PROPOSED NEW BASELINE AND MONITORING METHODOLOGY OR METHODOLOGICAL TOOL FORM FOR EMISSION REDUCTIONS ACTIVITIES
(Version 02.0)

INFORMATION TO BE COMPLETED BY THE SECRETARIAT AND METHODOLOGIES EXPERT PANEL	
Type of standard	Choose an item.
Unique reference number and title of the proposed new methodology or new methodological tool	>>
Date when this form was received at UNFCCC secretariat:	Click or tap to enter a date.
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SECTION A.	Summary and applicability of the baseline and monitoring methodology or methodological tool

A.1. Title, submission date and version

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Title: N_2O abatement from nitric acid production

Submission date: 25/08/2025

Version: 02.1

A.2. If this methodology or methodological tool is based on a previous submission or an approved Article 6.4 mechanism methodology or methodological tool, please state the reference numbers here. Explain briefly the main differences and their rationale.

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This methodology is based on previously submitted proposed methodology A6.4-PNM002. The main differences between the versions are to reflect and follow the newly published standards and forms.

A.3. Summary description of the methodology or methodological tool, including major baseline and monitoring methodological steps.

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The baseline for N_2O emissions is calculated based on the amount of N_2O produced per ton of nitric acid (HNO_3) produced, following typical industry practice in the absence of abatement technology. The baseline considers pre-existing practices and the contribution of N_2O emissions that would otherwise be vented into the atmosphere without mitigation efforts.

Activity participants shall calculate the difference between the baseline emissions and the business-as-usual (BAU) emissions as an annual and total amount with respect to the crediting period, and shall choose one of the baseline scenarios that are given by the methodology.

All data collected as part of monitoring should be archived electronically and be kept for two years after the end of the crediting period. One hundred per cent of the data should be monitored. All measurements should be conducted with calibrated measurement equipment according to relevant industry standards.

<u>Pre-Activity Scenario Description</u>

Mechanism methodology requires activity participants to describe the pre-activity scenario in the Project Design Document (PDD). The pre-activity scenario must reflect the actual conditions at the project site right before the implementation of the N_2O abatement under the Article 6.4 project activity. This includes, but is not limited to:

a) The type of nitric acid production process (e.g., pressure type);

b) Confirming that neither a secondary nor tertiary N_2O abatement technology or a combination of them is installed at the nitric acid plant at the start date of the Article 6.4 project activity (if applicable).

If relevant, the scenario must also account for policies or regulations that formally integrate the Article 6.4 Mechanism as an implementation tool. In the absence of such policies, the pre-activity scenario is assumed to reflect business-as-usual operations without abatement.

SECTION B.	Proposed new baseline and monitoring methodology or methodological tool

1. Introduction

1. The following table presents a summary of the key elements of a methodology:

Table 1. Methodology key elements

Type of GHG mitigation measure(s)	☐ Fuel/feedstock switch ☐ Technology switch ☒ GHG destruction ☐ GHG formation avoidance ☐ Engineered carbon dioxide removal ☐ Nature based carbon dioxide removal
Types of mitigation outcomes achieved under this methodology	☒ Emission reductions ☐ Removals
Are the mitigation outcomes under this methodology at risk of reversal?	☐ Yes ☒ No
Typical projects eligible under the methodology	Project activities that introduce N_2O abatement measures in nitric acid plants can use this mechanism methodology

2. Scope 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. Entry into force

3.

2.3. Applicability of sectoral scopes

4. Designated operational entities validating and verifying Article 6.4 activities that use this methodology shall apply sectoral scope(s):

3. Definitions

5. In addition to the definitions contained in the 'Article 6.4 mechanism Glossary of Terms', the following definitions apply for the purpose of this methodology:

(a) **Existing nitric acid plant** refers to a plant with the start of commercial operation on or before the date of initial submission of the proposed methodology A6.4-PNM002, i.e. 12/05/2025;

(b) **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;

(c) **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.

4. Normative references

6. This proposed baseline and monitoring methodology is based on the following proposed new methodologies and/or approved or consolidated methodologies:

    (a) Large-scale consolidated CDM methodology: ACM0019: N_2O abatement from nitric acid production, version 04.0

7. This methodology also refers to the latest approved versions of the following methodological tools[1]:

    (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

    (c) Article 6.4 Sustainable development tool

8. This methodology is based on the following sources of information:

    (a) IPCC 2019 Refinement to the 2006 IPCC Guidelines for National GHG Inventories[2] (hereinafter called "IPCC 2019")[3]

    (b) Relevant decisions by the CMA (e.g. Global warming potential of N_2O)

5. Applicability

9. This methodology applies to existing[4] nitric acid plants only and to following technologies:

    (a) Secondary N_2O abatement technology (e.g., catalyst in ammonia burner);

    (b) Tertiary N_2O abatement technology (e.g., selective catalytic reduction unit);

    (c) A combination of secondary and tertiary N_2O abatement system, installed simultaneously at the Article 6.4 project activity start date.

10. Further, this methodology is applicable under the following conditions:

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[1] Some of these tools are currently under development by the MEP and shall be applied once adopted.

[2] https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/3_Volume3/19R_V3_Ch03_Chemical_Industry.pdf

[3] In accordance with RMP 36(ii), where a Host Party has established a baseline emission factor for nitric acid production, it shall be applied, if it is more conservative than the IPCC 2019 emission factor.

[4] As defined by this methodology; Please refer to section 3 for details!

(a) Activity participants shall demonstrate that the nitric acid plant started commercial operation before the implementation of the Article 6.4 project activity, and that no secondary or tertiary N_2O abatement technology or a combination of them was installed in the respective nitric acid plant at project start date of the Article 6.4 project activity.

Activity participants shall demonstrate the incentive provided by participating in the the Article 6.4 mechanism by confirming that the N_2O abatement system was never installed in any nitric acid plant, and that no emission reductions were previously claimed for the same period or equipment.

(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 Article 6.4 project activity.

(c) No law or regulation, which mandates the destruction of N_2O from nitric acid plants exists in the host country, where the Article 6.4 project activity is implemented.[5]

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

12. Each applicability condition shall be assessed once at the initial validation of the Article 6.4 project activity or, where the required information is not yet available, at the first verification of the Article 6.4 project activity.

6. Avoidance of double-counting

13. In order to avoid any double-counting, this mechanism methodology requires:

(a) A Host Party confirmation that the same N_2O emission reductions are not claimed under mandatory domestic mitigation schemes or other domestic frameworks,

(b) A confirmation from the activity participants that the same N_2O emission reductions from the respective nitric acid plant already covered by mandatory schemes are not claimed,

(c) A confirmation from the activity participants that the same N_2O emission reductions from the respective nitric acid plant are not claimed under any other national or international environmental markets.

7. Demonstration of alignment with the policies, options and implementation plans with regard to the NDC and LT-LEDS of the host Party and the long-term temperature goal of the Paris Agreement and long-term goals of the Paris Agreement

14. Activity participants shall provide to the DOE responsible to perform the validation of the Article 6.4 project an assessment, undertaken by the DNA of the host Party, of the activity's consistency with Decision 3/CMA.3 paragraph 40 (c) and paragraph 27 (a) as part of the host Party's approval.

[5] The validity of the original baseline shall be reassessed at the time of each renewal of crediting period.

8. Activity Boundary

15. The activity boundary is defined at the methodology level. 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.

16. Activity participants shall delineate the geographical boundary of the Article 6.4 project activity using a recognized coordinate system, and shall submit its location in the form of KML-files or equivalent formats.

17. If the Article 6.4 project activity introduces only secondary and no tertiary N_2O abatement, then the only gas to be included as activity emissions is the N_2O that is not destroyed and is still present in the tail gas stream of the plant. The secondary N_2O abatement takes place in the ammonia oxidation reactor (AOR). The situation using a secondary abatement technology is illustrated below in Figure 1.

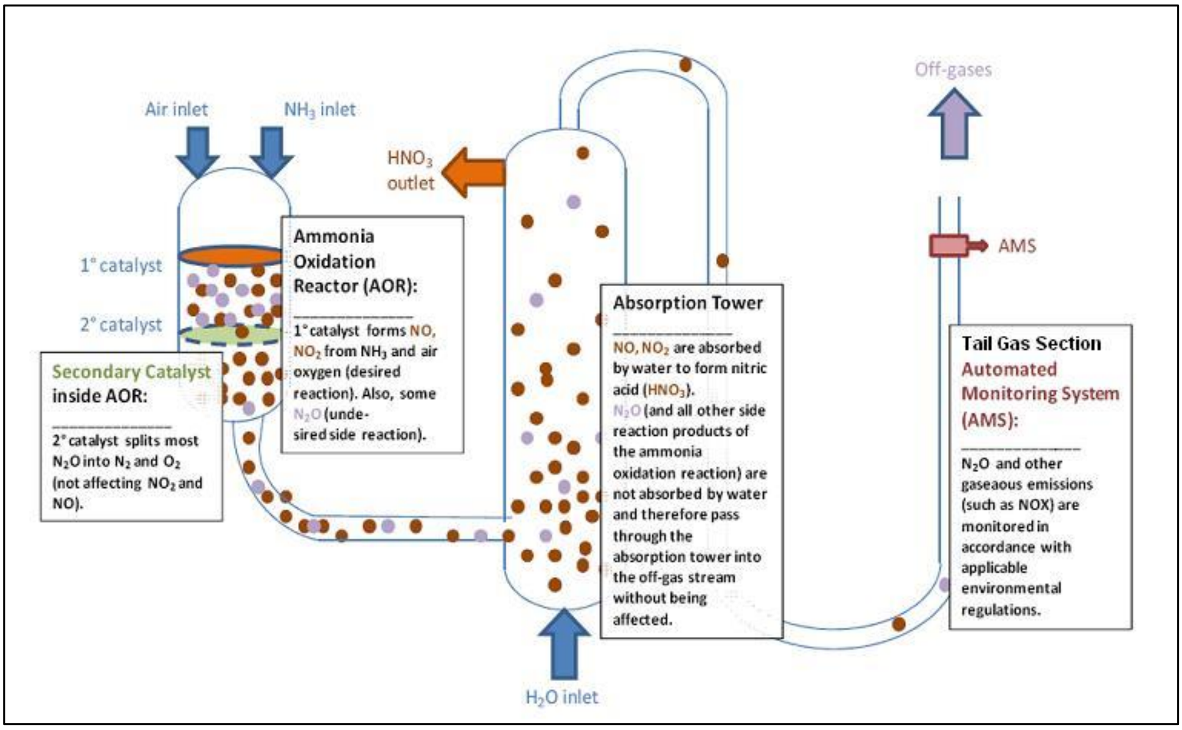

Figure 1. Project boundary if the Article 6.4 project activity includes the introduction of a secondary N_2O abatement measure (simplified standard nitric plant layout displaying the location of the N_2O abatement catalyst, process sources of N_2O and the sampling point location for the Automated Monitoring System (AMS))

18. If the Article 6.4 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 activity emissions in the project boundary. The tertiary N_2O abatement takes place in the tail gas stream. The situation using a tertiary N_2O abatement technology is illustrated below in Figure 2.

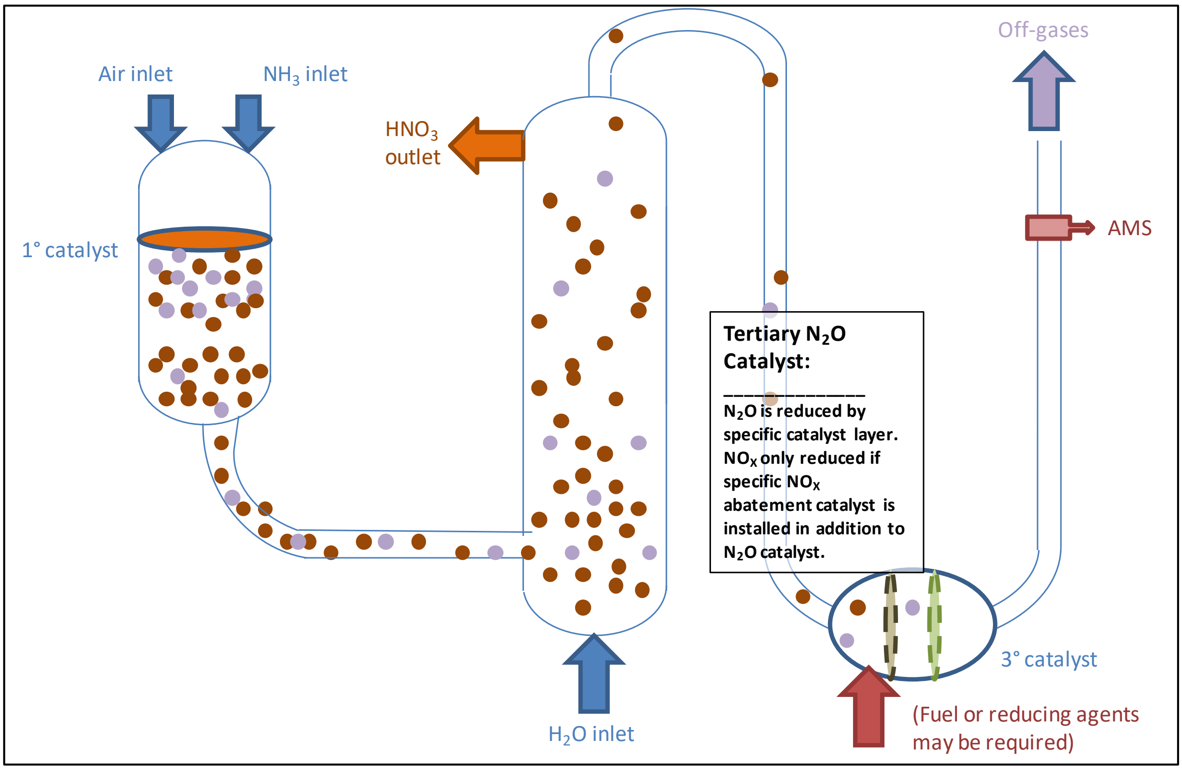

Figure 2. Project boundary if the Article 6.4 project activity includes the introduction of a tertiary N_2O abatement measure (simplified standard nitric plant layout displaying the location of the N_2O abatement catalyst, process sources of N_2O and the sampling point location for the Automated Monitoring System (AMS))

19. If the Article 6.4 project activity introduces a combination of secondary and tertiary N_2O abatement, the gas to be included as activity emissions in the project boundary is the N_2O that is not destroyed and is still present in the tail gas stream of the plant, and CO_2 emissions arising from the operation of the tertiary N_2O abatement system. The secondary N_2O abatement takes place in the AOR, while the tertiary N_2O abatement takes place in the tail gas stream. The situation using a combined operation of secondary and tertiary N_2O abatement technology is illustrated below in Figure 3.

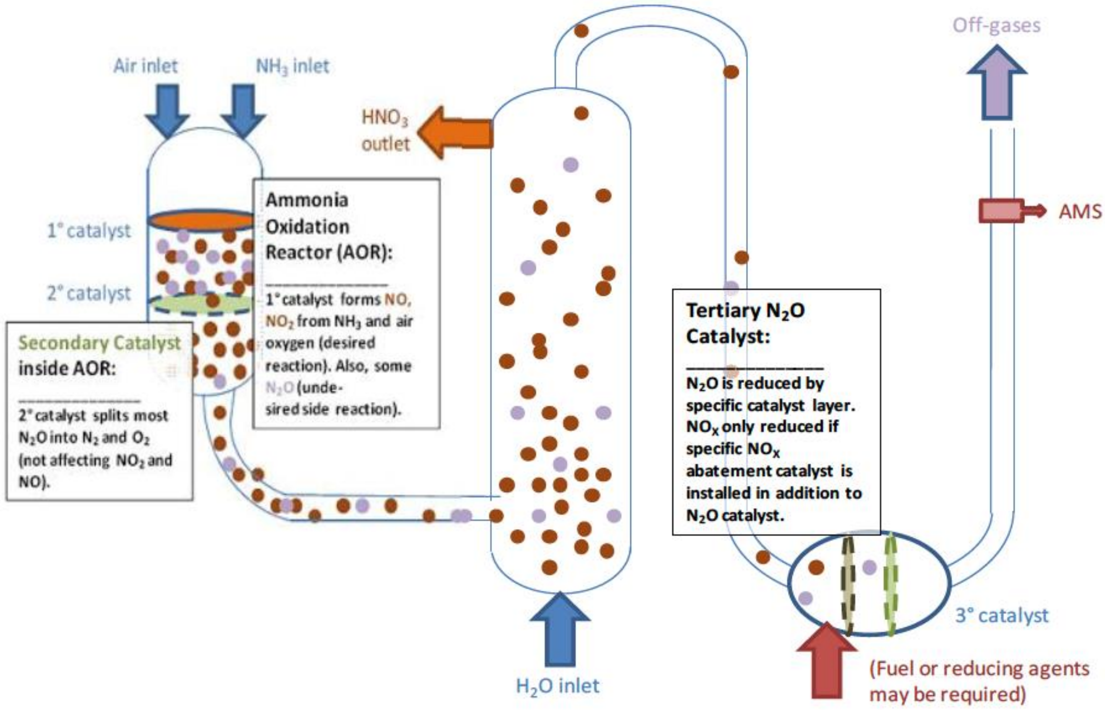

Figure 3. Project boundary if the Article 6.4 project activity includes a combination of secondary and tertiary N_2O abatement measure (simplified standard nitric plant layout displaying the location of the N_2O abatement catalyst, process sources of N_2O and the sampling point location for the AMS)

Table 2. Emissions sources and sinks included in or excluded from the activity boundary

Source		GHG[6]			Justification / Explanation
BASELINE	NH_3 oxidation at the primary catalyst gauze	CO_2	☐ Included ☒ Not included	☐ Controlled ☐ Related to ☐ Affected by	The Article 6.4 project activity has no influence on these types of emissions, if present.
		CH_4	☐ Included ☒ Not included	☐ Controlled ☐ Related to ☐ Affected by	
		N_2O	☒ Included ☐ Not included	☐ Controlled ☒ Related to ☐ Affected by	Included, main emission source
ACTIVITY	NH_3 oxidation at the primary catalyst gauze	CO_2	☐ Included ☒ Not included	☐ Controlled ☐ Related to ☐ Affected by	The Article 6.4 project activity has no influence on these types of emissions, if present.
		CH_4	☐ Included ☒ Not included	☐ Controlled ☐ Related to ☐ Affected by	
		N_2O	☒ Included ☐ Not included	☒ Controlled ☐ Related to ☐ Affected by	Included, main emission source

[6] Refer to Appendix 1 of A6.4-STAN-AC-002 and A6.4-STAN-AC-004.

Source		GHG[6]			Justification / Explanation
	Operation of a tertiary N_2O abatement facility	CO_2	☒ Included ☐ Not included	☒ Controlled ☐ Related to ☐ Affected by	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 negligible and not taken into account.
		CH_4	☐ Included ☒ Not included	☐ Controlled ☐ Related to ☐ Affected by	
		N_2O	☒ Included ☐ Not included	☒ Controlled ☐ Related to ☐ Affected by	Included
	Transport of equipment and catalysts	CO_2	☐ Included ☒ Not included	☐ Controlled ☐ Related to ☐ Affected by	CO_2 emissions arising from the transport of equipment and catalysts are assumed to be negligible and not taken into account.
		CH_4	☐ Included ☒ Not included	☐ Controlled ☐ Related to ☐ Affected by	
		N_2O	☐ Included ☒ Not included	☐ Controlled ☐ Related to ☐ Affected by	
		CH_4	☐ Included ☒ Not included	☐ Controlled ☐ Related to ☐ Affected by	
		N_2O	☐ Included ☒ Not included	☐ Controlled ☐ Related to ☐ Affected by	
LEAKAGE	Any leakage emissions sources are deemed to be negligible.	CO_2	☐ Included ☒ Not included	☐ Controlled ☐ Related to ☐ Affected by	-
		CH_4	☐ Included ☒ Not included	☐ Controlled ☐ Related to ☐ Affected by	
		N_2O	☐ Included ☒ Not included	☐ Controlled ☐ Related to ☐ Affected by	
		-----	☐ Included ☒ Not included	☐ Controlled ☐ Related to ☐ Affected by	

9. Demonstration of additionality

9.1. Regulatory analysis

21. The activity participants shall submit an analysis of legal requirements in the host country based on credible and current evidence. The analysis shall demonstrate and justify that the emission reductions resulting from the Article 6.4 project activity would not occur as a result of any legal requirement (including laws and regulations), legally binding decisions (such as licenses or permits), and other local, regional or national enforceable obligations requiring the abatement of N_2O, unless such legal requirement explicitly refers to or formally integrates the Article 6.4 mechanism as a means of implementation.

22. The regulatory analysis shall be conducted at each renewal of the crediting period or at least every five years, to ensure continued additionality.

9.2. Avoidance of locking-in the level of emissions

23. The lifetime of an N_2O abatement technology is longer than the crediting period of an Article 6.4 project activity. Therefore:

- The host country will benefit from the installed N_2O abatement technology even beyond the end of the Article 6.4 project activity´s crediting period.
- The Article 6.4 project activity does not lead to the adoption or the prolongation of the lifetime of technologies or practices that are incompatible with long term goals of the Paris Agreement, taking into account different national circumstances, approaches and pathways; instead, it supports a transition toward low-emission development, aligns with the Host Party's NDC.
- This mechanism methodology has been developed based on actual and reliable data of nitric acid plants taking into consideration the technologies, which achieve lower N_2O emission levels. This leads to lower emissions nationally and globally and contributes to achieve the long-term goals of the Paris Agreement. Hence, it can be ensured that crediting levels won´t undermine the host country's achievement of NDCs and Long-term Low-Emission Development Strategy (LT-LEDS).

24. An analysis of the lock-in risk shall be conducted acc. to the tool[7].

9.3. Investment analysis, Barrier analysis and Common practice analysis

9.3.1. Investment analysis

25. In the absence of regulations requiring the abatement of N_2O emissions in the host country, the operator of a nitric acid plant has no economic incentives to take any N_2O abatement measures, because this would entail significant capital and operating costs, but no financial benefits. Hence, the income from selling certified and approved emission reductions generated by an Article 6.4 project activity is the only income stream and motivation for an operator of a nitric acid plant to invest in an N_2O abatement measure.

26. Therefore, the Article 6.4 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.

9.3.2. Barrier analysis

27. Not applicable.

9.3.3. Common practice analysis

28. Activity participants shall perform a simple common practice analysis for the region, where the Article 6.4 project activity is situated.

[7] Tool is currently under development by the MEP and shall be applied once adopted.

9.4. Performance-based approach

29. Not applicable.

10. Baseline scenario

10.1. Selection of the baseline approaches from paragraph 36 of the rules, modalities and procedures

☐ Best available technologies that represent an economically feasible and environmentally sound course of action, where appropriate.

☒ An ambitious benchmark approach where the baseline is set at least at the average emission level of the best performing comparable activities providing similar outputs and services in a defined scope in similar social, economic, environmental and technological circumstances.

☐ An approach based on existing actual or historical emissions, adjusted downwards to ensure alignment with paragraph 33 of the RMP.

30. Justification of choice: Basis for determining conservative baseline emissions are the default N_2O emission factors as per *IPCC 2019 Refinement to the 2006 IPCC Guidelines for National GHG Inventories*, which distinguish different pressure types of nitric acid plants. An ambitious benchmark for the baseline N_2O emission factor is reached, when the given lower uncertainty is considered. Therefore, mitigation activities using these emission factors might receive fewer credits than they reduce emissions, resulting in a net mitigation benefit.

10.2. Application of the selected approach, prior to implementation of a downward adjustment

10.2.1. Procedure for the identification of the baseline scenario

31. Ambitious benchmark approach is applied based on the N_2O emission factors under consideration of the lower uncertainty given by the IPCC 2019 guidelines:

Activity NA plant		**N_2O emission factor** [kg N_2O / t HNO_3][8]	**Conservative uncertainty** [%]	**Baseline N_2O emission factor** [kg N_2O / t HNO_3]
Singel pressure	Low pressure	5.00	-10	4.50
	Medium pressure	8.00	-20	6.40
	High pressure	9.00	-40	5.40
Dual pressure	L/M	7.00	-20	5.60
	M/H	9.00	-30	6.30

32. In accordance with RMP 36(ii), where a Host Party has established a baseline emission factor for nitric acid production, it shall be applied, if it is more conservative than the IPCC 2019 emission factor.

33. The following alternatives for the baseline scenario must be considered:

[8] Reference: IPCC 2019

(a) Scenario 1: Continued N_2O emissions without any abatement
In the absence of legal 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 significant capital and operating costs, but no financial benefits.

(b) Scenario 2: Installation and operation of secondary abatement technology to reduce N_2O emissions

(c) Scenario 3: Installation and operation of tertiary abatement technology to reduce N_2O emissions

(d) Scenario 4: Installation and operation of a combination of secondary and tertiary abatement technology to reduce N_2O emissions

34. Activity participants shall identify and list, which of these alternatives comply with mandatory regulations for nitric acid production, air emission standards, or other relevant regulatory frameworks in the Host Party. Where Scenario 1 is not a plausible alternative and either secondary and/or tertiary abatement is the most likely alternative, the Article 6.4 project activity is not considered additional. Where Scenario 1 is the most plausible scenario, it is identified as the baseline scenario, and activity participants shall proceed with the additionality analysis.

35. The methodology introduces a nitric acid production cap to ensure that emission reductions are only credited for output that reflects business-as-usual condition, and to avoid perverse incentives to produce more nitric acid than without the Article 6.4 project activity. The cap shall be based on the designed daily production capacity of the nitric acid plant (t HNO_3/day) as documented in plant design specifications.

10.2.2. Calculation of baseline emissions prior to downward adjustment

36. Unadjusted baseline emissions are calculated as follows:

$$BE_{unadj,y} = min\left(P_{production,y}\colon P_{product,max}\right) * (1 - UNC_P) * EF_y * \frac{\left(h_y - h_{r,y}\right)}{h_y} * GWP_{N2O} * 10^{-3} \qquad \text{Equation (1)}$$

Where:

$BE_{unadj,y}$	=	Unadjusted baseline emissions in year *y* (t CO_2e)
$P_{production,y}$	=	Production of nitric acid in year *y* (t HNO_3)
$P_{product,max}$	=	Design capacity of nitric acid production (t HNO_3)
UNC_P	=	Uncertainty of nitric acid production (fraction)
EF_y	=	Conservative baseline N_2O emission factor acc. to the operating pressure of the ammonia burner 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: a) Secondary N_2O abatement system was not installed, underperforming or failed; b) Tertiary N_2O abatement system is by-passed, underperforming or failed

Calculation of $h_{r,y}$

37. An abatement system is deemed to be by-passed, not working, underperforming or failed in the hour h in year y if:

$$F_{N2O,tail\ gas,h} > EF_y \times P_{NA,h} \qquad \text{Equation (2)}$$

Where:

$P_{NA,h}$	=	Nitric acid produced in the hour *h* (t HNO_3)
EF_y	=	Conservative baseline N_2O emission factor acc. to the operating pressure of the ammonia burner in year *y* (kg N_2O/t HNO_3)
$F_{N2O,tailgas,h}$	=	Mass flow of N_2O in the gaseous stream of the tail gas in hour *h* (kg N_2O/h)

10.3. Calculation of the downward adjusted baseline

38. The adjusted baseline emissions ($BE_{adj,y}$) are calculated by using Equation (1) above and by considering the following instructions for the downward adjustment:

    (a) 1% annual downward adjustment (*DA*) shall be applied to baseline emissions for each year after the first crediting year.

    (b) The annual increase in the downward adjustment (*DAi*) shall correspond to at least 1% of the baseline emissions in the calendar year of the start date of the first crediting period.

    (c) Each calendar year *y* lasts from 1.1. – 31.12. and the downward adjustment will be applied accordingly.

39. For N_2O abatement projects, particularly those employing secondary and/or tertiary systems, adjustment factors take into account the economic viability of such technologies, which remain capital-intensive and are not widely adopted yet. These systems typically achieve high performance, but require significant capital and operational expenditure to maintain efficiency. For existing nitric acid plants, no inherent significant technological development or improvement exists. Therefore, 1% annual downward adjustment shall be applied to baseline emissions for each year after the first crediting year.

10.4. Identification of the conservative BAU scenario

40. Nitrous oxide (N_2O) is an unwanted by-product of the manufacture process of nitric acid (HNO_3), where it is formed alongside the main product nitric oxide (NO) during the catalytic oxidation of ammonia (NH_3). The plant operator has no economic incentives to take any N_2O abatement measures, because this entails significant capital and operating costs, but no financial benefits.

41. As historical data is usually not credible and verifiable, as no economically viable abatement is observed as common practice and a combination of these options is unrealistic, the BAU scenario shall be determined using a standardized, conservative approach based on applicable IPCC emission factors. In addition, the BAU scenario and associated emissions shall incorporate:

(a) Any active or scheduled policies as of the time of validation, unless the mechanism is formally integrated as an implementation tool. All legal requirements are assumed to be enforced from the validation stage onward.

(b) Any sector-specific national or sub-national targets supported by policy frameworks, while excluding general, non-specific goals.

10.4.1. Calculation of the conservative BAU emissions

42. The following stepwise procedure shall be followed by activity participants:

Step 1: Identify plant operating parameters

- Type of process / operating pressure;
- Presence or absence of N_2O abatement technologies in the existing nitric acid plant (if any).

Step 2: Determine the BAU N_2O emission factor

- Refer to the IPCC 2019 guidelines default N_2O emission factors and select the relevant value based on the identified process type as BAU N_2O emission factor.

Step 3: Determine the BAU baseline emissions

$$BE_{BAU,y} = P_{production,y} * EF_{BAU} * GWP_{N2O} * 10^{-3} \quad \text{Equation (3)}$$

Where:

$BE_{BAU,y}$	=	BAU baseline emissions in year y (t CO_2e)
$P_{production,y}$	=	Production of nitric acid in year y (t HNO_3)
EF_{BAU}	=	Default BAU baseline N_2O emission factor acc. to the operating pressure of ammonia burner (related to 100 % pure acid) (kg N_2O/t HNO_3)
GWP_{N2O}	=	Global warming potential N_2O

Step 4: Determine the conservative BAU baseline emissions

$$BE_{BAU,cons,UNC,y} = BE_{BAU,y} * (1 - UNC_{BAU}) \quad \text{Equation (4)}$$

Where:

$BE_{BAU,cons,UNC,y}$	=	Conservative BAU baseline emissions considering uncertainty in year y (t CO_2e)
$BE_{BAU,y}$	=	BAU baseline emissions in year y (t CO_2e)
UNC_{BAU}	=	Uncertainty at the lower bound of the uncertainty interval relative to the central estimate of ex-ante quantified most likely net BAU baseline emissions (fraction)[9]

Step 5: Determine the minimum conservative BAU baseline emissions

$$BE_{BAU\ min,y} = BE_{BAU,y} - \left(BE_{BAU,y} - AE_y\right) * 0.1 \quad \text{Equation (5)}$$

[9] When requesting the renewal of crediting period, the uncertainty during the first crediting period shall be used.

Where:

$BE_{BAU\ min,y}$	=	Minimum conservative BAU baseline emissions in year y (t CO_2e)
AE_y	=	Activity emissions in year y (t CO_2e)

<u>Step 6: Determine the lowest BAU baseline emissions</u>

Compare step 5 ($BE_{BAUcons,UNC,y}$) and step 6 ($BE_{BAU\ \ min,y}$), and the lower value shall be considered as the lowest most conservative BAU baseline emissions:

$$BE_{BAU\ cons,y} = min\ (BE_{BAU\ min,y} : BE_{BAU,cons,UNC,y}) \qquad \text{Equation (6)}$$

Where:

$BE_{BAU\ cons,y}$	=	Lowest conservative BAU baseline emissions in year y (t CO_2e)

43. For the sources of the different parameters please refer to section 14 and 15 below.

10.5. Comparison of the downward adjusted baseline and the conservative business-as-usual baseline

44. Activity participants shall compare the ex-ante downward adjusted baseline emissions calculated based on section 10.3. and the conservative BAU baseline emissions calculated based on section 10.4.1. as an annual and total amount with respect to the crediting period. In case the conservative BAU baseline emissions are lower than the downward adjusted baseline emissions for any calendar year or cumulatively over the crediting period, activity participants are requested to increase the downward adjustment to ensure that the downward adjusted baseline emissions are at least as low as the conservative BAU baseline emissions for each calendar year and cumulatively for the crediting period.

45. Activity participants are further requested to compare ex-post for each individual calendar year during the crediting period, the ex-post calculated downward adjusted baseline emissions for the year and the ex-post calculated conservative BAU baseline emissions for the same year and confirm that the downward adjusted baseline emissions are lower than the conservative BAU baseline emissions. If it is not, then the conservative BAU baseline emissions shall be used for that calendar year.

$$BE_y = \min\ (BE_{adj,y} : BE_{BAU\ cons,y}) \qquad \text{Equation (7)}$$

Where:

BE_y	=	Baseline emissions in year *y* (t CO_2e)
$BE_{adj,y}$	=	Adjusted baseline emissions in year *y* (t CO_2e)
$BE_{BAU\ cons,y}$	=	Conservative BAU baseline emissions in year *y* (t CO_2e)

11. Activity scenario

11.1. Calculation of activity emissions

46. Activity 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. They are calculated as follows:

47.

$$AE_y = AE_{N2O,y} + AE_{CO2,tertiary,y} \quad \text{Equation (8)}$$

Where:

AE_y	=	Activity emissions in year *y* (t CO_2e)
$AE_{N2O,y}$	=	Activity emissions of N_2O from the project plant in year *y* (t CO_2e)
$AE_{CO2,tertiary,y}$	=	Activity emissions of CO_2 from the operation of the tertiary N_2O abatement facility in year *y* (t CO_2)

<u>Activity emissions of N_2O from the project plant</u>

48. The amount of N_2O emissions from the Article 6.4 project activity are emissions from the N_2O contained in the tail gas stream of the plant which is released to the atmosphere. Accordingly, $AE_{N2O,y}$ is determined as follows:

$$AE_{N2O,y} = \sum_{1}^{h_y - h_{r,y}} F_{N2O,tail\ gas,h} \times GWP_{N20} \times 10^{-3} \quad \text{Equation (9)}$$

Where:

$AE_{N2O,y}$	=	Activity emissions of N_2O from the project plant in year *y* (t CO_2e)
GWP_{N20}	=	Global warming potential of N_2O valid for the commitment period
$F_{N2O,tailgas,h}$	=	Mass flow of N_2O in the gaseous stream of the tail gas in 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: (a) Secondary N_2O abatement system was not installed, underperforming or failed; (b) Tertiary N_2O abatement system is by-passed, underperforming or failed

<u>Determination of $F_{N2O,tailgas,h}$</u>

49. The amount of N_2O emissions from the tail gas stream of the project plant shall be determined using the latest approved version of “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”. In applying the tool, the following provisions apply:

    (a) Throughout the crediting periods of the Article 6.4 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 (2015) or any recent update of that standard, or any equivalent national 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 activity 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 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.

Activity emissions from the operation of the tertiary N_2O abatement facility

50. This emission source only needs to be estimated if a tertiary N_2O abatement facility is installed under the Article 6.4 project activity and if fossil fuels are used to operate the facility or re-heat the gas after the facility. The emissions related to the operation of the N_2O destruction facility include only onsite emissions due to the fossil fuel use as input to the N_2O destruction facility:

$$AE_{CO2,tertiary,y} = AE_{FF,y}$$ Equation (10)

Where:

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

51. Activity participants shall use the latest approved version of the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion” to calculate the activity emissions related to fossil fuels used in year *y*. Specific guidance on the use of the tool:

(a) The parameter $PE_{FC,j,y}$ used in the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion” corresponds to the parameter $AE_{FF,y}$ 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.

52. Assumptions and source of data:

- All relevant parameters are included and fully described, and for unavailable data a conservative reassessment/replacement shall be applied.
- Parameters are measured by calibrated instruments, which undergo maintenance and calibration routines based on the manufacturer specifications and in accordance with relevant approved standards (Article 6.4 validation and verification standards for projects, etc.).
- N_2O emission factors are based on IPCC 2019 guidelines.

12. Leakage

12.1. Identification of leakage emission sources

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

12.2. Avoidance or minimization of leakage

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

12.3. Addressing leakage emissions

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

13. Emission reductions

56. This methodology applies exclusively to N_2O abatement activities implemented in nitric acid production plants using secondary and/or tertiary abatement technologies. These activities result solely in emission reductions of N_2O, a potent greenhouse gas, by converting it into harmless nitrogen and oxygen through catalytic decomposition. Therefore, the methodology classifies the mitigation outcomes from such activities as emission reductions only. As a result, no separate accounting for net removals is required for monitoring periods. All monitoring procedures focus on quantifying the volume of N_2O emissions avoided (in tCO_2e) due to the operation of the abatement system.

57. Emission reductions shall be monitored and calculated at the frequency defined in the monitoring section. These values shall be aggregated to calendar years by summing the monitored emission reductions corresponding to each calendar year. This ensures full compliance with the requirement to allocate emission reductions to calendar years. Emission reductions are calculated as follows:

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

Where:

ER_y	=	Emission reductions in year *y* (t CO_2e)
BE_y	=	Baseline emissions in year *y* (t CO_2e)
AE_y	=	Activity emissions in year *y* (t CO_2e)

14. Data and parameters not monitored

Data / Parameter table 1.

<table>
<tr><td>Data/parameter</td><td>Operating pressure</td></tr>
<tr><td>Description</td><td>Operating pressure of nitric acid plant (AOR and absorber)</td></tr>
<tr><td>Data unit</td><td>bar</td></tr>
<tr><td>Equations referred</td><td>Equation (1), Equation (2), Equation (3)</td></tr>
<tr><td>Purpose of data</td><td>☒ Baseline emissions ☐ Project emissions ☐ Leakage emissions</td></tr>
<tr><td>Value(s) applied</td><td>The following table provides the different ranges of nitric acid plant pressure (according to IPCC 2019):
<table>
<tr><th rowspan="2">Operating conditions</th><th colspan="2">Applied pressure in Bar</th></tr>
<tr><th>Oxidation</th><th>Absorption</th></tr>
<tr><td>Single low pressure</td><td colspan="2">0 – 1.7</td></tr>
<tr><td>Dual low/medium (L/M) pressure</td><td><1.7</td><td>1.7 – 6.5</td></tr>
<tr><td>Single medium pressure</td><td colspan="2">1.7 – 6.5</td></tr>
<tr><td>Dual medium/high (M/H) pressure</td><td>1.7 – 6.5</td><td>6.5 – 13</td></tr>
<tr><td>Single high pressure</td><td colspan="2">6.5 – 13</td></tr>
</table></td></tr>
<tr><td>Source of data</td><td>☐ Measured ☒ Other sources</td></tr>
<tr><td>Choice of data or measurement methods and procedures</td><td>Manufacturer specifications</td></tr>
<tr><td>Treatment of uncertainty</td><td>Not applicable (The operating pressure of the nitric acid plant is solely used for classification of the plant´s pressure category in accordance with IPCC 2019 guidelines.)</td></tr>
<tr><td>Additional comments</td><td>The parameter is used to determine the nitric acid plant´s operating pressure.</td></tr>
</table>

Data / Parameter table 2.

Data/parameter	$P_{product,max}$
Description	Design capacity of nitric acid production
Data unit	t product
Equations referred	Equation (1)
Purpose of data	☒ Baseline emissions ☐ Project emissions ☐ Leakage emissions

Value(s) applied	-
Source of data	☐ Measured ☒ Other sources
Project operator and/or technology provider	Project operator and/or technology provider
Treatment of uncertainty	Not applicable
Additional comments	-

Data / Parameter table 3.

Data/parameter	**EF_y**
Description	Conservative baseline N_2O emission factor acc. to the operating pressure of the ammonia burner in year y (related to 100 % pure acid)
Data unit	kg N_2O/t HNO_3
Equations referred	Equation (1), Equation (2)
Purpose of data	☒ Baseline emissions ☐ Project emissions ☐ Leakage emissions
Value(s) applied	The emission factors for all plant types are given below: (see table below) In accordance with RMP 36(ii), where a Host Party has established a baseline emission factor for nitric acid production, it shall be applied, if it is more conservative than the IPCC 2019 emission factor.
Source of data	☐ Measured ☒ Other sources
Choice of data or measurement methods and procedures	IPCC 2019
Treatment of uncertainty	Uncertainty is applied conservative of IPCC N_2O emission factors according to section 10.3 above.
Additional comments	-

Year	**Single pressure**			**Dual pressure**	
	Low	**Medium**	**High**	**L/M**	**M/H**
n	4.50	6.40	5.40	5.60	6.30

Data / Parameter table 4.

Data/parameter	**EF_{BAU}**
Description	Default BAU baseline N_2O emission factor acc. to the operating pressure of ammonia burner (related to 100 % pure acid)
Data unit	kg N_2O/t HNO_3
Equations referred	Equation (3)
Purpose of data	☒ Baseline emissions ☐ Project emissions ☐ Leakage emissions
Value(s) applied	The emission factors for all plant types are given below: (see table below)

Single pressure			**Dual pressure**	
Low	**Medium**	**High**	**L/M**	**M/H**
5.00	8.00	9.00	7.00	9.00

Source of data	☐ Measured ☒ Other sources
Choice of data or measurement methods and procedures	IPCC 2019
Treatment of uncertainty	Not applicable
Additional comments	-

Data / Parameter table 5.

Data/parameter	**GWP_{N2O}**
Description	Global warming potential of N_2O valid for the commitment period
Data unit	t CO_2e/t N_2O
Equations referred	Equation (1), Equation (3), Equation (9)
Purpose of data	☒ Baseline emissions ☒ Project emissions ☐ Leakage emissions
Value(s) applied	265
Source of data	☐ Measured ☒ Other sources
Choice of data or measurement methods and procedures	Relevant decisions by the CMA
Treatment of uncertainty	Not applicable
Additional comments	-

Data / Parameter table 6.

Data/parameter	**DA**
Description	Baseline downward adjustment
Data unit	%
Equations referred	Equation (1)
Purpose of data	☒ Baseline emissions ☐ Project emissions ☐ Leakage emissions
Value(s) applied	1
Source of data	☐ Measured ☒ Other sources
Choice of data or measurement methods and procedures	Refer to section 10.3.
Treatment of uncertainty	Not applicable
Additional comments	-

Data / Parameter table 7.

Data/parameter	**DAi**
Description	Downward adjustment increase
Data unit	%

Equations referred	Equation (1)		
Purpose of data	☒ Baseline emissions	☐ Project emissions	☐ Leakage emissions
Value(s) applied	1		
Source of data	☐ Measured	☒ Other sources	
Choice of data or measurement methods and procedures	Refer to section 10.3.		
Treatment of uncertainty	Not applicable		
Additional comments	-		

15. Data and parameters monitored

Data / Parameter table 8.

Data/parameter	$P_{production,y}$	
Description	Production of nitric acid in year *y*	
Data unit	t HNO_3	
Equations referred	Equation (1), Equation (3)	
Purpose of data	☒ Baseline emissions ☐ Project emissions ☐ Leakage emissions	
Measurement and updating frequency	Not specified on methodological level	
Measurement methods and procedures	Measurements by activity participants and production reports	
Entity/person responsible for the measurement	Not specified on methodological level	
Measuring instrument(s)	*Type of instrument*	Not specified on methodological level
	Accuracy class	Not specified on methodological level
	Calibration requirements	Not specified on methodological level
	Location	Not specified on methodological level
QA/QC procedures	Measurement devices such as weight scales shall follow QA/QC supplier recommendations.	
Treatment of uncertainty	The uncertainty will be derived based on type and specification of the measurement instruments and acc. to supplier recommendations.	
Additional comment	$P_{NA,h}$ (nitric acid produced in hour h) represents the hourly value of $P_{production,y}$ and is used for determining $h_{r,y}$.	

Data / Parameter table 9.

Data/parameter	h_y
Description	Number of hours of operation in year y

Data unit	h	
Equations referred	Equation (1), Equation (9)	
Purpose of data	☒ Baseline emissions ☒ Project emissions ☐ Leakage emissions	
Measurement and updating frequency	Not specified on methodological level	
Measurement methods and procedures	Not specified on methodological level	
Entity/person responsible for the measurement	Not specified on methodological level	
Measuring instrument(s)	*Type of instrument*	Not specified on methodological level
	Accuracy class	Not specified on methodological level
	Calibration requirements	Not specified on methodological level
	Location	Not specified on methodological level
QA/QC procedures	-	
Treatment of uncertainty	Not applicable	
Additional comment	Records to be maintained during the crediting period.	

Data / Parameter table 10.

Data/parameter	**$h_{r,y}$**	
Description	Number of hours (h) in year y where: (a) Secondary N_2O abatement system was not installed, underperforming or failed; (b) Tertiary N_2O abatement system is by-passed, underperforming or failed	
Data unit	h	
Equations referred	Equation (1), Equation (9)	
Purpose of data	☒ Baseline emissions ☒ Project emissions ☐ Leakage emissions	
Measurement and updating frequency	Not specified on methodological level	
Measurement methods and procedures	Not specified on methodological level	
Entity/person responsible for the measurement	Not specified on methodological level	
Measuring instrument(s)	*Type of instrument*	Not specified on methodological level
	Accuracy class	Not specified on methodological level
	Calibration requirements	Not specified on methodological level
	Location	Not specified on methodological level

QA/QC procedures	Not specified on methodological level
Treatment of uncertainty	Not applicable
Additional comment	Records to be maintained during crediting period.

58. Monitoring, Reporting, and Verification (MRV) requirements: The provisions as mentioned in above parameter tables shall be followed to ensure accuracy, transparency, and reliability of data throughout the crediting period. Furthermore, allocation of roles and responsibilities for MRV implementation, including data collection, validation, documentation, and reporting shall be defined prior to the first verification of GHG emission reductions.

15.1. Frequency of submission of monitoring reports

59. Not applicable

16. Methodologies principles

16.1. Encouraging ambition over time

60. The respective baseline is considering a continuous ambition level by downward adjusted baseline emissions.

61. Deployed technology and GHG levels: This methodology deploys the use of secondary and/or tertiary technology (catalytic reduction) for reducing N_2O in nitric acid plants. The respective technologies stand for significant N_2O reductions, cost-effectiveness, ease of integration, and low maintenance. Catalytic reduction has following advantages:

(a) *High efficiency*: Catalytic reduction can achieve high removal efficiencies for N_2O. This makes it a very effective technology for nitric acid plants.

(b) *Selective reduction*: The catalysts are highly selective, meaning they specifically target the N_2O molecules and convert them to nitrogen and oxygen, without affecting other components of the tail gas.

(c) *Integration with existing plant*: Catalytic reduction systems are typically retrofit to existing nitric acid plants; these systems can be integrated into the existing tail gas treatment system without major modifications to the core production processes.

(d) *Energy efficiency*: Catalytic reduction, operate at relatively low temperatures, making them more energy-efficient than alternatives like thermal decomposition. This reduces the overall energy consumption of nitric acid plants, improving their economic sustainability.

16.2. Contributing to the equitable sharing of mitigation benefits between participating Parties

62. The lifetime of secondary and tertiary N_2O abatement technologies (as described in this methodology) typically exceeds the total crediting period of the Article 6.4 activity. Consequently, the abatement system is expected to continue operating and delivering

emission reductions beyond the crediting period. These post-crediting period climate benefits are not claimed or credited and shall accrue to the host Party.

63. Given the extended operational life of such abatement systems, only a proportion of their total lifetime emission reductions shall be credited and transferred. The remaining uncredited mitigation benefits shall be retained by the host Party to support its Long-Term Low Emission Development Strategy (LT-LEDS).

16.3. Encouraging broad participation

64. This mechanism methodology encourages broad participation by the following:

(a) *Nitric acid plant*: It covers all nitric acid plant types (single and dual pressure);

(b) *N_2O abatement technologies*: It covers the most efficient N_2O abatement types in nitric acid plants (secondary and tertiary);

(c) *Geographical coverage*: globally applicable;

(d) *Project scale*: It covers all nitric acid plant scales without limitation.

(e) *Accuracy, simple and clear, no constrains and data sources*:

i. All relevant parameters are included and fully, accurately described. For unavailable data a conservative reassessment/replacement shall be applied.

ii. Methodology uses simple, clear equations to calculate the baseline emissions, activity emissions and emission reductions with few monitoring parameters.

iii. Methodology doesn´t constrain and is open to be applied by all nitric acid plant operators in eligible host countries.

iv. Methodology doesn't use single data sources for the respective parameters, but offers conservative approaches in case of unavailable data (e.g. conservative data reassessment/replacement for unavailable measured data for a specific period due to lack of data or to a temporary problem of a measuring device).

16.4. Attributability of emission reductions or net removals to the Article 6.4 activity

65. To ensure that quantified emission reductions result solely from the Article 6.4 project activity and not from exogenous factors, this methodology requires:

(a) *Measurements*: Emission reductions are quantified only when the N_2O abatement system is operating, using continuous monitoring of N_2O concentration and tail gas flow.

(b) *Conservative baseline application*:

i. Conservative IPCC default emission factors are applied.

ii. All instruments involved in the quantification of baseline emissions must undergo regular calibration, verification, and maintenance in accordance with the manufacturer's or supplier's specifications. These procedures shall be documented in the QA/QC plan and maintained throughout the crediting period.

iii. An uncertainty factor will be applied in the baseline emissions calculations. This factor will be derived based on the type and specifications of measurement instruments, and will be verified during the issuance stage.

(c) Activity emissions are mainly based on the N_2O concentration and volume or mass flow of the tail gas. These parameters shall be measured and monitored in accordance with EN 14181, which ensures robust, standardized quality assurance of AMS. This standard guarantees data accuracy, reliability, and transparency for emission monitoring. All instruments involved in the quantification of activity emission must undergo regular calibration, verification, and maintenance as per the manufacturer's or supplier's recommendations. These procedures shall be documented as part of the QA/QC plan and shall be implemented throughout the crediting period.

16.5. Potential perverse incentives

66. Not applicable

16.6. Rebound effects

67. Not applicable

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Document information

Version	*Date*	*Description*
0.2.0	19 August 2025	Revision to incorporate new sections and sub-sections in line with current standards; provide completion instructions, realign their sequence, and allow inclusion of explanatory notes.
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