



**Project design document form
(Version 10.1)**

Complete this form in accordance with the instructions attached at the end of this form.

BASIC INFORMATION

Title of the project activity	Catalytic N ₂ O destruction project in the tail gas of the Nitric Acid Plant of Abu Qir Fertilizer Co.
Scale of the project activity	<input checked="" type="checkbox"/> Large-scale <input type="checkbox"/> Small-scale
Version number of the PDD	4.2
Completion date of the PDD	13/12/2017
Project participants	CARBON Egypt Ltd.; Carbon Climate Protection GmbH; RWE Power AG
Host Party	Arab Republic of Egypt
Applied methodologies and standardized baselines	Applied methodology: ACM0019 Version 2.0.0 N ₂ O abatement from nitric acid production
Sectoral scopes linked to the applied methodologies	Sectoral scope 5: Chemical Industries
Estimated amount of annual average GHG emission reductions	1,273,974 tCO ₂ e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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(1) Purpose of project activity

Carbon Egypt has implemented a project for GHG emission reduction by catalytic N₂O destruction in Abu Qir, Egypt. The project activity includes development, design, engineering, procurement, finance, construction, operation and maintenance of a system for catalytic reduction of N₂O. The EnviNOx® process used in the Abu Qir II nitric acid plant is based on the catalytic reduction of NO_x (NO and NO₂) with ammonia (NH₃) and of nitrous oxide (N₂O) with a hydrocarbon. The hydrocarbon used is natural gas of which the main constituent is methane (CH₄). The reactions take place over two iron zeolite catalyst beds.

(a) Scenario existing prior to the implementation of the project activity

Nitric acid plants are, in the vast majority of cases, part of a chemical complex and are built and operated to supply acid for consumption in downstream process units. The most common use for nitric acid is for fertilisers, with smaller quantities going into the manufacture of organic compounds and mining explosives.

Nitrous oxide (N₂O) is an unwanted, invisible and previously neglected by-product of the manufacture of nitric acid. It is formed alongside the main, desired product nitric oxide (NO) during the catalytic oxidation of ammonia in air over noble metal gauzes. When leaving the ammonia oxidation reactor, there is no relevant loss of N₂O in the tail gas section unless a N₂O destruction facility is installed. N₂O that leaves the ammonia oxidation reactor is thus discharged to atmosphere in the tail gas, and has no economic value.

The scenario existing prior to the start of the implementation of the project activity is that the N₂O is emitted to the atmosphere with no N₂O abatement measure being implemented.

(b) Baseline scenario

According to the applied methodology ACM0019 "N₂O abatement from nitric acid production" (Version 02.0.0) operators of nitric acid plants have no economic incentives to take any N₂O abatement measures in the absence of regulations requiring the abatement of N₂O emissions, because this entails capital and operating costs, but no financial benefits. Therefore, the baseline scenario is that the N₂O is emitted to the atmosphere with no N₂O abatement measure being implemented.

Since no laws or regulations exist at present, which mandate the complete or partial destruction of N₂O from nitric acid plants in the Arab Republic of Egypt, AFC has no economic incentives to take any N₂O abatement measures in its nitric acid plant. Hence, the baseline scenario is that the N₂O is emitted to the atmosphere with no N₂O abatement measure being implemented.

Annual average of GHG emission reductions during second crediting period:	1,273,974 tCO ₂ e
Total GHG emission reductions during second crediting period:	8,917,815 tCO ₂ e

(2) Projects contribution to sustainable development

The project developer and the project operator agreed on spending a share of the total income from selling of the CERs for a Social Fund for the area of Abu Qir. This fund contributes to the social benefit of the people living in the area of the CDM project activity by financing sustainable projects like projects in schools, hospitals and infrastructure.

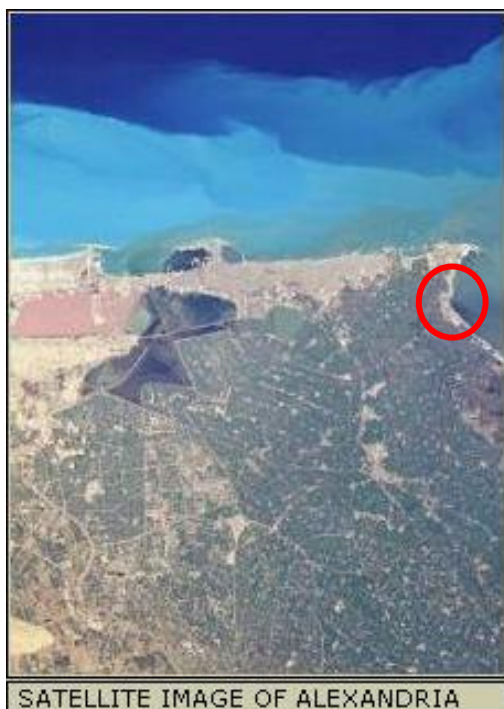
A.2. Location of project activity

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Host Party(ies): Arab Republic of Egypt
 Region/State/Province: Al-Iskandariyah Province (Alexandria Province)
 City/Town/Community: Abu Qir
 Physical/Geographical location: GPS coordinates: N31.272513° E30.09755°

Address: ABU QIR FERTILIZER Co.
 El-Tabya Plants
 Rasheed Road
 Postal Code: 21911
 Alexandria
 Egypt

Figure 1: Satellite Image of Alexandria



AFC, the largest fertilizer company in Egypt, is located about 15 km east of downtown Alexandria, in a rural area, approximately 5 km outside the small town of Abu Qir. Abu Qir is situated north-east of Alexandria, bordering the suburbs of Alexandria. AFC is located on the shores of the Mediterranean Sea. The company has road and rail access as well as a nearby ship loading terminal.

A.3. Technologies/measures

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(a) Technologies and measures employed by the project activity

The applied technology, the EnviNOx®-system, is a tertiary measure for the destruction of N₂O from nitric acid plant tail gas streams based on the catalytic decomposition or catalytic reduction of N₂O. The EnviNOx®-system is located between tail gas heater IV and the tail gas turbine which is the position with the highest tail gas temperature in the nitric acid production process at AFC. The current tail gas temperature at design capacity is around 414°C and sufficient to permit very high rates of N₂O removal by virtue of the use of small quantities of methane (hydrocarbon) as a reducing agent. There is therefore no requirement to make modifications to the nitric acid plant to increase the tail gas temperature.

The implementation of the N₂O destruction project at AFC involves that natural gas, a mixture of hydrocarbons of which the main constituent is methane (CH₄), is employed as a reducing agent for

N₂O removal. The EnviNOx®-system reactor also incorporates NO_x reduction using ammonia in order to lower the NO_x concentration to a very low level.

Decommissioning of existing DeNO_x reactor:

The nitric acid plant was retrofitted with a DeNO_x reactor in 1999. The reactor was installed upstream of the final tail gas heater. The existing SCR-DeNO_x-unit reduces NO_x (a mixture of nitric oxide (NO) and nitrogen dioxide (NO₂)) to nitrogen and water vapour with ammonia over a vanadium pentoxide V₂O₅-based catalyst. The implementation of the proposed project activity involves the removal of the existing SCR DeNO_x-unit (SCR = Selective Catalytic Reduction), whereas the new EnviNOx®-system takes over the function of the existing SCR DeNO_x-unit as it too accomplishes the reduction of NO_x with ammonia. As far as the amount of NO_x-removal is concerned the performance of the EnviNOx®-system is at least as good as the existing SCR DeNO_x-unit.

Ammonia feed:

Liquid ammonia taken from downstream of the existing ammonia filter (liquid) is vaporised and superheated in the ammonia evaporator with low pressure steam. The superheated ammonia is supplied to the EnviNOx®-system under flow control. If for any reason the supply of ammonia to the EnviNOx® system must be interrupted, either due to a trip or operator intervention, an automatic double block and bleed system isolates the ammonia system from the tail gas side of the nitric acid plant. In case of the proposed project activity a SCR DeNO_x unit is already installed prior to the starting date of the project activity, therefore the project ammonia input will be considered equal to the ammonia input in the baseline scenario.

Natural gas feed:

Natural gas at ambient temperature is let down from the supply pressure and then supplied to the EnviNOx®-system under flow control. As with the ammonia supply system, the natural gas is isolated from the tail gas side of the nitric acid plant in case of an interruption of supply caused by operator action or an interlock by means of a double block and bleed arrangement. The proposed project activity uses about 700,000 Nm³ natural gas per year.

The natural gas (hydrocarbon) used at Abu Qir consists mainly of methane (CH₄) with small quantities of higher saturated hydrocarbons (ethane, propane, butane, etc.), nitrogen, carbon dioxide and ppm quantities of sulphur compounds. The higher hydrocarbons behave as reducing agents towards N₂O just as methane does. The CO₂ (<1% vol. in natural gas) and N₂ behave as inerts in the EnviNOx®-system. The low levels of sulphur have no effect on the catalyst.

Mixer:

Natural gas and ammonia vapour are supplied together to the lance of the tail gas / ammonia / natural gas static mixer. This inline device ensures that the reducing agents ammonia and natural gas are intimately mixed with the tail gas before the tail gas reaches the EnviNOx® reactor.

N₂O and NO_x reduction:

At the inlet of the EnviNOx® reactor the NO_x concentration can reach 200 ppm and the N₂O concentration is typically at 1,250 ppm.

The NO_x concentration increases with plant load and temperature in the absorption tower while increased absorption tower pressure reduces the NO_x concentration. Thus the NO_x concentration is subject to short term fluctuations without any long term trend.

While the tail gas N₂O concentration can also increase with increasing plant load it additionally depends significantly on the state of the ammonia oxidation platinum-/ rhodium gauzes in the ammonia burners. The state of the gauzes deteriorates over the length of a production campaign. So the short term fluctuations in N₂O concentration are generally – although not in every campaign – overlaid with a long term trend to higher N₂O concentrations as the campaign advances. The EnviNOx® reactor contains two catalyst beds arranged in series as described above. In the first bed the EnviCat-NO_x catalyst reduces the concentration of NO_x to a very low level by reaction with

ammonia while in the second EnviCat®-N₂O-2 bed the reduction of N₂O with the hydrocarbons in the natural gas takes place.

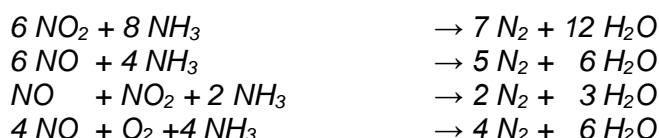
A small quantity of methane leaves the reactor unreacted. This is measured by the online methane analyser downstream of the EnviNOx® reactor, and electronically recorded. Compared with the reduction in greenhouse gas emission achieved by the destruction of N₂O the additional greenhouse gas emissions (CO₂ and CH₄) caused by the process are insignificant.

The installation of the EnviNOx®-system requires significant investment for the supply and installation of the equipment, as well as operating cost for the natural gas used as well as for replacement of the catalyst and the on-going monitoring and maintenance of the facility. The proposed project activity also includes training courses for operation of the EnviNOx®-system and also for accurate monitoring. The implementation of the proposed project activity does not increase the capacity or operating efficiency of AFC's nitric acid plant.

(b) Description of catalytic decomposition process (EnviNOx® process)

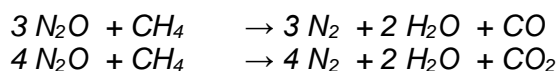
Catalytic decomposition of N₂O occurs when the N₂O is split into its constituent elements by contact with a catalyst. A catalyst is a material which accelerates the speed of the reaction without itself being transformed or consumed by the reaction.

The first bed contains an iron zeolite that is especially effective in catalysing the reduction of NO_x with ammonia according to such reactions as:



Effectively all the NO_x is removed. Some destruction of N₂O also occurs.

The second and main bed contains an iron zeolite that is particularly efficient in catalysing the reduction of nitrous oxide with hydrocarbons.



Similar reactions take place between nitrous oxide and the small quantities of higher hydrocarbons such as ethane C₂H₆, propane C₃H₈ and butane C₄H₁₀ that are present in natural gas. N₂O reduction by these reactions is much more effective when NO_x is absent.

A large proportion of the carbon monoxide that is formed is further oxidised to carbon dioxide:

$$2 \text{ CO} + \text{O}_2 \rightarrow 2 \text{ CO}_2$$

All the above reactions are exothermic which leads to a temperature rise over the EnviNOx® reactor. A small quantity of methane leaves the reactor unreacted. This is measured by the online methane analyser downstream of the EnviNOx® reactor, and electronically recorded.

The proposed project activity reduces the N₂O emissions from the Nitric Acid Plant of Abu Qir Fertilizer Co. by up to 99% by installing the EnviNOx® process. It is important to emphasise that the purpose of the hydrocarbon and ammonia is not that of a fuel, increasing the temperature of the tail gas to a level at which high rates of N₂O decomposition can take place, but that they are used as genuine chemical reagents that take part in reactions with N₂O and NO_x respectively on specific sites on the surface of catalysts specially developed for the purpose by Uhde. Thus the

consumption of hydrocarbons corresponds to the stoichiometric ratio given in the reaction equations above.

(c) Scenario existing prior to the implementation of the project activity

The nitric acid plant was designed without any N₂O abatement measure. The production of nitric acid takes place in three main process steps as indicated by the following reactions:

1. Ammonia (NH₃) combustion to form nitric oxide (NO):



Simultaneously nitrous oxide (N₂O), nitrogen (N) and water (H₂O) are formed as well, in accordance with the following equations:

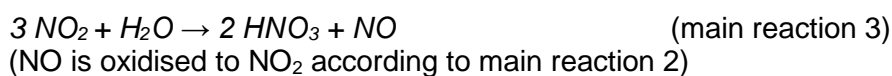


NO yield depends mainly on pressure and temperature in the ammonia oxidation process and usually is in a range of 95% to 97%.

2. NO is oxidised to nitrogen dioxide (NO₂):



3. (According to the technical process) Absorption of NO₂ in water to form nitric acid (HNO₃):



When leaving the ammonia oxidation reactor, there is no relevant loss of N₂O in the tail gas section unless a N₂O destruction facility is installed. N₂O that leaves the ammonia oxidation reactor is thus discharged to atmosphere in the tail gas, and has no economic value.

According to the applied methodology ACM0019 "N₂O abatement from nitric acid production" (Version 02.0.0) operators of nitric acid plants have no economic incentives to take any N₂O abatement measures in the absence of regulations requiring the abatement of N₂O emissions, because this entails capital and operating costs, but no financial benefits. Therefore, the baseline scenario is that the N₂O is emitted to the atmosphere with no N₂O abatement measure being implemented.

Since no laws or regulations exist at present, which mandate the complete or partial destruction of N₂O from nitric acid plants in the Arab Republic of Egypt, AFC has no economic incentives to take any N₂O abatement measures in its nitric acid plant. Hence, the baseline scenario is that the N₂O is emitted to the atmosphere with no N₂O abatement measure being implemented.

(d) Know-how transfer

The technology transfer has led to improved understanding of high advanced air cleaning technologies within the Arab Republic of Egypt. Furthermore plant personnel benefits from training courses taking place for operation and maintenance purposes of the tertiary abatement facility.

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Arab Republic of Egypt (Host)	CARBON Egypt Ltd.	No
Republic of Austria	Carbon Climate Protection GmbH	No
Federal Republic Germany	RWE Power AG	No

Project applicant, developer and sponsor is CARBON Egypt Ltd. (furthermore called "CARBON"). CARBON Egypt Ltd. is registered under the laws of the Arab Republic of Egypt. The company is a subsidiary of CARBON Projektentwicklung GmbH, Austria, and RWE Power AG, Germany.

CARBON Projektentwicklung GmbH was founded as a limited liability company located and registered in Austria under Austrian law in order to develop, finance and operate high quality JI/CDM Projects. Carbon Climate Protection GmbH is as well a subsidiary of RWE Power AG and CARBON Projektentwicklung GmbH and has vast experience with CDM-project development in Africa, Latin America and Asia and is specialized on the catalytic N₂O destruction in the tail gas of nitric acid plants.

The RWE Group is one of Europe's leading integrated electricity and gas companies. RWE Power AG is the continental power generation company within the RWE Group and Germany's biggest power producer. RWE Power has a diverse generation portfolio including lignite, hard coal, nuclear energy, gas and renewable sources such as hydro, wind and biomass. RWE invests and participates actively in projects under the Clean Development Mechanism and Joint Implementation. The RWE team combines a track record in global commodities and emissions trading as well as risk management with broad experience and a deep understanding of specific risks inherent in CDM and JI projects.

Host Country is the Arab Republic of Egypt. The Arab Republic of Egypt ratified the Kyoto Protocol in January 2005. The other Party involved in the project at the time of registration is the Republic of Austria. Subsequent to the initial registration of the project activity, the Federal Republic Germany has been added as a Party involved in the project.

A.5. Public funding of project activity

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No public funds are available for the financing of the project activity.

A.6. History of project activity

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The Project Participants confirm:

- (a) The CDM project activity is already registered as a CDM project activity and a post-registration change (type "correction") is now submitted;
- (b) The CDM project activity is not a project activity that has been deregistered.

The Project Participants declare:

- (a) The CDM project activity was not a CPA that has been excluded from a registered CDM PoA;
- (b) No other registered CDM project activity or a CPA under a registered CDM PoA exists in the same geographical location as the CDM project activity.

A.7. Debundling

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Not applicable.

SECTION B. Application of selected methodologies and standardized baselines**B.1. Reference to methodologies and standardized baselines**

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(a) Selected methodology: ACM0019 “N₂O abatement from nitric acid production” (Version 02.0.0)¹

(b) Any tools and other methodologies to which the selected methodology refers:

Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion (Version 02)²

Tool to determine the mass flow of a greenhouse gas in a gaseous stream (Version 02.0.0)³

B.2. Applicability of methodologies and standardized baselines

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According to the used methodology, the project activity is applicable under following conditions:

Applicability criteria #1: The methodology applies to project activities that introduce N₂O abatement measures in nitric acid plants;

Justification #1: The proposed project activity destroys N₂O emissions by the reduction of N₂O in the tail gas stream of the nitric acid plant of AFC at Abu Qir (tertiary abatement technology).

Applicability criteria #2: 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 abatement technology installed in the respective nitric acid plant;

Justification #2: Since the start of the commercial operation no secondary or tertiary abatement technology was installed in the AFC nitric acid plant prior to the implementation of the CDM project in 2006 (first crediting period). Evidence for this was already demonstrated during first crediting period.

Applicability criteria #3: Continuous real-time measurements of the N₂O concentration and the total gas volume flow can be carried out in the tail gas stream after the abatement of N₂O emissions throughout the crediting period of the project activity;

Justification #3: Continuous real-time measurements of the N₂O concentration and the total gas volume flow can be carried out in the tail gas stream after the abatement of N₂O emissions throughout the crediting period of the project activity. A dedicated Automated Monitoring System (AMS) was already installed in the plant prior to the beginning of the first crediting period of the project activity. This AMS will be adapted – if needed – in order to meet the requirements of the applied monitoring methodology.

Applicability criteria #4: No law or regulation which mandates the complete or partial destruction of N₂O from nitric acid plants exists in the host country where the CDM project activity is implemented.

Justification #4: At present no laws or regulations exist, which mandate the complete or partial destruction of N₂O from nitric acid plants in the host country, the Arab Republic of Egypt.

¹<http://cdm.unfccc.int/methodologies/DB/MNMFNF10VUEOJACEIRX3EHYC9QXGDC>

²<http://cdm.unfccc.int/methodologies/PAmethodologies/tools/>

³<http://cdm.unfccc.int/methodologies/PAmethodologies/tools/>

B.3. Project boundary, sources and greenhouse gases (GHGs)

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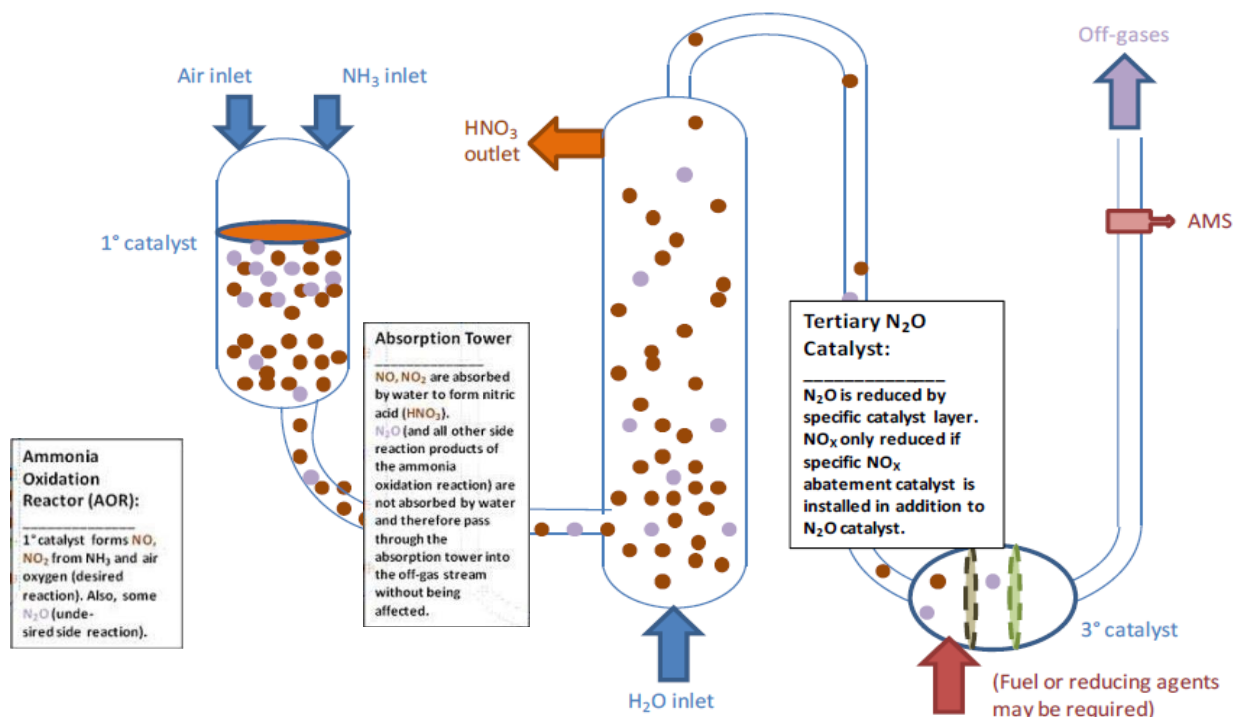


Figure 2: Project boundary of the project activity as tertiary N_2O abatement measure (simplified standard nitric acid plant layout displaying the location of the N_2O abatement catalyst, process sources of N_2O and the sampling point location for the Automated Monitoring System (AMS))

As shown in the figure above, the only baseline emissions considered are the N_2O emissions formed in the Ammonia Oxidation Reactor, a part of the nitric acid plant.

The project activity introduces a tertiary N_2O abatement facility, physically located in the tail gas stream of the nitric acid plant. It is expected that the tertiary abatement facility will destroy N_2O emissions to a high extent. The remaining N_2O which is not destroyed and still present after the abatement facility is measured by the AMS downstream of the tertiary abatement measure and is considered as project emissions. Fossil fuels will be used when operating the tertiary abatement facility, for this reason emissions from this source are to be considered as well.

The following table illustrates in detail, which emissions sources are included and which are excluded from the project boundary for determination of both baseline and project emissions

Table: GHG included in or excluded from the project boundary

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

B.4. Establishment and description of baseline scenario

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At present no laws or regulations exist, which mandate the complete or partial destruction of N₂O from nitric acid plants in the host country, the Arab Republic of Egypt. This is attested by a letter of the Egyptian Environmental Affairs Agency (EEAA).

In accordance with the methodology, AFC has no economic incentives to take any N₂O abatement measures in its nitric acid plant in the absence of regulations requiring such measures, as this would entail capital and operating costs, but no financial benefits. Therefore, the proposed CDM project is considered additional and the baseline scenario is that the N₂O emitted to the atmosphere with no N₂O abatement measure being implemented.

B.5. Demonstration of additionality

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According to the applied methodology ACM0019 the CDM project activity is considered additional in case of the absence of regulations requiring the abatement of N₂O emissions, as the operator of the nitric acid plant has no economic incentives to take any N₂O abatement measures.

Since it was clearly demonstrated in section B.4 above that in Egypt no regulations exist, which require the abatement of N₂O emissions in nitric acid plants, the proposed project activity "Catalytic N₂O destruction project at AFC nitric acid plant" is considered additional.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

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Baseline Emissions

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

AFC nitric acid plant has used AM0028 in the first crediting period. Then on May 31st, 2013, the methodology ACM0019 v.2.0 came into effect, substituting the methodologies AM0028 and AM0034 for their use in N₂O reduction projects in nitric acid plants. Hence, the methodology

ACM0019 is applied for the second crediting period of the proposed project activity and the baseline emissions are calculated as follows:

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

Where:

BE_y	=	Baseline emissions in year y (t CO ₂ e)
$P_{product,max}$	=	Design capacity (t HNO ₃)
$P_{production,y}$	=	Production of nitric acid in year y (t HNO ₃)
$EF_{existing,y}$	=	N ₂ O emission factor for nitric acid plants that have used AM0028 or AM0034 in the first crediting period in year y (kg N ₂ O/t HNO ₃)
$EF_{new,y}$	=	Baseline N ₂ O emission factor for nitric acid production in year y (kg N ₂ O/t HNO ₃)
GWP_{N_2O}	=	Global Warming Potential of N ₂ O valid for the commitment period
h_y	=	Number of hours in year y during which the plant was in operation (h)
$h_{r,y}$	=	Number of hours (h) in year y where: (a) For secondary N ₂ O abatement: the abatement system was not installed, underperforming or failed; (b) For tertiary N ₂ O abatement: the abatement system is by-passed, underperforming or failed

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

$$EF_{existing,y} = \min\{EF_{historical}; EF_{default,y}\} \quad \text{Equation (2)}$$

Where:

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

Since the proposed project activity used AM0028 in its first crediting period, Case 1 applies and Case 2 has not to be considered.

Calculation of $h_{r,y}$

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

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

$$F_{N_2O,tail\ gas,h} > EF_{existing,y} \times P_{NA,h} \quad \text{Equation (3)}$$

Where:

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

$$F_{N_2O, tail\ gas, h} = \text{Mass flow of } N_2O \text{ in the gaseous stream of the tail gas in the hour } h \text{ (kg } N_2O/h)$$

Since the proposed project activity used AM0028 in its first crediting period, Case 1 applies and Case 2 has not to be considered.

Project emissions

Project emissions include N_2O emissions, 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. Project emissions are calculated as follows:

$$PE_y = PE_{N_2O, y} + PE_{CO_2, tertiary, y} \quad \text{Equation (4)}$$

Where:

$$\begin{aligned} PE_y &= \text{Project emissions in year } y \text{ (t } CO_2e) \\ PE_{N_2O, y} &= \text{Project emissions of } N_2O \text{ from the project plant in year } y \text{ (t } CO_2e) \\ PE_{CO_2, tertiary, y} &= \text{Project emissions of } CO_2 \text{ from the operation of the tertiary } N_2O \text{ abatement facility in year } y \text{ (t } CO_2) \end{aligned}$$

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

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

$$PE_{N_2O, y} = \sum_1^{h_y - h_{r, y}} F_{N_2O, tail\ gas, h} \times GWP_{N_2O} \times 10^{-3} \quad \text{Equation (5)}$$

Where:

$$\begin{aligned} PE_{N_2O, y} &= \text{Project emissions of } N_2O \text{ from the project plant in year } y \text{ (t } CO_2e) \\ GWP_{N_2O} &= \text{Global warming potential of } N_2O \text{ valid for the commitment period} \\ F_{N_2O, tailgas, h} &= \text{Mass flow of } N_2O \text{ in the gaseous stream of the tail gas in the hour } h \text{ (kg } N_2O/h) \\ h_y &= \text{Number of hours in year } y \text{ during which the plant was in operation (h)} \\ h_{r, y} &= \text{Number of hours (h) in year } y \text{ where:} \\ &\quad (a) \text{ For secondary } N_2O \text{ abatement. Abatement system was not installed, underperforming or failed;} \\ &\quad (b) \text{ For tertiary } N_2O \text{ abatement. The abatement system is by-passed, underperforming or failed} \end{aligned}$$

Determination of $F_{N_2O, tailgas, h}$

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”. 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 N₂O concentration and the volume or mass flow of the tail gas based on two seconds (or shorter) interval readings that are recorded and stored electronically. These N₂O data sets shall be identified by means of a unique time/date key indicating when exactly the values were observed;
 - (c) The correction factors derived from the calibration curve of the QAL2 audit for the monitoring components as determined during the QAL2-test in accordance with EN14181 must be applied to both the N₂O concentration and the volume or mass flow of the tail gas. This can either be applied automatically to the raw data recorded by the data storage system at the plant or it can be applied to the calculated hourly averages as part of the calculation of project emissions;
 - (d) If data for either the N₂O concentration or the volume or mass flow of the tail gas are not available for more than 1/3 of any hour while the plant was in operation, the value for that hour shall be replaced with the maximum value of N₂O concentration or volume or mass flow of the tail gas observed during the monitoring period. If data for neither the N₂O concentration nor the volume or mass flow of the tail gas are available for more than 1/3 of any hour while the plant was in operation, the maximum value of mass flow of N₂O calculated during the monitoring period shall be applied to any such hour. Values observed during five operating hours before and after a plant start-up and shut-down shall not be used for the determination of the maximum values;
 - (e) In the case that the N₂O concentration and the volume or mass flow of the tail gas and bypass are automatically converted to normal conditions by the AMS during the monitoring process, the parameters P_t and T_t do not need to be monitored except, if applicable, for the purpose of determining the moisture content in the gaseous stream.

According to the applied tool the mass flow of greenhouse gas i in the gaseous stream in time interval t ($F_{i,t}$) is calculated based on measurements of (a) the total volume flow or mass flow of the gas stream, (b) the volumetric fraction of the gas in the gaseous stream and (c) the gas composition and water content. The flow and volumetric fraction may be measured on a dry basis or wet basis. The tool covers the possible measurement combinations, providing six different calculation options to determine the mass flow of a particular greenhouse gas (Option A to F).

Based on the currently available information **Option A** of the tool will be applied (measurement options for option A: volume flow of gaseous stream on dry basis, volumetric fraction on dry or wet basis), which states two ways how to demonstrate that the gaseous stream is dry. These are:

- a) Measure the moisture content of the gaseous stream ($C_{H_2O,t,db,n}$) and demonstrate that this is less or equal to 0.05 kg H₂O/m³ dry gas; or
- b) Demonstrate that the temperature of the gaseous stream (T_t) is less than 60°C (333.15 K) at the flow measurement point.

The mass flow of greenhouse gas i ($F_{i,t}$)⁴ is determined as follows:

$$F_{i,t} = V_{t,db} \times v_{i,t,db} \times \rho_{i,t} \quad \text{Equation (6)}$$

With

$$\rho_{i,t} = \frac{P_t \times MM_i}{R_u \times T_t} \quad \text{Equation (7)}$$

Where:

$F_{i,t}$ = Mass flow of greenhouse gas i in the gaseous stream in time interval t (kg gas/h)

⁴ $F_{i,t}$ corresponds to the parameter $F_{N_2O,tail\ gas,h}$ of the methodology ACM0019.

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

Option A of the tool can be applied since currently available information shows that the moisture content of the gaseous stream ($C_{H_2O,t,db,n}$) will be less than 0.05 kg H₂O/m³ dry gas and therefore the gas is considered to be dry⁵. The moisture content of the gaseous stream will be measured according to the prevailing methodology and tool as well as to relevant current norms and standards.

According to the applied methodology the amount of N₂O emissions from the tail gas stream of the project plant shall be determined using the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”, but 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 – if the N₂O concentration and the volume or mass flow of the tail gas and by-pass are automatically converted to normal conditions by the AMS during the monitoring process.

Since the N₂O concentration and the volume flow of the tail gas and by-pass are automatically converted to normal conditions, the parameters P_t and T_t need not to be monitored. The term m³ used in the units for the volumetric flow ($V_{t,db}$) and the volumetric fraction ($V_{i,t,db}$) refer to m³ at these mentioned standard conditions throughout this document. Therefore, when applying equation 6 of the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (which is referred to as equation 7 of this PDD; see above) in order to determine a fixed value for the N₂O density at normal conditions ($P_t = P_n = 101,325$ Pa; $T_t = T_n = 273.15$ K), the N₂O density at normal conditions was determined to be 1.96 kg/m³.

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

This emission source only needs to be estimated if a tertiary N₂O abatement facility is installed under the project activity and if fossil fuels are used to operate the facility or re-heat the gas after the facility. This applies to the project activity as a tertiary N₂O abatement facility will be installed.

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

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

Where:

$PE_{CO_2,tertiary,y}$	=	Project emissions of CO ₂ from the operation of the tertiary N ₂ O 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)

⁵ The ex-ante determination of the moisture content at the measuring point according to process parameters shows a value of about 0.00157 kgH₂O/m³ dry gas. Hence Option A is applicable.

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

Specific guidance on the use of the tool:

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

It shall be considered that for synchronizing the applied tool with the methodology, “Annual”, “Yearly”, “yr” and the year “ y ” are understood to cover the same time period unless otherwise explained.

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

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

Where:

$PE_{FC,j,y}$	=	Are the CO ₂ emissions from fossil fuel combustion in process j during the year y (tCO ₂ /yr)
$FC_{i,j,y}$	=	Is the quantity of fuel type i combusted in process j during the year y (mass or volume unit/yr)
$COEF_{i,y}$	=	Is the CO ₂ emission coefficient of fuel type i in year y (tCO ₂ /mass or volume unit)
i	=	Are the fuel types combusted in process j during the year y

According to the applied tool the CO₂ emission coefficient $COEF_{i,y}$ can be calculated using one out of two options, depending on the availability of data on the fossil fuel type i . Option A should be the preferred approach, if the necessary data is available.

Based on currently available information **Option A** of the applied tool can be applied as the necessary data such as chemical composition of the used fossil fuel (i.e. natural gas) will be provided by the natural gas supplier. According to Option A the CO₂ emission coefficient $COEF_{i,y}$ is calculated based on the chemical composition of the fossil fuel type i , using the following approach:

If $FC_{i,j,y}$ is measured in a mass unit: $COEF_{i,y} = w_{C,i,y} \times 44/12$ Equation (10)

If $FC_{i,j,y}$ is measured in a volume unit: $COEF_{i,y} = w_{C,i,y} \times \rho_{i,y} \times 44/12$ Equation (11)

Where:

$COEF_{i,y}$	=	Is the CO ₂ emission coefficient of fuel type i (t CO ₂ /mass or volume unit)
$w_{C,i,y}$	=	Is the weighted average mass fraction of carbon in fuel type i in year y (t C/mass unit of the fuel)
$\rho_{i,y}$	=	Is the weighted average density of fuel type i in year y (mass unit/volume unit of the fuel)
i	=	Are the fuel types combusted in process j during the year y

Since the amount of used fossil fuel will be measured in a mass unit, Equation (10) will be applied.

Leakage

Any leakage emissions sources are deemed to be negligible.

Emission reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad \text{Equation (12)}$$

Where:

ER_y = Emission reductions in year y (t CO₂e)

BE_y = Baseline emissions in year y (t CO₂e)

PE_y = Project emissions in year y (t CO₂e)

B.6.2. Data and parameters fixed ex ante

Data / parameter table 1.

Data/Parameter	Operating pressure
Data unit	KPa
Description	Operating pressure of the ammonia burner
Source of data	Manufacturer's specifications
Value(s) applied	383 (equivalent to 3.83 barg)
Choice of data or measurement methods and procedures	N/A
Purpose of data	The parameter is used to determine whether the nitric acid plant operates at a low, medium or high pressure.
Additional comment	N/A

Data / parameter table 2.

Data/Parameter	EF _{historical}
Data unit	kg N ₂ O/t HNO ₃
Description	Historical baseline emission factor of the nitric acid plant
Source of data	Historical information from issuance reports of CDM-PDD documents
Value(s) applied	7.23
Choice of data or measurement methods and procedures	Plants that used AM0028 in the first crediting period shall use the lowest baseline emission factor obtained in one calendar year, from 1 January to 31 December, obtained during the first crediting period; AFC plant used AM0028 in the first crediting period accordingly the lowest baseline emission factor obtained in one calendar year, from 1 January to 31 December, obtained during the first crediting period is used. Calculation of EF _{historical} is based on actual data of overall historical baseline emission factor of the nitric acid plant of the first crediting period from issuance reports of CDM-PDD.
Purpose of data	Calculation of baseline emissions
Additional comment	This value will remain constant over the second and third crediting period.

Data / parameter table 3.

Data/Parameter	EF _{default,y}				
Data unit	kg N ₂ O/t HNO ₃				
Description	Default emission factor according to the operating pressure of the ammonia burner in year y (related to 100 per cent pure acid)				
Source of data	This default N ₂ O baseline emission factor will vary every year. In the year 2013 the emission factors will be 5.5; 8.4; and 12.6 kg N ₂ O/t HNO ₃ for low, medium and high pressure ammonia burners. For each subsequent year, the emission factors will decrease by 0.2 kg N ₂ O/t HNO ₃ until they reach a value of 2.5 or 2.4. After reaching the values of 2.5 or 2.4 the emission factor will remain constant over time.				
	Value(s) applied				
Choice of data or measurement methods and procedures	N/A				
Purpose of data	Calculation of baseline emissions				
Additional comment	The decrease in the value for the baseline emission factor over time is to reflect the technological development.				

Data / parameter table 4.

Data/Parameter	EF _{new,y}
Data unit	kg N ₂ O/t HNO ₃
Description	Baseline N ₂ O emission factor for nitric acid production in year y (related to 100

	per cent pure acid)	
Source of data	The baseline N_2O emission factor for nitric acid production will vary every year. In year 2005 the emission factor will be 5.1 and then it will decrease every year until it reaches a final value of 2.5 in the year 2020. The value of 2.5 will remain constant after 2020.	
	Year	Emission factor (kg N_2O/t HNO_3)
	2005	5.10
	2006	4.90
	2007	4.70
	2008	4.60
	2009	4.40
	2010	4.20
	2011	4.10
	2012	3.90
	2013	3.70
	2014	3.50
	2015	3.40
	2016	3.20
	2017	3.00
	2018	2.80
	2019	2.70
	2020	2.50
	2021	2.50
	2022	2.50
	2023	2.50

	Year n	2.50
Value(s) applied	Year	Emission factor (kg N_2O/t HNO_3)
	2013	3.70
	2014	3.50
	2015	3.40
	2016	3.20
	2017	3.00
	2018	2.80
	2019	2.70
	2020	2.50
Choice of data or measurement methods and procedures	N/A	
Purpose of data	Calculation of baseline emissions	
Additional comment	The decrease in the value for the baseline emission factor over time is to reflect the technological development.	

Data / parameter table 5.

Data/Parameter	P_{product,max}
Data unit	t product
Description	Design capacity of nitric acid production during the first crediting period
Source of data	Manufacture's specifications
Value(s) applied	700,800

Choice of data or measurement methods and procedures	N/A
Purpose of data	Calculation of baseline emissions
Additional comment	This parameter is only for project activities applying case 1.

Data / parameter table 6.

Data/Parameter	GWP_{N2O}
Data unit	t CO ₂ e/t N ₂ O
Description	Global warming potential of N ₂ O valid for the commitment period
Source of data	Relevant decisions by the CMP
Value(s) applied	298
Choice of data or measurement methods and procedures	None
Purpose of data	Calculation of baseline and project emissions
Additional comment	N/A

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

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

Data/Parameter	MM _i		
Data unit	kg/kmol		
Description	Molecular mass of greenhouse gas i		
Source of data	“Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0)		
Value(s) applied	Compound	Structure	Molecular mass (kg/kmol)
	Nitrous oxide	N ₂ O	44.02
Choice of data or measurement methods and procedures	Specified in the tool		
Purpose of data	Calculation of project emissions		
Additional comment	N/A		

Data/Parameter	P_n
Data unit	Pa
Description	Total pressure at normal conditions
Source of data	"Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 02.0.0)
Value(s) applied	101,325 Pa
Choice of data or measurement methods and procedures	Specified in the tool
Purpose of data	Calculation of project emissions
Additional comment	This parameter will be used to determine the mass flow of the N ₂ O in the tail gas.

Data/Parameter	T_n
Data unit	K
Description	Temperature at normal conditions
Source of data	"Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 02.0.0)
Value(s) applied	273.15 K
Choice of data or measurement methods and procedures	Specified in the tool
Purpose of data	Calculation of project emissions
Additional comment	This parameter will be used to determine the mass flow of the N ₂ O in the tail gas.

B.6.3. Ex ante calculation of emission reductions

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Baseline Emissions

Since the proposed project activity used AM0028 in the first crediting period, Case 1 was applied and therefore baseline emissions are given by the following equation:

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

Where:

BE_y	= Baseline emissions in year y (t CO ₂ e)
$P_{product,max}$	= Design capacity (t HNO ₃)
$P_{production,y}$	= Production of nitric acid in year y (t HNO ₃)
$EF_{existing,y}$	= N ₂ O emission factor for nitric acid plants that have used AM0028 or AM0034 in the first crediting period in year y (kg N ₂ O/t HNO ₃)
$EF_{new,y}$	= Baseline N ₂ O emission factor for nitric acid production in year y (kg N ₂ O/t HNO ₃)
GWP_{N_2O}	= Global Warming Potential of N ₂ O valid for the commitment period
h_y	= Number of hours in year y during which the plant was in operation (h)

$h_{r,y}$ = Number of hours (h) in year y where:

- (a) For secondary N₂O abatement: the abatement system was not installed, underperforming or failed;
- (b) For tertiary N₂O abatement: the abatement system is by-passed, underperforming or failed

Year	BE _y	EF _{existing,y}	EF _{new,y}	P _{production,y}	P _{product,max}	h _y	h _{r,y}	GWP _{N2O}
	tCO ₂ e	kgN ₂ O / tHNO ₃	kgN ₂ O / tHNO ₃	tHNO ₃	tHNO ₃	h	h	-
15/09 – 31/12/2013	382,878	7.23	3.70	177,712	207,360	2,343	0	298
2014	1,293,984	7.23	3.50	600,600	700,800	7,920	0	298
2015	1,293,984	7.23	3.40	600,600	700,800	7,920	0	298
2016	1,293,984	7.23	3.20	600,600	700,800	7,920	0	298
2017	1,293,984	7.23	3.00	600,600	700,800	7,920	0	298
2018	1,293,984	7.23	2.80	600,600	700,800	7,920	0	298
2019	1,288,647	7.20	2.70	600,600	700,800	7,920	0	298
01/01 – 14/09/2020	882,145	7.00	2.50	422,888	493,440	5,577	0	298

The operating hours (h_y) were calculated on the basis of 330 operating days per full year of operation: (1 h x 24 h / day x 330 days (number of intervals) = 7,920 h / year)

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

Where:

$EF_{existing,y}$ = N₂O emission factor for nitric acid plants that have used AM0028 or AM0034 in the first crediting period in year y (kg N₂O/t HNO₃)

$EF_{historical}$ = Historical baseline emission factor of the nitric acid plant (kg N₂O/t HNO₃)

$EF_{default,y}$ = Default emission factor according to the operating pressure of the ammonia burner in year y (kg N₂O/t HNO₃)

Year	EF _{existing,y}	EF _{historical,y}	EF _{default,y} (for medium pressure)
	kgN ₂ O/tHNO ₃	kgN ₂ O/tHNO ₃	kgN ₂ O/tHNO ₃
15/09 – 31/12/2013	7.23	7.23	8.40
2014	7.23	7.23	8.20
2015	7.23	7.23	8.00
2016	7.23	7.23	7.80
2017	7.23	7.23	7.60
2018	7.23	7.23	7.40
2019	7.20	7.23	7.20
01/01 – 14/09/2020	7.00	7.23	7.00

Project Emissions

Project emissions are defined by the following equation:

$$PE_y = PE_{N2O,y} + PE_{CO2,tertiary,y}$$

Where:

PE_y = Project emissions in year y (t CO₂e)

$PE_{N_2O,y}$ = Project emissions of N₂O from the project plant in year y (t CO₂e)

$PE_{CO_2,tertiary,y}$ = Project emissions of CO₂ from the operation of the tertiary N₂O abatement facility in year y (t CO₂)

Year	PE_y	$PE_{N_2O,y}$	$PE_{CO_2,tertiary,y}$
	tCO ₂ e	tCO ₂ e	tCO ₂
15/09– 31/12/2013	4,471	4,029	442
2014	15,111	13,617	1,494
2015	15,111	13,617	1,494
2016	15,111	13,617	1,494
2017	15,111	13,617	1,494
2018	15,111	13,617	1,494
2019	15,111	13,617	1,494
01/01– 14/09/2020	10,640	9,588	1,052

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

$$PE_{N_2O,y} = \sum_{h_y-h_{r,y}} F_{N_2O,tail\ gas,h} \times GWP_{N_2O} \times 10^{-3}$$

Where:

$PE_{N_2O,y}$ = Project emissions of N₂O from the project plant in year y (t CO₂e)

GWP_{N_2O} = Global warming potential of N₂O valid for the commitment period

$F_{N_2O,tailgas,h}$ = Mass flow of N₂O in the gaseous stream of the tail gas in the hour h (kg N₂O/h)

h_y = Number of hours in year y during which the plant was in operation (h)

$h_{r,y}$ = Number of hours (h) in year y where:

- For secondary N₂O abatement. Abatement system was not installed, underperforming or failed;
- For tertiary N₂O abatement. The abatement system is by-passed, underperforming or failed

Year	$PE_{N_2O,y}$	$F_{N_2O,tailgas,h}$	h_y	$h_{r,y}$	GWP_{N_2O}
	tCO ₂ e	kgN ₂ O/h	h	h	-
15/09– 31/12/2013	4,029	5.77	2,343	0	298
2014	13,617	5.77	7,920	0	298
2015	13,617	5.77	7,920	0	298
2016	13,617	5.77	7,920	0	298
2017	13,617	5.77	7,920	0	298
2018	13,617	5.77	7,920	0	298
2019	13,617	5.77	7,920	0	298
01/01– 14/09/2020	9,588	5.77	5,577	0	298

The operating hours (h_y) were calculated on the basis of 330 operating days per full year of operation: (1 h x 24 h / day x 330 days (number of intervals) = 7,920 h / year)

According to currently available information $F_{N_2O, tail gas, h}$ was determined to 5.77 kg N₂O/h and was used for ex-ante determination.

Since the N₂O concentration and the volume flow of the tail gas and by-pass are automatically converted to normal conditions, the parameters P_t and T_t need not to be monitored. Therefore, Equation 5, 6 and 11 of the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” were derived in order to determine a fixed value for the N₂O density at normal conditions ($P_t = P_n = 101,325$ Pa; $T_t = T_n = 273.15$ K). Accordingly, the N₂O density at normal conditions was determined to be 1.96 kg/m³.

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

With

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

Where

$F_{i,t}$	=	Mass flow of greenhouse gas i in the gaseous stream in time interval t (kg gas / h)
$V_{t,db}$	=	Volumetric flow of the gaseous stream in time interval t on a dry basis at OPERATING CONDITIONS (m ³ dry gas / h)
$V_{t,db,n}$	=	Volumetric flow of the gaseous stream in time interval t on a dry basis at NORMAL CONDITIONS (m ³ dry gas / h)
$v_{i,t,db}$	=	Volumetric fraction of greenhouse gas i in the gaseous stream in a time interval t on a dry basis (m ³ gas i / m ³ dry gas)
$\rho_{i,t}$	=	Density of greenhouse gas i in the gaseous stream in time interval t (kg gas i / m ³ gas i)
P_t	=	Absolute pressure of the gaseous stream in time interval t (Pa)
MM_i	=	Molecular mass of greenhouse gas i (kg/kmol)
R_u	=	Universal ideal gases constant (Pa m ³ / kmol K)
T_t	=	Temperature of the gaseous stream in time interval t (K)
T_n	=	Temperature at normal conditions (K)
P_n	=	Pressure at normal conditions (Pa)

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

→ Tool is used, exclusively formulae therein are applied

In the case that the N₂O concentration and the volume or mass flow of the tail gas and by-pass are automatically converted to normal conditions by the AMS during the monitoring process, the parameters P_t and T_t do not need to be monitored except, if applicable, for the purpose of determining the moisture content in the gaseous stream.

→ Reached through transformation of formulae → P_t and T_t need not to be monitored, since the N₂O concentration and the volume flow of the tail gas and by-pass are automatically converted to normal conditions.

Year	$F_{N_2O, tail gas, h} = F_{i,t}$	$\rho_{i,t}$	$V_{t,db}$	$v_{i,t,db}$
	kgN ₂ O/h	kg gas i/m ³ gas i	Nm ³ dry gas/h	m ³ gas i/ m ³ dry gas
15/09 –31/12/2013	5.77	1.96	235,000	1.25E-05
2014	5.77	1.96	235,000	1.25E-05

2015	5.77	1.96	235,000	1.25E-05
2016	5.77	1.96	235,000	1.25E-05
2017	5.77	1.96	235,000	1.25E-05
2018	5.77	1.96	235,000	1.25E-05
2019	5.77	1.96	235,000	1.25E-05
01/01 – 14/09/2020	5.77	1.96	235,000	1.25E-05

Year	$\rho_{i,t}$	P_n	MM_i	R_u	T_n
	kg gas i/m ³ gas i	Pa	kg/kmol	Pa.m ³ /kmol.K	K
15/09 – 31/12/2013	1.96	101,325	44.02	8,314	273.15
2014	1.96	101,325	44.02	8,314	273.15
2015	1.96	101,325	44.02	8,314	273.15
2016	1.96	101,325	44.02	8,314	273.15
2017	1.96	101,325	44.02	8,314	273.15
2018	1.96	101,325	44.02	8,314	273.15
2019	1.96	101,325	44.02	8,314	273.15
01/01 – 14/09/2020	1.96	101,325	44.02	8,314	273.15

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

$$PE_{CO_2,tertiary,y} = PE_{FF,y}$$

Where:

$PE_{CO_2,tertiary,y}$ = Project emissions of CO₂ from the operation of the tertiary N₂O abatement facility in year y (t CO₂)

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

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

Year	$PE_{CO_2,tertiary,y} = PE_{FF,y} = PE_{FC,j,y}$
	tCO ₂ /y
15/09 – 31/12/2013	442
2014	1,494
2015	1,494
2016	1,494
2017	1,494
2018	1,494
2019	1,494
01/01 – 14/09/2020	1,052

$$PE_{FC,j,y} = \sum_i FC_{i,j,y} \times COEF_{i,y}$$

Where:

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

Year	$PE_{FC,j,y}$	$FC_{i,j,y}$	$COEF_{j,y}$
	tCO ₂ /y	Nm ³ /y	tCO ₂ /Nm ³
15/09 – 31/12/2013	442	207,123	2.13E-03
2014	1,494	700,000	2.13E-03
2015	1,494	700,000	2.13E-03
2016	1,494	700,000	2.13E-03
2017	1,494	700,000	2.13E-03
2018	1,494	700,000	2.13E-03
2019	1,494	700,000	2.13E-03
01/01 – 14/09/2020	1,052	492,877	2.13E-03

Based on the currently available information **Option A** of the tool will be applied, as the chemical composition of the used fossil fuel (i.e. natural gas) will be provided by the natural gas supplier.

The CO₂ emission coefficient $COEF_{i,y}$ is calculated based on the chemical composition of the fossil fuel type i , using the following approach:

$$COEF_{i,y} = w_{C,i,y} \times \rho_{i,y} \times 44 / 12$$

$FC_{i,j,y}$ is measured in a volume unit

Where:

- $COEF_{i,y}$ = Is the CO₂ emission coefficient of fuel type i (t CO₂/mass or volume unit)
- $w_{C,i,y}$ = Is the weighted average mass fraction of carbon in fuel type i in year y (t C/mass unit of the fuel)
- $\rho_{i,y}$ = Is the weighted average density of fuel type i in year y (mass unit/volume unit of the fuel)
- i = Are the fuel types combusted in process j during the year y

Year	$COEF_{i,y}$	$\rho_{i,y}$	$w_{C,i,y}$
	tCO ₂ /Nm ³	t/Nm ³	tC/t
15/09 – 31/12/2013	2.13E-03	7.80E-04	0.75
2014	2.13E-03	7.80E-04	0.75
2015	2.13E-03	7.80E-04	0.75
2016	2.13E-03	7.80E-04	0.75
2017	2.13E-03	7.80E-04	0.75
2018	2.13E-03	7.80E-04	0.75
2019	2.13E-03	7.80E-04	0.75
01/01 – 14/09/2020	2.13E-03	7.80E-04	0.75

Leakage

According to the applied methodology any leakage emissions sources are deemed to be negligible.

Emission Reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$

Where:

ER_y = Emission reductions in year y (t CO₂e)

BE_y = Baseline emissions in year y (t CO₂e)

PE_y = Project emissions in year y (t CO₂e)

Year	ER _y	BE _y	PE _y
	tCO ₂ e	tCO ₂ e	tCO ₂ e
15/09 – 31/12/2013	378,406	382,878	4,471
2014	1,278,874	1,293,984	15,111
2015	1,278,874	1,293,984	15,111
2016	1,278,874	1,293,984	15,111
2017	1,278,874	1,293,984	15,111
2018	1,278,874	1,293,984	15,111
2019	1,273,536	1,288,647	15,111
01/01 – 14/09/2020	871,505	882,145	10,640

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

Year	Baseline emissions (t CO ₂ e)	Project emissions (t CO ₂ e)	Leakage (t CO ₂ e)	Emission reductions (t CO ₂ e)
15/09 – 31/12/2013	382,878	4,471	0	378,406
2014	1,293,984	15,111	0	1,278,874
2015	1,293,984	15,111	0	1,278,874
2016	1,293,984	15,111	0	1,278,874
2017	1,293,984	15,111	0	1,278,874
2018	1,293,984	15,111	0	1,278,874
2019	1,288,647	15,111	0	1,273,536
01/01– 14/09/2020	882,145	10,640	0	871,505
Total	9,023,592	105,776	0	8,917,815
Total number of crediting years	7 years			
Annual average over the crediting period	1,289,085	15,111	0	1,273,974

Note that actual estimation of overall emission reductions as presented in chapters B6.3 and B6.4 has been done in an excel book. Conservative rounding has been made for final ER_y calculation only.

B.7. Monitoring plan

>>

All data collected as part of monitoring will be archived electronically and be kept at least for 2 years after the end of the last crediting period. 100% of the data will be monitored if not indicated otherwise in the tables below. All measurements will be conducted with calibrated measurement equipment according to relevant industry standards.

The accuracy of the N_2O emissions monitoring results will be ensured by installing a monitoring system that has been certified to meet 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) will be used as the basis for selecting and operating the monitoring system.

The value(s) applied in the parameter tables below are an estimate of the data/parameters that will be monitored during the crediting period, but are used for the purpose of calculating estimated emission reductions above. The value(s) applied are generally based on historic values from the 1st crediting period, taking into consideration future trends.

B.7.1. Data and parameters to be monitored

Data / Parameter table 7.

Data/Parameter	$P_{\text{production},y}$
Data unit	t HNO_3
Description	Nitric acid produced in year y
Source of data	<p>Production reports</p> <p>The actual nitric acid production is measured according to the installed instruments. The instrument signals are recorded in the control room and used to determine whether the nitric acid production is within the historical designed capacity.</p> <p>The HNO_3 production data are derived from production reports, which are prepared in accordance with AFC's quality management system ISO 9001:2008.</p> <p>The cumulative volume of HNO_3 and the dedicated temperature in the HNO_3 line are recorded. The concentration of the nitric acid is analysed and recorded as well.</p> <p>The daily HNO_3 production and the daily average concentration are recorded by AFC. This data is used for cross-check purpose.</p>
Value(s) applied	600,600
Measurement methods and procedures	<p>FT 21411 Type: Magnetic flow meter Accuracy class: + 0.25% Calibration frequency: 2 years from commissioning or latest general maintenance (meter verification)</p> <p>TE 21042 Type: Temperature Transmitter Accuracy class: + 0.15°C digital accuracy in accordance with IEC 751 Calibration frequency: 2 years</p>
Monitoring frequency	Recording frequency: daily

QA/QC procedures	In order to prove plausibility of HNO ₃ production cross-checks will be performed (conversion efficiency). The quality assurance and quality control procedures, in terms of equipment operations and maintenance, have been incorporated in the ISO 9001:2008 and ISO 14001:2009 procedures of AFC.
Purpose of data	Calculation of baseline emissions
Additional comment	The parameter P _{NA,h} (Nitric acid produced in the hour h) represents the hourly value of P _{production,y} and is used for determining h _{r,y} as described in section 5.3.3 of the applied methodology (Equation 4).

Data / Parameter table 8.

Data/Parameter	h_y
Data unit	h
Description	Number of hours of operation in year y
Source of data	Measured
Value(s) applied	No measurements available at this stage of the project. The assumed values for ex-ante Emission Reductions calculations can be found in respective calculation tables in section B.6.3.
Measurement methods and procedures	The operation temperature of the two oxidation burners ranges from 850 – 910°C (as defined by the technology supplier) and this range corresponds to the real operation hours of the reactor. Therefore the plant is considered to be in operation when the temperature is in a range from 850 – 910°C. The temperature is reported automatically by two independent measurement points for each burner measuring the temperature at the same time. Instruments TAG numbers: Burner I: TE 21014 TE 21015 Burner II: TE 21020 TE 21021 The values of the instrument with the TAG numbers TE 21015 and TE 21021 were selected as main signals for monitoring the operation temperature; TE 21014 and TE 21020 will be used as back-up signals in case of malfunction of the main signals. The information will be stored in electronic records and paper during whole project's lifetime.
Monitoring frequency	Every monitoring period
QA/QC procedures	Periodic calibration of relevant temperature transmitter as above mentioned will be performed according to supplier's recommendations. The quality assurance and quality control procedures, in terms of equipment operations and maintenance, have been incorporated in the ISO 9001:2008 and ISO 14001:2009 procedures of AFC.
Purpose of data	Calculation of baseline and project emissions
Additional comment	Records to be maintained during project's lifetime

Data / Parameter table 9.

Data/Parameter	h_{r,y}
Data unit	h
Description	For tertiary N ₂ O abatement, Number of hours (h) in year y where the abatement system is by-passed, underperforming or failed
Source of data	Measured

Value(s) applied	No measurements available at this stage of the project. The assumed values for ex-ante Emission Reductions calculations can be found in respective calculation tables in section B.6.3.
Measurement methods and procedures	AFC nitric acid plant has used AM0028 in the first crediting period, accordingly the abatement system is deemed to be by-passed, not working or failed in the hour h in year y if: $F_{N2O,tailgas,h} > EF_{existing,y} \times P_{NA,h}$ <p>The parameters mentioned above will be determined and monitored as explained in the respective sections of this PDD ($P_{NA,h} \rightarrow$ Parameter table 7; $F_{N2O,tailgas,h} \rightarrow$ Parameter table 10 – 12; $EF_{existing,y} \rightarrow$ need not to be monitored, since it's fixed for the crediting period).</p>
Monitoring frequency	Every monitoring period
QA/QC procedures	The quality assurance and quality control procedures, in terms of equipment operations and maintenance, have been incorporated in the ISO 9001:2008 and ISO 14001:2009 procedures of AFC.
Purpose of data	Calculation of baseline and project emissions
Additional comment	Records to be maintained during project's lifetime. The parameter $P_{NA,h}$ (Nitric acid produced in the hour h) represents the hourly value of $P_{production,y}$ and is used for determining $h_{r,y}$ as described in section 5.3.3 of the applied methodology (Equation 4).

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

Data / Parameter table 10.

Data/Parameter	$V_{t,db,n}$
Data unit	m ³ dry gas/h
Description	Volumetric flow of the gaseous stream in time interval t on a dry basis
Source of data	Measured
Value(s) applied	No measurements available at this stage of the project. The assumed values for ex-ante Emission Reductions calculations can be found in respective calculation tables in section B.6.3.
Measurement methods and procedures	Volumetric flow measurement will refer to normal conditions. Calculated based on the dry basis flow measurement plus water concentration measurement (according to Option A of the tool).
Monitoring frequency	Continuous monitoring
QA/QC procedures	According to European Norm 14181.
Purpose of data	Calculation of project emissions
Additional comment	Option A parameter, according to the applied tool The volume flow is converted to normal conditions according to the applied methodology. Therefore, the respective parameters were determined at normal conditions ($P_t = P_n = 101,325$ Pa; $T_t = T_n = 273.15$ K).

Data / Parameter table 11.

Data/Parameter	$V_{i,t,db}$
Data unit	m ³ gas i/m ³ dry gas
Description	Volumetric fraction of greenhouse gas i in a time interval t on a dry basis
Source of data	Measured
Value(s) applied	No measurements available at this stage of the project. The assumed values for ex-ante Emission Reductions calculations can be found in respective calculation tables in section B.6.3.

Measurement methods and procedures	AT 218002 Type: Non-dispersion infrared absorption analyser Calibration frequency: as per EN 14181 Continuous gas analyser operating in dry-basis. Volumetric flow measurement refers to normal conditions.
Monitoring frequency	Continuous monitoring
QA/QC procedures	According to European Norm 14181. Calibration should include zero verification with an inert gas (N ₂) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). Certified (certificates confirming stability of standard) standard gases are used. The quality assurance and quality control procedures, in terms of equipment operations and maintenance, have been incorporated in the ISO 9001:2008 and ISO 14001:2009 procedures of AFC.
Purpose of data	Calculation of project emissions
Additional comment	The N ₂ O concentration is converted to normal conditions according to the applied methodology. Therefore, the respective parameters were determined at normal conditions ($P_t = P_n = 101,325 \text{ Pa}$; $T_t = T_n = 273.15 \text{ K}$).

Data / Parameter table 12.

Data/Parameter	C_{H2O,t,db,n}
Data unit	mg H ₂ O/m ³ dry gas
Description	Moisture content of the gaseous stream at normal conditions, in time interval t
Source of data	Measurements according to the USEPA CF42 method 4 – Gravimetric determination of water content
Value(s) applied	No measurements available at this stage of the project. Calculated value for ex-ante determination of emission reductions is 1,575 mg H ₂ O/m ³ dry gas (= 0.00157 kg H ₂ O/m ³ dry gas)
Measurement methods and procedures	Discrete measurement procedure No measurements available at this stage of the project.
Monitoring frequency	The mean value among three consecutive measurements performed in the same day (at least 2 hours each) shall be considered. Measurements will coincide with the Annual Surveillance Test (associated with requirements of the EN 14181 standard) or the calibration of the flow meter for the gaseous stream.
QA/QC procedures	According to the USEPA CF42 method 4
Purpose of data	Calculation of project emissions
Additional comment	Option A parameter for proving that the gaseous stream is dry.

Data/Parameter	T_t
Data unit	K
Description	Temperature of the gaseous stream in time interval t
Source of data	N/A
Value(s) applied	N/A
Measurement methods and procedures	N/A
Monitoring frequency	N/A
QA/QC procedures	N/A
Purpose of data	Calculation of baseline emissions
Additional comment	Need not to be monitored, since the N ₂ O concentration and the volume flow are converted to normal conditions according to the applied methodology.

Data/Parameter	P_t
Data unit	Pa
Description	Pressure of the gaseous stream in time interval t

Source of data	N/A
Value(s) applied	N/A
Measurement methods and procedures	N/A
Monitoring frequency	N/A
QA/QC procedures	N/A
Purpose of data	N/A
Additional comment	Need not to be monitored, since the N ₂ O concentration and the volume flow are converted to normal conditions according to the applied methodology.

Parameters from the “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion” (Version 02)

Data / Parameter table 13.

Data/Parameter	FC_{i,j,y}
Data unit	Nm ³ /y
Description	Quantity of fuel type i combusted in process j during the year y
Source of data	Onsite measurements The natural gas used as reducing agent is measured by standard flow meter. Flow is converted to standard conditions based on temperature and pressure measurement.
Value(s) applied	700,000
Measurement methods and procedures	FT 218002 Type: Natural gas flow meter Accuracy class: + 1.6% in accordance with VDI/VDE 3513 Calibration frequency: 2 years TE 218004 Type: Temperature transmitter Accuracy class: + 0.1% of calibrated span Calibration frequency: 2 years PT 218004 Type: Pressure transmitter Accuracy class: + 0.075% of calibrated span Calibration frequency: 2 years
Monitoring frequency	Continuous monitoring; daily recording
QA/QC procedures	As far as feasible the consistency of metered fuel consumption quantities should be cross-checked for plausibility by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should be cross-checked with available purchase invoices from the financial records. The quality assurance and quality control procedures, in terms of equipment operations and maintenance, have been incorporated in the ISO 9001:2008 and ISO 14001:2009 procedures of AFC.
Purpose of data	Calculation of project emissions
Additional comment	N/A

Data / Parameter table 14.

Data/Parameter	WC_{i,y}
Data unit	tC/mass unit of the fuel type
Description	Weighted average mass fraction of carbon in fuel type i in year y
Source of data	Certificate of hydrocarbon supplier

Value(s) applied	0.75						
Measurement methods and procedures	<p>The following data sources may be used if the relevant conditions apply:</p> <table border="1"> <thead> <tr> <th>Data source</th><th>Conditions for using the data source</th></tr> </thead> <tbody> <tr> <td>a) Value provided by the fuel supplier in invoices</td><td>This is the preferred source</td></tr> <tr> <td>b) Measurement by the project participants</td><td>If a) is not available</td></tr> </tbody> </table> <p>Composition of the delivered hydrocarbon is measured by the supplier and provided on specific certificates.</p>	Data source	Conditions for using the data source	a) Value provided by the fuel supplier in invoices	This is the preferred source	b) Measurement by the project participants	If a) is not available
Data source	Conditions for using the data source						
a) Value provided by the fuel supplier in invoices	This is the preferred source						
b) Measurement by the project participants	If a) is not available						
Monitoring frequency	Measuring; In order to assure conservativeness a certificate from the hydrocarbon supplier is requested at least on a yearly basis. The mass fraction of carbon should be obtained regularly, from which weighted average annual values should be calculated.						
QA/QC procedures	It will be verified, if the applied value is within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines.						
Purpose of data	Calculation of project emissions						
Additional comment	Applicable where Option A of the tool is used						

Data / Parameter table 15.

Data/Parameter	$\rho_{i,y}$						
Data unit	t/Nm ³						
Description	Weighted average density of fuel type i in year y						
Source of data	Certificate of hydrocarbon supplier						
Value(s) applied	7.8*10 ⁻⁴						
Measurement methods and procedures	<p>The following data sources may be used if the relevant conditions apply:</p> <table border="1"> <thead> <tr> <th>Data source</th><th>Conditions for using the data source</th></tr> </thead> <tbody> <tr> <td>a) Value provided by the fuel supplier in invoices</td><td>This is the preferred source</td></tr> <tr> <td>b) Measurement by the project participants</td><td>If a) is not available</td></tr> </tbody> </table> <p>Composition of the delivered hydrocarbon is measured by the supplier and provided on specific certificates.</p>	Data source	Conditions for using the data source	a) Value provided by the fuel supplier in invoices	This is the preferred source	b) Measurement by the project participants	If a) is not available
Data source	Conditions for using the data source						
a) Value provided by the fuel supplier in invoices	This is the preferred source						
b) Measurement by the project participants	If a) is not available						
Monitoring frequency	Measuring; In order to assure conservativeness a certificate from the hydrocarbon supplier is requested at least on a yearly basis. The mass fraction of carbon should be obtained regularly, from which weighted average annual values should be calculated.						
QA/QC procedures	N/A						
Purpose of data	Calculation of project emissions						
Additional comment	Applicable where Option A is used and where $FC_{i,j,y}$ is measured in a volume unit. Preferably the same data source should be used for $w_{C,i,y}$ and $\rho_{i,y}$.						

Leakage emissions

According to the methodology any leakage emissions sources are deemed to be negligible.

B.7.2. Sampling plan

>>

Not applicable for the project activity.

B.7.3. Other elements of monitoring plan

>>

The emission reductions achieved by the project activity will be monitored using the requirements of the approved consolidated baseline and monitoring methodology ACM0019 "N₂O abatement from nitric acid production" (Version 02.0.0) and of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 02.0.0).

Measurement of the N₂O concentration and the total gas volume flow

The project will employ the latest state of the art monitoring and control equipment that measures, records and reports all key parameters to determine the GHG emission reductions. The plant will be equipped with an Automated Monitoring System (AMS) in order to allow continuous real-time measurements of the N₂O concentration and the total gas volume flow, which is required by the methodology.

The amount of N₂O emissions from the tail gas stream of the project plant shall be determined using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream". In applying the tool, the following provisions apply:

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

The European Norm EN 14181 stipulates three levels of quality assurance tests and one annual functional test for AMS, which are recommended to be used as guidance regarding the selection, installation and operation of the AMS under the applied monitoring methodology. The three quality assurance levels (QAL) are as follows:

1. Quality assurance of tested AMS. AMS will have performance certificate with calculation of uncertainty before installation. The specific performance characteristics of the monitoring system chosen by the project will be listed in the Monitoring Reports.
2. Quality assurance of installation and calibration of the Automated Measuring System according to the Standard Reference Measurement Method (SRM) for concentration measurements, determination of the measurement uncertainty/variability of the AMS and inspection of the compliance with the prescribed measurement uncertainties. Such tests will be carried out by organisations that have an accredited quality assurance system.
3. Continuous quality assurance through the local operator/manager.
 - a) Permanent quality assurance during the plant operation by the operating staff;
 - b) Assurance of reliable and correct operation of the monitoring equipment (maintenance evidence);
 - c) Regular controls as scheduled by the manufacturer (maintenance intervals);

In addition, annual functionality tests including SRM measurements to check for uncertainties in the data measured by the AMS are planned. Such tests will be carried out by organisations that have an accredited quality assurance system.

Operational and Management structure

Project Operator is Abu Qir Fertilizer Co. S.A.E. (furthermore called "AFC"), the biggest Fertilizer Company in Africa. AFC was founded as a joint stock company located and registered in the Alexandria Province under Egyptian law in 1976 and is the market leader with a market share of close to 70% of the local Egyptian fertilizer market. With closely to 3,000 employees AFC is among the major job providers in Alexandria area. The company is ISO 9001:2008 and ISO 14001:2009 certified and one of the most important companies of the Egyptian industry. The EnviNOx® system is incorporated into AFC's ISO 9001:2008 and ISO 14001:2009 standards.

The operating personnel of the EnviNOx® system has been trained by the technology provider UHDE and the supplier of the digital process control system (Delta V, EMERSON process management). Carbon Egypt is responsible for monitoring and reporting of data under the CDM Project. In terms of performing general supervision and cross-checks of monitoring and reporting data Carbon in Austria supports Carbon Egypt. Details are specified as per the "Procedures for CDM Project".

Data collection

The instruments transmitters continuously provide a 4 – 20 mA analogue signal according to range and units configured. These signals are transmitted to I/O cards (analogue input/output cards) and collected by the Delta V Processor. Resulting digital values are made available in the network to be further processed (e.g. in controller blocks, calculation of other variables) and are stored in the protected continuous historian server (CHS).

The reporting module of the Delta V system automatically generates aggregated daily reports based on the stored raw data from the continuous historian server.

Relevant parameters are exported for presentation of required parameters and calculation of baseline emissions, project emissions and emission reductions according to the formulae as required.

Daily production of the nitric acid plant ($P_{\text{production},y}$) is obtained from production reports for cross-checking.

Details are specified as per the "Procedures for CDM Project".

SECTION C. Start date, crediting period type and duration**C.1. Start date of project activity**

>>

09/10/2004 (the date when the contract between AFC and CARBON has been signed)

C.2. Expected operational lifetime of project activity

>>

25 years, 0 months

C.3. Crediting period of project activity**C.3.1. Type of crediting period**

>>

Renewable (second crediting period)

C.3.2. Start date of crediting period

>>

15/09/2013

C.3.3. Duration of crediting period

>>

7 years, 0 months

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

>>

The catalytic N₂O destruction project in the tail gas of the Nitric Acid Plant Abu Qir II is a sustainable project that contributes to the environmental, economic and social benefits in the Arab Republic of Egypt.

Environmental Impacts:

The ex-ante GHG emission reduction is estimated to be about 8.9 million tons of CO₂e in the second crediting period. Additionally, the EnviNOx®-system takes over the function of the DeNOx-unit at Abu Qir II as it accomplishes the reduction of NOx with ammonia as well. No further environmental impacts are expected.

The Environmental Assessment study was elaborated by an independent consultant and submitted to the Governorate of Alexandria. After the approval of the Governorate of Alexandria the study was submitted to the Egyptian Environmental Affair Agency (EEAA) for final approval.

EEAA final approval: 15/06/2006

EEAA approval letter No.: 02416 (Ministry of State for Environmental Affairs)

No transboundary impacts are expected.

According to the national Environment Law number 4 of Egypt (year 1994) and its latest revision by the prime minister resolution number 710 for 2012, the NOx emissions at nitric acid plants are

limited to 400 mg/m³ for the AFC nitric acid plant. Continuous measurement of the NO_x concentration at the outlet of the EnviNO_x® system during the first crediting period reports that the CDM Project operation is in compliance with the national environmental standards.

D.2. Environmental impact assessment

>>

In accordance with the Egyptian Environmental Law Number 4 (1994) a brief Environmental Assessment Study was prepared on the “Catalytic N₂O Destruction Project in the Tail Gas of the Nitric Acid Plant of Abu Qir Fertilizer Co.” and the project was approved by the Egyptian Environmental Affairs Agency.

The Environmental Affairs Agency accepts, from the environmental side, the said project conditioned the liability to all the specifications and procedures mentioned in the submitted study as well as all the conditions mentioned in the environment law no. (4) for the year 1994 with its executive regulations and to be obliged to the following conditions:

- Take the necessary precautions to limit any negative effects on the surrounded environment, resulting from building and operational procedures.
- Liability to the environmental management plan mentioned in the study, taking into consideration the necessary precautions to limit the gas emissions resulting from the project.
- Liability to supervision plan and periodical observation as well as the necessity to report the measurements in the environmental register and make it available upon environmental inspection.
- Liability to return the consumed catalysts to the supplier as mentioned in the study.
- Take into consideration the working environment correctness and the laborer's security as well as the necessity of its conformity with Annex (9) of the executive regulations of law no. (4) for the year 1994.
- This acceptance is from the environmental side only without breach to any of the laws or decisions or other organizing rules to this activity.

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

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CARBON has carried out an investigation on the local stakeholder comments on the proposed project activity in the formats of issuing questionnaires to introduce the aims and characteristics of the project and addressing in particular its potential environmental impacts.

A local stakeholder conference has been held by CARBON and AFC for stakeholders of the proposed project at the conference room of Hilton Green Plaza, Alexandria on 26th of March 2006. 49 participants attended the stakeholder conference, questionnaires were distributed and 32 had been returned.

Local public stakeholders were invited to the stakeholder meeting via personal invitation by AFC to the neighbours and companies around the area of Abu Qir. Furthermore, Egyptian governmental and non-governmental organizations and the DNA were invited. Moreover, to ensure that other interested parties were also invited, AFC published an announcement in the local newspaper. Lists of invited stakeholders and participants were presented to the DOE.

The contents of the stakeholder meeting are shown below.

- Welcoming address to the stakeholders by Mr. Mohammed Abdallah (Chairman of Abu Qir Fertilizer Co.)
- Welcoming address to the stakeholders by Mr. Ferdinand Heilig (Managing Director of Carbon)
- Welcoming address to the stakeholders by Dr. Sayed Mansour (Co-ordinator of Egyptian D.N.A.)
- Presentation of Abu Qir Fertilizer Co. & CDM project by Mr. Reda Kahlil (Vice President of Abu Qir Fertilizer Co.)
- Presentation of CDM-Project & Methodology by Mr. Ferdinand Heilig (Managing Director of Carbon)
- Questionnaires and Answers

Mr. Heilig was interviewed by the local Egyptian television which was broadcasted in Egypt.

E.2. Summary of comments received

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Translation of Environmental Stakeholder Consultation Meeting Minutes:

Statistics of Stakeholder's Conference for CDM Project

1. **Date** : March 26, 2006.

2. **Location** : At the conference room of Hilton Green Plaza, Alexandria

3. Number of Questionnaires returned

<i>Classification</i>	<i>Number</i>
Local Governmental Organisations	4
Local Non-Governmental Organisations	2
Austrian Embassy	2
Private	3
Neighbouring companies	2
Promotrade	1
Abu Qir Fertilizer Co.	9
UHDE Engineering Egypt Ltd.	7
Carbon GmbH	1
Carbon Egypt Ltd.	1
Total	32

4. Content of conference

Welcoming address to the stakeholders by Mr. Mohammed Abdallah (Chairman of Abu Qir Fertilizer Co.)

Welcoming address to the stakeholders by Mr. Ferdinand Heilig (Managing Director of Carbon)

Welcoming address to the stakeholders by Dr. Sayed Mansour (Co-ordinator of Egyptian D.N.A.)

Presentation of Abu Qir Fertilizer Co. & CDM project by Mr. Reda Kahlil (Vice President of Abu Qir Fertilizer Co.)

Presentation of CDM-Project & CARBON's Methodology AM0028 by Mr. Ferdinand Heilig (Managing Director of Carbon)
Questionnaires and Answers

5. Statistics of a survey of the stakeholders for the CDM project at Abu Qir Fertilizer Co.

- 32 stakeholders (out of 59 personal invited stakeholder) filled out the questionnaires

Questions to the Stakeholders	Yes	No
Do you think that the region and the Egyptian people living in the region will benefit from this CDM-Project?	32	0
Is your company or the organization you are working for / you are presenting influenced by this CDM-Project?	26	6
Will your company or the organization you are working for / you are presenting play a role in the implementation of this CDM-Project?	28	4
Do you think that the Egyptian government shall support this project?	31	1
Do you think that Egypt shall take efforts towards reducing greenhouse gas emissions within Egypt?	32	0
Do you consider that this CDM-Project will contribute to the sustainable development of Egypt?	32	0
Do you consider this CDM-Project as being "additional"?	30	2
Do you have any special remarks or questions the project participants shall answer to you? Which?		

6. Local News attending the Conference

Egyptian National TV: Interview with Mr. Heilig broadcasted in Egypt

Special remarks and questions discussed at the local stakeholder meeting:

- EEAA shall not hinder CDM Project with too much "bureaucracy";
- Benefit for local residents;
- Such CDM projects are not "additional" as they are "essential" for mankind;
- Possible measures against global warming.

E.3. Consideration of comments received

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The main concern of the local stakeholders was the impact of the project on the local air quality. The project sponsor and the project operator have explained and illustrated the guidelines for CDM projects under the United Nations Framework Convention on Climate Change and the effect of the proposed project activity on GHG emission reduction and NOX emission reduction.

Social Benefits: The project developer and the project operator agreed on spending a share of the total income from selling of the CERs for a Social Fund for the area of Abu Qir. This fund shall contribute to the social benefit of the people living in the area of the CDM project activity by financing sustainable projects like projects in schools, hospitals and infrastructure.

Economic Benefit: The project developer agreed to pay a share of the income of the CERs to the project operator, who is a major job provider in the region. Additionally, value and jobs were created in the region especially during the construction work of the EnviNOx®-system.

For the purpose of implementation this CDM Project CARBON Egypt Ltd. was founded and is registered under the laws of the Arab Republic of Egypt.

All remarks and questions were discussed at great length. No further comments were received during the stakeholder consultation process.

The project owner will pay attention to the comments and questions of stakeholders and will make all conceivable effort to achieve environmental benefits, social benefits and economic benefits.

SECTION F. Approval and authorization

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The letters of approval of the following Parties are available at the time of submitting the PDD to the validating DOE for renewal of crediting period:

- Egypt (Host)
- Austria
- Germany

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Appendix 1. Contact information of project participants

Organization name	CARBON EGYPT Ltd.
Country	Egypt
Address	2 Simon Bolivar Square, Garden City, Cairo
Telephone	+20 2 2792 0100
Fax	+20 2 2792 0200
E-mail	carboneg@internetegypt.com
Website	-
Contact person	Mr. Hani Riskalla

Organization name	Carbon Climate Protection GmbH
Country	Austria
Address	3550 Am Südblick 5/2, Langenlois
Telephone	+43-2734-32270
Fax	+43-2734-32270-99
E-mail	dunkel@carbon-austria.com
Website	-
Contact person	Mr. Gerald Dunkel

Organization name	RWE Power AG
Country	Germany
Address	Huyssenallee2 ,Essen
Telephone	+49 201 12 20222
Fax	+49 201 12 24132
E-mail	vlfocal-point@rwe.com
Website	
Contact person	Mr. Ludwig Kons

Appendix 2. Affirmation regarding public funding

No public funds are available for the financing of the project activity.

Appendix 3. Applicability of methodologies and standardized baselines

No additional information on the applicability of the methodology is to be mentioned.

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

No additional information on the ex ante calculation of emission reductions is to be mentioned.

Appendix 5. Further background information on monitoring plan

Please refer to chapter B.7.3 (Other elements of monitoring plan).

Appendix 6. Summary report of comments received from local stakeholders

Please refer to chapter E.2.

Appendix 7. Summary of post-registration changes

In monitoring period 28 (15/09/2013 – 30/06/2014) a temporary deviation applied. Any reasons for that have been remedied by technical works during the NA plant shutdown on 01/04/2014. Since then, the project fully complies with the registered monitoring plan and applied methodology.

Reference number of PRC: PRC-0490-001

Date of approval by EB: August 19th, 2014

In the course of verification of monitoring period 30 a post-registration change (type “corrections”) was submitted. The following corrections were done compared to the PDD v. 4.1:

- New version number and completion date of PDD;
- Update of information regarding project participants;
- Adding information to sections that were recently included to the PDD form;
- Correction and/or editorial changes of some information in the parameter tables.

No other post registration changes have been applied.

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Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: <ul style="list-style-type: none"> • Improve consistency with the “CDM project standard for project activities” and with the PoA-DD and CPA-DD forms; • Make editorial improvement.
09.0	24 May 2017	Revision to: <ul style="list-style-type: none"> • Ensure consistency with the “CDM project standard for project activities” (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the “Project design document form for small-scale CDM project activities” (CDM-SSC-PDD-FORM); • Make editorial improvement.
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.

<i>Version</i>	<i>Date</i>	<i>Description</i>
07.0	15 April 2016	Revision to ensure consistency with the “Standard: Applicability of sectoral scopes” (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revision to: <ul style="list-style-type: none"> • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.
05.0	25 June 2014	Revision to: <ul style="list-style-type: none"> • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from F-CDM-PDD to CDM-PDD-FORM; • Make editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.
Decision Class: Regulatory Document Type: Form Business Function: Registration Keywords: project activities, project design document		