procedures (if any): | None |
| Monitoring frequency: | - |
| QA/QC procedures: | - |
| Any comment: | The decrease in the value for the baseline emission factor over time is to reflect the technological development |

**Option 2**

| **Data / Parameter:** | **$EF_{existing, y}$** |
|---|---|
| Data unit: | kg $N_2O$/t $HNO_3$ |
| Description: | Default $N_2O$ emission factor (for nitric acid plants that have used AM0028 or AM0034 in the first crediting period) in the calendar year *y* of the monitoring period *y* (related to 100 per cent pure acid) |

| | |
|---|---|
| Source of data: | This default $N_2O$ baseline emission factor will vary every year. In year 2013 the emission factors will be 5.0; 7.0; and 9.0 kg $N_2O$/t $HNO_3$ for low, medium and high pressure ammonia burners and they will decrease every year by 0.2 kg $N_2O$ / 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: |

| **Year** | **Low pressure (0 – 200 kPa)** | **Medium pressure (200 – 600kPa)** | **High pressure (Over 600 kPa)** |
|---|---|---|---|
| 2013 | 5 | 7 | 9 |
| 2014 | 4.8 | 6.8 | 8.8 |
| 2015 | 4.6 | 6.6 | 8.6 |
| 2016 | 4.4 | 6.4 | 8.4 |
| 2017 | 4.2 | 6.2 | 8.2 |
| 2018 | 4 | 6 | 8 |
| 2019 | 3.8 | 5.8 | 7.8 |
| 2020 | 3.6 | 5.6 | 7.6 |
| 2021 | 3.4 | 5.4 | 7.4 |
| 2022 | 3.2 | 5.2 | 7.2 |
| 2023 | 3 | 5 | 7 |
| 2024 | 2.8 | 4.8 | 6.8 |
| 2025 | 2.6 | 4.6 | 6.6 |
| 2026 | 2.4 | 4.4 | 6.4 |
| 2027 | 2.4 | 4.2 | 6.2 |
| 2028 | 2.4 | 4 | 6 |
| 2029 | 2.4 | 3.8 | 5.8 |
| 2030 | 2.4 | 3.6 | 5.6 |

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| | |
|---|---|
| Measurement procedures (if any): | None |
| Monitoring frequency: | - |
| QA/QC procedures: | - |
| Any comment: | The decrease in the value for the baseline emission factor over time is to reflect the technological development |

**Data / Parameter table 3.**

| **Data / Parameter:** | ~~$EF_{new,y}$~~ $EF_{default,y}$ |
|---|---|
| Data unit: | kg $N_2O$/t $HNO_3$ |
| Description: | Default $N_2O$ baseline emissions factor in the calendar year *y* of the monitoring period *y* (related to 100 per cent pure acid) |

<table>
<tr><td>Source of data:</td><td>The default $N_2O$ baseline emission factor 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:
<table>
<tr><th>Year</th><th>Emission factor ($kgN_2O/t$ HNO3)</th></tr>
<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>
</table></td></tr>
<tr><td>Measurement procedures (if any):</td><td>None</td></tr>
<tr><td>Any comment:</td><td>The decrease in the value for the baseline emission factor over time is to reflect the technological development</td></tr>
</table>

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**Data / Parameter table 4.**

| | |
|---|---|
| **Data / Parameter:** | $P_{product,max}$ |
| Data unit: | t Product |
| Description: | Design capacity of nitric acid production during the first crediting period |
| Source of data: | Project operator and/or technology provider |
| Measurement procedures (if any): | - |
| Monitoring frequency: | - |
| QA/QC procedures: | - |
| Any comment: | This parameter is only for project activities applying case 1 |

**Data / Parameter table 5.**

| **Data / Parameter:** | **$GWP_{N2O}$** |
|---|---|
| Data unit: | t $CO_2$e/t $N_2O$ |
| Description: | Global warming potential of $N_2O$ valid for the commitment period |
| Source of data: | Relevant decisions by the CMP |
| Measurement procedures (if any): | None |
| Monitoring frequency: | - |
| QA/QC procedures: | - |
| Any comment: | - |

# 6. Monitoring methodology

## 6.1. Archival of monitoring information

34. All data collected as part of monitoring should be archived electronically and be kept at least for two years after the end of the last crediting period. One hundred per cent of the data should be monitored if not indicated otherwise in the tables below. All measurements should be conducted with calibrated measurement equipment according to relevant industry standards.

35. In addition, the monitoring provisions in the tools referred to in this methodology apply.

## 6.2. Data and parameters monitored

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**Data / Parameter table 6.**

| **Data / Parameter:** | **$P_{production, y}$** |
|---|---|
| Data unit: | t $HNO_3$ |
| Description: | Nitric acid produced in year *y* |
| Source of data: | Measurements by project participants and production reports |
| Measurement procedures (if any): | - |
| Monitoring frequency: | Every monitoring period |
| QA/QC procedures: | Measurement devices such as weight scales shall follow QA/QC supplier recommendations |
| Any comment: | - |

**Data / Parameter table 7.**

| **Data / Parameter:** | **~~$h_n$~~ $h_y$** |
|---|---|
| Data unit: | H |
| Description: | Number of hours of operation in year *y* |
| Source of data: | Measured |
| Measurement procedures (if any): | - |

| | |
|---|---|
| Monitoring frequency: | Every monitoring period |
| QA/QC procedures: | - |
| Any comment: | Records to be maintained during project's lifetime |

**Data / Parameter table 8.**

| **Data / Parameter:** | ~~$h_{r,n}$~~ $h_{r,y}$ |
|---|---|
| Data unit: | h |
| Description: | Number of hours (*h*) in year *y* where:<br>(a) For secondary $N_2O$ abatement. Abatement system was not installed, underperforming or failed;<br>(b) For tertiary $N_2O$ abatement. The abatement system is by-passed, underperforming or failed |
| Source of data: | Measured |
| Measurement procedures (if any): | - |
| Monitoring frequency: | Every monitoring period |
| QA/QC procedures: | - |
| Any comment: | Records to be maintained during project's lifetime |

**Data / Parameter table 9.**

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| ~~**Data / Parameter:**~~ | ~~$T_{released,n}$ $T_{open,n}$~~ |
|---|---|
| ~~Data unit:~~ | ~~hours %~~ |
| ~~Description:~~ | ~~Number of hours where the $N_2O$ was released to the atmosphere for unusual reason in monitoring period *n*~~<br><br>~~Fraction of time in monitoring period n during which the by-pass valve on the line feeding the tertiary $N_2O$ abatement facility was open to vent the gas directly to the atmosphere~~ |
| ~~Source of data:~~ | ~~Measured~~ |
| ~~Measurement procedures (if any):~~ | ~~-~~ |
| ~~Monitoring frequency:~~ | ~~Every monitoring period~~ |
| ~~QA/QC procedures:~~ | ~~-~~ |
| ~~Any comment:~~ | ~~$T_{released,n}$ cannot occur for more than 48 hours continuously and it only can occur for a maximum of 168 hours per year~~ |

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## Document information

| *Version* | *Date* | *Description* |
|---|---|---|
| 02.0 | 9 May 2013 | MP 59, Annex 3<br>To be considered by EB 73.<br>The revision:<br>• Provides default emission factors that can be adopted at the renewal of the crediting period for projects currently using AM0028 and AM0034 for nitric acid production project activities;<br>• Allows project participants to assume reductions as zero whenever the project emissions exceed the baseline emission benchmark;<br>• Incorporates provisions from “AM0034: Catalytic reduction of $N_2O$ inside the ammonia burner of nitric acid plants” and “AM0051: Secondary catalytic $N_2O$ destruction”. |
| 01.0.0 | 3 June 2011 | EB 61, Annex 4<br>Initial adoption. |

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