



**CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 - in effect as of: 1 July 2004)**

CONTENTS

- A. General description of project activity
- B. Application of a baseline methodology
- C. Duration of the project activity / Crediting period
- D. Application of a monitoring methodology and plan
- E. Estimation of GHG emissions by sources
- F. Environmental impacts
- G. Stakeholders' comments

Annexes

- Annex 1: Contact information on participants in the project activity
- Annex 2: Information regarding public funding
- Annex 3: Baseline information
- Annex 4: Monitoring plan

**SECTION A. General description of project activity****A.1 Title of the project activity:**

Catalytic N₂O destruction project in the tail gas of the Nitric Acid Plant of Abu Qir Fertilizer Co.

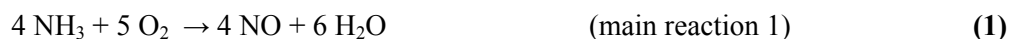
Version: 2 (b)

Date of Completion: 20/06/2006

A.2. Description of the project activity:**General Introduction:**

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. 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)¹:



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):



(NO is oxidised to NO₂ according to main reaction 2)

¹ Ammonia is reacted with air on noble metal catalyst in the oxidation section of nitric acid plants. Nitric oxide and water are formed in this process according to the above mentioned main equation.



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

On leaving the ammonia oxidation reactor some of the N_2O may be destroyed in the part of the plant upstream of the absorption tower by high temperature homogeneous gas phase decomposition and by catalytic decomposition on platinum deposits formed from metal lost from the ammonia oxidation catalyst. Since platinum dust carryover into the tail gas section of the plant is prevented by the absorption tower, which acts as a very efficient scrubber, and the temperatures encountered in the tail gas section of the plant are lower than those leading to homogeneous gas phase N_2O decomposition there is no relevant loss of N_2O in the tail gas section unless a N_2O destruction facility is installed. N_2O that has reached the tail gas section is thus discharged to atmosphere in the tail gas, and has no economic value.

Depending on technical parameters (e.g. tail gas temperature) the project applicant has to decide either to install a catalytic decomposition process or catalytic reduction process for the proposed project activity.

Description of catalytic decomposition process:

Catalytic decomposition of N_2O occurs when the N_2O 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.

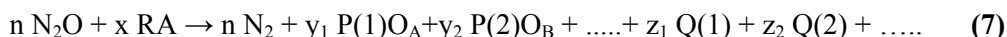
Overall reaction:



The products of N_2O decomposition are the substances that result from decomposition reaction (N_2 and O_2)

Description of catalytic reduction process:

Although the term catalytic reduction nowadays has a more general definition in terms of the transfer of electrons, the following definition is sufficient for present purposes: Catalytic reduction of N_2O occurs when reactions take place between N_2O and other substances in contact with a catalyst, such that the oxygen is removed from the N_2O molecule and forms one or more compounds with other species. The substance or substances that react with N_2O to remove oxygen are termed reducing agent. A general reaction equation for the catalytic reduction of N_2O can be given as:

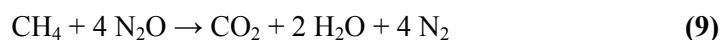
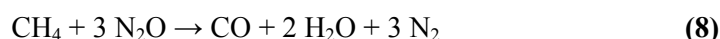


where RA is a molecule of the reducing agent, $P(1)O_A$, $P(2)O_B$ are the compound formed by reaction with the oxygen of the N_2O and $Q(1)$, $Q(2)$ represents further products of the oxidation reaction, n , x , y_1 , y_2 , z_1 , z_2 are the appropriate stoichiometric coefficients.

Equations reduction N_2O with hydrocarbons:

e.g.

Reducing agent is **methane**:



e.g.

Reducing agent is **ethane**, overall reaction is:

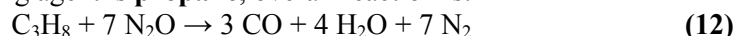


or

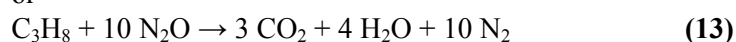


e.g.:

Reducing agent is **propane**, overall reaction is:

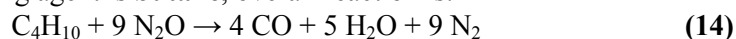


or



e.g.

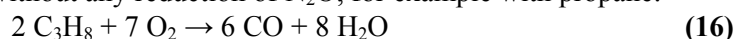
Reducing agent is **butane**, overall reaction is:



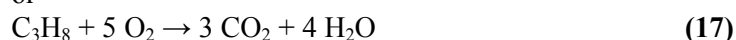
or



The definition does not exclude the possibility of side reactions resulting in consumption of reducing agent without any reduction of N_2O , for example with propane:



or



The world's nitric acid plants represent the single greatest industrial process source of N_2O emissions. Currently, approx. 700 nitric acid plants are operated globally with an estimated amount of N_2O emissions of 400,000 t N_2O p.a. (corresponding to 125 Mio t CO_2e p.a.).

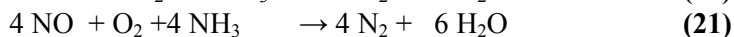
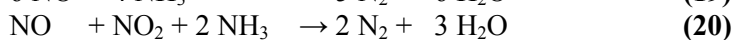
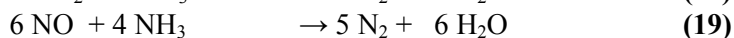
In response to this, UHDE GmbH (see section A.3.), a leading company in the field of nitric acid technology, has undertaken the task of developing processes for removing N_2O from nitric acid plant tail gas streams based on the catalytic decomposition or catalytic reduction of N_2O . Efforts have been concentrated on treating the tail gas, as this end-of-pipe approach offers the general advantage, compared with other possible measures (called primary and secondary measures, see section A.4.3.), that minimum interference with the nitric acid production process is caused. In particular, any possibility of nitric acid product contamination, or loss of NO that could otherwise influence nitric acid production, is eliminated.

Project Specific description:

Principles of the EnviNOx® process

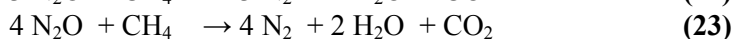
The EnviNOx® process used in the Abu Qir II nitric acid plant is based on the catalytic reduction of NO_x (NO and NO_2) with ammonia (NH_3) and of nitrous oxide (N_2O) with a hydrocarbon. The hydrocarbon used is natural gas of which the main constituent is methane (CH_4). The reactions take place over two iron zeolite catalyst beds.

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 N_2O also occurs.

The second and main bed contains an iron zeolite that is particularly efficient in catalysing the reduction of nitrous oxide with hydrocarbons. The proposed project activity will use about 52 kg CH_4 /h.



Similar reactions take place between nitrous oxide and the small quantities of higher hydrocarbons such as ethane C_2H_6 , propane C_3H_8 and butane C_4H_{10} that are present in natural gas. N_2O 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:



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. Compared with the reduction in greenhouse gas emission achieved by the destruction of N_2O the additional greenhouse gas emissions (CO_2 and CH_4) caused by the process are insignificant.

The proposed project activity will reduce the N_2O emissions from the Nitric Acid Plant of Abu Qir Fertilizer Co. by up to 99% by installing the EnviNOx® process. The project will use CH_4 as reducing agent.

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 N_2O decomposition can take place, but that they are used as genuine chemical reagents that take part in reactions with N_2O 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.

The proposed project activity will consume about 52 kg methane per hour. The consumption will be fine-tuned during commissioning of the EnviNOx® reactor.

CARBON Egypt Ltd. (see section A.3.) will invest in the most efficient catalytic destruction technology for N_2O emissions reduction in the tail gas of nitric acid plants (furthermore called “EnviNOx®-System”) provided by the technology provider UHDE GmbH (see section A.3.). CARBON will have one EnviNOx®-System installed at all the nitric acid plant of ABU QIR II (see section A.3.) that are in full commercial operation. AFC will operate the EnviNOx®-System at its nitric acid plant ABU QIR II, which was constructed by UHDE in 1991.



The **project's aim** is to reduce (almost eliminate) N₂O emissions at the nitric acid plant ABU QIR II, with potential additional environmental and secure social benefits. The project activity will not result in any revenues except the income from the sale of CERs. The catalytic N₂O destruction project activity is expected to reduce 98% of the N₂O emissions that would be emitted without the project activity. Under related project circumstances at the nitric acid of AMI in Austria, UHDE's EnviNOx[®]-System reduces more than 98% of all N₂O emissions of the nitric acid plant. The project applicant and project operator will voluntarily invest a share of the income from the sale of the CERs in a "Social Fund" to support social projects in the area of Abu Qir (additional social benefit).

A.3. Project participants:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly 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	KOMMUNALKREDIT PUBLIC CONSULTING GmbH	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

Host Country is the **Arab Republic of Egypt**. The Arab Republic of Egypt ratified the Kyoto Protocol in January 2005.

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 100% daughter company of CARBON Projektentwicklung GmbH, Austria.

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 Projektentwicklung GmbH has 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.

Kommunalkredit Public Consulting (KPC) was appointed for the Programme Management on behalf of the Austrian Ministry of Agriculture and Forestry, Environment & Water Management. The Programme is operational since August 2003.

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 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 3000 employees AFC is among the major job providers in Alexandria area. The company is ISO 9001/2000 and ISO 14001 certified and one of the most important companies of the Egyptian industry. Owners of AFC are Egyptian banks, petroleum corporations, other industrial shareholders, insurance companies and the labour union as well as individual shareholders.

In the light of huge reserves of natural gas in Egypt, the recent major agricultural projects (irrigation) and the increasing over-population in Egypt, the fertilizer industry is considered to be one of the most important industries in Egypt, both today and in the future.

The nitric acid plant ABU QIR II was constructed by UHDE GmbH, Germany in July 1991. With a capacity of 1,830 t of nitric acid per day, ABU QIR II is one of the largest nitric acid plants in the world.

Project Technology Provider is UHDE GmbH (furthermore called “UHDE”), a 100% subsidiary of ThyssenKrupp. UHDE is world market leader in the field of fertilizer technology engineering and construction. Consequently, UHDE has constructed many modern fertilizer plants including nitric acid plants. Among these plants is AFC’s nitric acid plant. In response to increasing concerns surrounding climate change and the destruction of the ozone layer, UHDE has developed catalyst-based processes for removing N₂O from nitric acid tail gas streams.

A.4. Technical description of the project activity:
--

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Arab Republic of Egypt

A.4.1.2. Region/State/Province etc.:

AI-Iskandariyah Provice (Alexandria Province)

A.4.1.3. City/Town/Community etc:
--

Abu Qir



A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

Figure: Map of the Arab Republic of Egypt



Nominally independent from the UK in 1922, Egypt acquired full sovereignty following World War II. The completion of the Aswan High Dam in 1971 and the resultant Lake Nasser have altered the time-honoured place of the River Nile in the agriculture and ecology of Egypt. A rapidly growing population (the largest in the Arab world) will continue to stress Egyptian society and overtax resources. Due to the extremely small amount of fertile and irrigated land (only 31,000 km² out of 1,002,000 km²), the Aswan High Dam (that holds back Nile mud as natural fertilizer) as well as the rapidly growing population, the fertilizer industry plays an essential role for the survival of Egyptian society.

Figure: Satellite Image of Alexandria



Alexandria a city of 3.9 million inhabitants (2003 estimate) is situated on the Mediterranean Sea, with Lake Mariout two kilometres inland. The city is a commercial and economic centre, and about 80% of all of Egypt's imports and exports go through its harbours. Alexandria is also a very important tourist resort, with a 20 km long waterfront, serving the rich and the middle class of Cairo while the summer heat makes living in the capital unpleasant.

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.4.2. Category(ies) of project activity:

Sectoral scope: 5 Chemical Industry

A.4.3. Technology to be employed by the project activity:

The possible ways to destroy or reduce N₂O emissions at nitric acid plants can be categorized into three groups:

- **Primary:** N₂O is prevented from forming. This requires modifications to the precious metal ammonia oxidation gauzes to reduce N₂O formation. Alternative materials can also be employed as the ammonia oxidation catalyst. Cobalt oxide, for example, does not generate any N₂O by-product, but suffers from being less selective for the production of N₂O.
- **Secondary:** N₂O, once formed, is removed anywhere between the outlet of the ammonia oxidation gauzes and the inlet of the absorption tower. The preferred position of choice for secondary methods is directly after the gauzes.



- Tertiary: N₂O is removed from the tail gas downstream of the absorption tower by catalytic destruction (either by catalytic decomposition or by catalytic reduction). In general the optimum position for a tertiary N₂O destruction facility is at the hottest position in the tail gas stream.
- In tertiary catalytic N₂O destruction processes a hydrocarbon input may be necessary to achieve the highest available N₂O destruction rate. Thus hydrocarbons may be used to increase the tail gas temperature for catalytic decomposition processes (considered as leakage emissions) or as a reducing agent in catalytic reduction processes of N₂O (considered as project emissions).

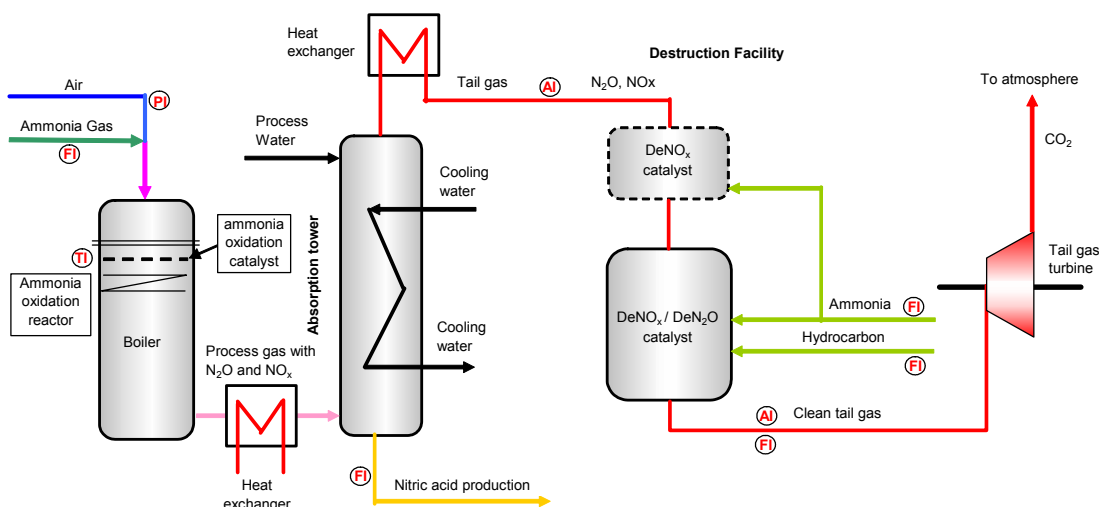
A tertiary approach offers a number of advantages:

- The tertiary approach, as an end-of-pipe technology, is analogous to the various well-established catalytic NO_x reduction processes. Acceptance of this technology by plant operators is therefore not expected to be seen as a problem.
- There is no interference with the nitric acid production process itself. The tertiary N₂O destruction technology will not cause a nitric acid production increase and therefore no financial incentive for the implementation of the proposed project activity exists.
- A tertiary process incorporates a selective catalyst suitable for destroying N₂O and possibly also NO_x, which can lead to additional environmental benefit.
- No technical possibility that relevant N₂O will be destroyed downstream the tertiary N₂O destruction facility. Consequently, an overestimation of N₂O baseline emissions is not possible whenever tertiary N₂O destruction facility will be installed.

The project technology provider has developed a most efficient and low risk catalytic N₂O destruction process for nitric acid plants called the EnviNOx[®]-System. Efforts have been concentrated on treating the tail gas, as this end-of-pipe approach offers the general advantage - compared with other possible measurements - that minimum interference with the nitric acid production process is caused. In particular, any possibility of nitric acid product contamination, or loss of the valuable intermediate product nitric oxide (NO) that could otherwise influence nitric acid production, is eliminated.

The EnviNOx[®]-System is an example of 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. Therefore the EnviNOx[®]-System is located between the tail gas heaters and the tail gas turbine of the nitric acid plant. The reactor in an EnviNOx[®]-System houses one or two catalyst beds through which the tail gas flows.

Figure 1: Location of the EnviNOx-System as a tertiary measure



A hydrocarbon input may be necessary to achieve the best N_2O destruction rate. Thus hydrocarbons may be used to increase the tail gas temperature for catalytic decomposition processes or hydrocarbons may be used as a reducing agent to increase the efficiency of the catalytic reduction process.

Technology to be used at AFC:

The EnviNOx[®]-System will be 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 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 proposed project activity will use about 52 kgCH₄/h. The EnviNOx[®]-System reactor also incorporates NO_x reduction using ammonia in order to lower the NO_x concentration to a very low level. The tail gas temperature in the ABU QIR II nitric acid plant is around 414°C. A catalytic reduction process will be installed at AFC.

The natural gas 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.

Decommissioning of existing DeNOx 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 new EnviNO_x[®]-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 EnviNO_x®-System is at least as good as the existing SCR DeNO_x-unit.

Location of EnviNO_x® system:

The EnviNO_x® system requires the highest temperature available in the tail gas heat recovery train and is therefore installed between the final tail gas heater and the tail gas turbine. The inlet temperature of the EnviNO_x® reactor is 414°C at normal operating conditions.

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 EnviNO_x® system under flow control. If for any reason the supply of ammonia to the EnviNO_x® 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 EnviNO_x® 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 will use about 52 kgCH₄/h.

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 EnviNO_x® reactor.

N₂O and NO_x reduction:

At the inlet of the EnviNO_x® reactor the NO_x concentration can reach 200 ppm and the N₂O concentration is typically 1,020 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 EnviNO_x® 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 EnviNO_x® 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.



Due to the heat released by the exothermic reduction reactions the temperature of the tail gas increases from 414°C to 427°C over the EnviNOx® reactor.

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 ongoing 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 will not increase the capacity or operating efficiency of AFC's nitric acid plant.

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

The project activity comprises the installation of a EnviNOx®-System to catalytically reduce N₂O emissions in the tail gas stream of the nitric acid plant Abu Qir II. The EnviNOx®-System itself includes a steel reactor containing two catalyst beds. The catalytic N₂O destruction project activity is expected to reduce more than 94% of the N₂O emissions that would be emitted without the project activity. Under similar technical nitric acid plant circumstances at AMI Plant in Linz, Austria, UDHE's EnviNOx®-System reduced more than 98% of all N₂O emissions of the nitric acid plant. As far as the amount of NO_x removal is concerned the performance of the EnviNOx®-System is at least as good as the SCR DeNO_x-unit.

The implementation of the project activity will result in an ex-ante estimation of GHG emission reductions of conservatively calculated 1.07 million t CO₂e per year. Please note - that estimates of GHG emission reductions are made for reference purposes only - actual emission reductions will be determined based on measurement results on ex-post basis. The global warming potential of N₂O is set at 310 according to the Kyoto Protocol rules.

Due to the already installed SCR DeNO_x-unit, no significant change in the ammonia input is expected. To achieve the best available N₂O destruction rate, hydrocarbon as a reducing agent will be injected to the EnviNOx®-System to enhance the efficiency of the catalytic reduction process. Emissions arising from hydrocarbon input as a reducing agent will be monitored.

Under business-as-usual conditions the project activity would not be implemented for the following reasons:

- Currently, there are no national regulations or legal obligations in the Arab Republic of Egypt concerning N₂O emissions. It is unlikely that any such limits on N₂O emissions will be imposed in the near future. In fact, given the cost and complexity of suitable N₂O destruction or abatement technologies, it is unlikely that a limit would be introduced.
- However, adjustments of legal regulations in the Arab Republic of Egypt on N₂O emissions will be monitored. If legal regulations on N₂O emissions are introduced or altered during the crediting period, the baseline emissions will be adjusted at the time the legislation has to be implemented.
- The installation of a N₂O destruction facility requires significant investment without any additional economic benefits. The project activity would not be commercially viable even taking into account the market value of any potential by-product of the N₂O destruction technology without the revenues from the sales of the CERs. Although the production of nitric acid generates



N₂O as a by-product, N₂O is typically released into the atmosphere as it does not have any economic value.

- National regulations on NO_x emissions are more than fulfilled at AFC's nitric acid plant.

A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:

The implementation of the project activity will result in an ex-ante estimation of GHG emission reductions conservatively calculated at 7.46 million t CO₂e over the first seven-year crediting period. Please note - that estimates of GHG emission reductions are made for reference purposes only - actual emission reductions will be determined based on measurement results on ex-post basis. The global warming potential of N₂O is set at 310 according to the Kyoto Protocol rules.

Table: Summary Emission Reduction 2007-2013

Years (First Crediting Period)	Annual estimation of emission reductions in tonnes of CO₂ e
09/ 2006	310,882
2007	1,065,881
2008	1,065,881
2009	1,065,881
2010	1,065,881
2011	1,065,881
2012	1,065,881
01-08/ 2013	754,999
Total estimated reductions (tonnes of CO₂ e)	7,461,165
Total number of crediting years	7 years²
Annual average over the crediting period of estimated reductions (tonnes of CO₂ e)	1,065,881

A.4.5. Public funding of the project activity:

No public funds are available for the financing of the project activity. Therefore CARBON will finance the project investment and all running costs out of its own private corporate funds.

² 7 years of each period × 3 crediting periods = 21 crediting years

**SECTION B. Application of a baseline methodology****B.1. Title and reference of the approved baseline methodology applied to the project activity:**

Approved baseline methodology **AM0028**: “Catalytic N₂O destruction in the tail gas of Nitric Acid Plants”.

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

The proposed project activity destroys N₂O at AFC’s nitric acid plant Abu Qir II.

The use of the methodology is justified because the following statements are true:

- The methodology will be applied to the existing production capacity installed no later than 31 December 2005.
- The Abu Qir II nitric acid plant has currently *not* installed any N₂O destruction or abatement technology. The project activity will not result in any shut down of an existing N₂O destruction or abatement facility at Abu Qir II.
- The project activity will not cause a nitric acid production increase.
- DeNO_x-unit is already installed at Abu Qir II. The project activity will result in NO_x emission reductions that are at least as effective as the existing DeNO_x-unit.
- The DeNO_x-unit installed at Abu Qir II is a SCR DeNO_x-unit.
- The N₂O concentrations will be measured in real time at the inlet and the outlet of the N₂O destruction facility.

B.2. Description of how the methodology is applied in the context of the project activity:

The approved baseline methodology “Catalytic N₂O destruction in the tail gas of Nitric Acid Plants “ is applied to the “Catalytic N₂O destruction project in the tail gas of the Nitric Acid Plant of Abu Qir Fertilizer Co.” in the following four steps:

Step 1: Identify technically feasible baseline scenario alternatives to the project activity:

The baseline scenario alternatives should include all technically feasible options which are realistic and credible.

Step 1a: The baseline scenario alternatives should include all possible options that are technically feasible to handle N₂O emissions. For Abu Qir II these options are:

- Status quo: The continuation of the current situation, where there will be no installation of technology for the destruction or abatement of N₂O
- Alternative use of N₂O:
 - Recycling of N₂O as a feedstock for the plant;
 - The use of N₂O for external purposes.
- Installation of a Non-Selective Catalytic Reduction (NSCR) DeNO_x unit³

³ NSCR: As NSCR DeNO_x unit will reduce N₂O emissions as a side reaction to the NO_x-reduction. Consequently, new NSCR installation can be seen as alternative N₂O reduction technology.



- The installation of a N₂O destruction or abatement technology
 - Tertiary measure for N₂O destruction (proposed project activity)
 - Primary or secondary measures for N₂O destruction or abatement.

These options include the CDM project activity not implemented as a CDM project.

Technologically not feasible options:

The use of N₂O for external purposes is technically not feasible at AFC's nitric acid plant, as the quantity of gas to be treated is enormous compared to the amount of nitrous oxide that could be recovered. Note, the N₂O concentration in the tail gas at AFC's nitric acid plant is expected to be in the range of 0.06% to 0.2%. The use of N₂O for external purposes is neither in the region/country nor in any other nitric acid plant applied.

The recycling of N₂O as a feedstock for the plant is technically not practicable, as N₂O is not a feedstock for nitric acid production. The recycling of N₂O as a feedstock is neither in the region/country nor in any other nitric acid plant applied.

Therefore the following alternatives are technically not feasible:

- Recycling of N₂O as a feedstock for the plant;
- The use of N₂O for external purposes.

Step 1b: In addition to the baseline scenario alternatives of step 1a, all possible options that are technically feasible to handle NO_x emissions should be considered. The installation of a NSCR DeNO_x unit could also cause N₂O emission reduction. Therefore NO_x emission regulations have to be taken into account in determining the baseline scenario. The respective options are:

- The continuation of the current situation, where a DeNO_x unit is installed;
- Installation of new Selective Catalytic Reduction (SCR) DeNO_x unit;
- Installation of new Non-Selective Catalytic Reduction (NSCR) DeNO_x unit;
- Installation of new tertiary measures combining NO_x and N₂O emission reductions. (project scenario).

The national Environment Law number 4 of Egypt (year 1994) limits NO_x emissions at nitric acid plants only:

Type of Nitric Acid Plant	Limit of NO _x -emissions from exhaust
Existing plant (old)	3000 mg/m ³
New plant	400 mg/m ³

At AFC's nitric acid plant national legal regulations on NO_x emissions are more than fulfilled. AFC already operates a SCR DeNO_x-unit with an average 40 ppmv, which is far below the legal limit of 3000 mg/m³ NO_x from exhaust for existing nitric acid plants. As there is already a SCR DeNO_x unit installed at Abu Qir II nitric acid plant, the installation of an NSCR DeNO_x unit, which is not state of the art⁴, is not conceivable as baseline alternative. Therefore it is obvious that AFC will not install another DeNO_x unit.

Therefore the following alternatives are technically not feasible:

- Installation of a new Selective Catalytic Reduction (SCR) DeNO_x unit;
- Installation of a new Non-Selective Catalytic Reduction (NSCR) DeNO_x unit;

⁴ See also: UBA 2001: Umweltbundesamt. State-of-the-art for production of Nitric Acid with regard to the IPPC Directive. Vienna 2001. EFMA 2000: European Fertilizer Manufacturers' Association, Production of Nitric Acid, Best Available Techniques for Pollution Prevention and Control in the European Fertilizer Industry, Brussels 2000.



Step 2: Eliminate baseline alternatives that do not comply with legal or regulatory requirements:

Currently, there are no national regulations or legal obligations in the Arab Republic of Egypt concerning N₂O emissions. All named baseline alternatives are in compliance with all relevant legal and regulatory requirements on N₂O and NO_x emissions. Therefore no baseline alternative is eliminated at step 2.

Step 3: Eliminate baseline alternatives that face prohibitive barriers (barrier analysis):

Sub-Step 3a: On the basis of the alternatives that are technically feasible and in compliance with all legal and regulatory requirements, the project participant should establish a complete list of barriers that would prevent alternatives to occur in the absence of CDM.

In the case of the “Catalytic N₂O destruction project in the tail gas of the Nitric Acid Plant of Abu Qir Fertilizer Co.” project the following barriers that would prevent baseline alternatives to occur in the absence of CDM are identified:

- **Investment barriers (economic/financial barriers):**
The N₂O destruction facility generates no financial or economical benefits other than CDM related income. No income from any kind of potential product or by-product except CERs are able to pay back investment costs as well as running costs for the installation of a N₂O destruction or abatement technology as no marketable product or by-product exists. As national regulations on NO_x emissions are more than fulfilled at the nitric acid plant of AFC and no national regulations or legal obligations in the Arab Republic of Egypt concerning N₂O emissions exists, investment barriers are clearly identified for all baseline options which require significant investments (primary, secondary and tertiary N₂O destruction or abatement).
- **Technological barriers:**
In addition to investment barriers identified above, technological barriers are identified as primary and secondary N₂O emission reduction technologies interfere with the nitric acid production process. The implementation of primary or secondary measures could cause an intervention in the nitric acid production process, which is not in the mind of AFC. Besides, N₂O destruction efficiency is considered significantly lower at primary or secondary measures.
- **Barriers due to prevailing practice:**
No nitric acid plant in the Arab Republic of Egypt has installed any N₂O destruction or abatement technologies. The proposed project activity is the “first of its kind”.

Therefore the following baseline alternatives are eliminated:

- Primary or secondary measures for N₂O destruction or abatement
- Tertiary measure for N₂O destruction (proposed project activity)

Sub-Step 3b: Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed CDM project activity):



In conclusion, the single scenario that does not face barriers (see step 2) is:

- The continuation of the current situation, where a DeNO_x unit is installed at AFC's nitric acid plant and national legal regulations on NO_x emissions are more than fulfilled. No N₂O destruction or abatement technology will be installed. As national regulations on NO_x emissions are more than fulfilled at the nitric acid plant of AFC and no national regulations or legal obligations in the Arab Republic of Egypt concerning N₂O emissions exists, investment barriers (and also technological barriers) are clearly identified for all baseline options except the continuation of the status quo.

Therefore the continuation of the status quo can be pre-selected as baseline scenario.

As the outcome of the barrier analysis (step 3) is clear, Step 4 of the methodology is omitted.

Step 4: Identify the most economically attractive baseline scenario alternative:

Determine which of the remaining project alternatives that are not prevented by any barrier is the most economically or financially attractive, and then is a possible baseline scenario.

Sub-step 4a: Determine appropriate analysis method

Sub-step 4b: Option I: Apply simple cost analysis

As the outcome of the barrier analysis (step 3) clearly identifies the baseline scenario, Step 4 of the methodology is omitted.

The procedure to identify the baseline scenario clearly results in that the most likely baseline scenario is the continuation of the status quo and therefore the continuation of emitting N₂O to the atmosphere, without the installation of N₂O destruction or abatement technologies.

Therefore the continuation of the current situation is clearly identified as the baseline scenario.

Step 5: Re-assessment of baseline scenario in course of proposed project activity's lifetime:

At the start of a crediting period, a re-assessment of the baseline scenario due to new or modified NO_x or N₂O emission regulations should be executed as follows:

Sub Step 5a: New or modified NO_x emission regulations:

If new or modified NO_x emission regulations are introduced after the project start, determination of the baseline scenario will be re-assessed at the start of a crediting period. Baseline scenario alternatives to be analysed should include, inter alia:

- Selective Catalytic Reduction (SCR);
- Non-Selective Catalytic Reduction (NSCR);
- Tertiary measures incorporating a selective catalyst for destroying N₂O and NO_x emissions;
- Continuation of baseline scenario.

For the determination of the adjusted baseline scenario the project participant should re-assess the baseline scenario and shall apply baseline determination process as stipulated above (Step 1 – 5).



Potential outcomes of the re -assessment of the baseline scenario (to be in line with NO _x regulation)	Consequence (adjusted baseline scenario)
SCR DeNO _x installation	Continuation of original (N ₂ O) baseline scenario
NSCR DeNO _x installation	The N ₂ O emissions outlet of NSCR become adjusted baseline N ₂ O emissions, as NSCR may reduce N ₂ O emissions as well as NO _x .
Tertiary measure that combines NO _x and N ₂ O emission reduction	Adjusted baseline scenario results in zero N ₂ O emissions reduction
Continuation of original baseline scenario	Continuation of original baseline scenario

Note, Abu Qir II has already installed a SCR DeNO_x unit. New or modified NO_x emission regulations introduced after the project start will be taken into account for the next crediting period.

Sub Step 5b: New or modified N₂O-regulation:

If legal regulations on N₂O emissions are introduced or changed during the crediting period, the baseline emissions shall be adjusted at the time the legislation has to be legally implemented.

Therefore the pre-selected baseline scenario can be adopted as the Baseline Scenario.

Key parameters for the determination of the baseline scenario are:

Key Parameters	Detail	Data Source
Current legal regulation on N ₂ O emissions	No regulation	Egyptian Environment Law No. 4
Current legal regulation on NO _x emissions	Regulation as described above. Au Qir II more than fulfils all legal obligations.	Egyptian Environment Law No. 4
Technological barriers	Several technological barriers	Internal technical evaluation has shown that primary or secondary measure could cause an intervention in the nitric acid production process, which is not in the mind AFC. Besides, N ₂ O destruction efficiency is considered significantly lower at primary or secondary measures.
Investment and running costs for the N ₂ O destruction facility	No financial incentive exists	
Income to finance the project activity	No other income exists	



Step 5 will be executed by monitoring the relevant regulations.

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity:

The **baseline scenario** is the continuation of the status quo and N₂O emissions are not reduced by any N₂O destruction or abatement technology at AFC. Therefore the baseline emissions are measured at the inlet of the EnviNOx[®]-System.

The baseline scenario consists of the continuation of the currently installed SCR DeNO_x-unit in which only NO_x (nitric oxide NO, and nitrogen dioxide NO₂) is reduced to water vapour and nitrogen by reaction with ammonia.

The **project scenario** is the implementation of the proposed project activity consisting of the installation of an EnviNOx[®]-Systems at Abu Qir II nitric acid plant.

Tertiary measures offer a number of advantages:

- The proposed project activity (tertiary measure), as an end-of-pipe technology, is analogous to the various well-established catalytic NO_x reduction processes.
- There is no interference with the nitric acid production process itself. The tertiary N₂O destruction technology will neither cause a nitric acid production increase nor decrease.
- A tertiary process incorporates a selective catalyst suitable for destroying N₂O and NO_x, which will lead to additional environmental benefit.

Taking into account that:

- Abu Qir II nitric acid plant was built by UHDE and UHDE is also the supplier of technology for the proposed project activity,
- the proposed project activity (tertiary measure) is analogous to the already successful implemented SCR DeNO_x unit,
- the expected N₂O reduction rate of tertiary measures up to 99%,
- primary and secondary measures requires modifications to the ammonia oxidation reactor (operational risks),
- a tertiary measures will not influence the production process of AFC's core business

Based on this line of arguments, AFC obviously and explicitly gives their technological preference to a tertiary technology.

The EnviNOx[®]-System is a tertiary technology for destruction of N₂O emissions in the tail gas of Abu Qir II nitric acid plant and is located between the tail gas heaters and the tail gas turbine. It is expected that the project activity reduces minimum 94% of the N₂O emissions that would be emitted without the project activity (under related project circumstances at the nitric acid plant of AMI in Austria, the EnviNOx[®]-System reduces more than 98% of N₂O emissions).

Abu Qir II:

A catalytic N₂O reduction process will be installed at Abu Qir II nitric acid plant. The implementation of the proposed project activity involves the removal of the existing SCR DeNO_x unit, with the new EnviNO_x® reactor taking on the function of the existing SCR DeNO_x unit as it too accomplishes the reduction of NO_x with ammonia. As far as the degree of NO_x removal is concerned the performance of the EnviNO_x® reactor is superior to the existing SCR DeNO_x unit.

GHG emission reductions achieved by the project activity will only be claimed for the destruction of N₂O emissions, taking national regulations on N₂O emissions into account. If legal regulations on N₂O emissions are introduced or altered during the crediting period, the baseline emissions will be adjusted immediately at the time the legislation has to be implemented.

The additionality of the project activity is demonstrated and assessed using the “Tool for demonstration and assessment of additionality” agreed by the Executive Board.

Step 0: Preliminary screening based on the starting data of the project activity**Sub-Step 0a. Evidence of the starting date:**

CARBON made the decision to develop the proposed project activity in 2004. Therefore the starting date of the proposed project activity falls between 1 January 2000 and the registration date of the project activity.

The project activity's starting date is 9th October 2004 (signing date contract AFC and CARBON).

The project design document has been submitted to the DOE in April 2005 and to the UNFCCC secretariat together with the proposed new baseline and monitoring methodology "Baseline Methodology for catalytic N₂O destruction in the tail gas of Nitric Acid Plants" - NM0111 in May 2005. NM0111 was finally approved as AM0028 by the Executive Board in March 2006.

Sub-Step 0b. Evidence incentives from CDM:

As the catalytic N₂O destruction facility generates no financial or economical benefits other than CDM related income, it is obvious that the CDM registration is therefore the only incentive for the development of the proposed project activity. Evidence that the incentive from CDM was seriously considered in the decision to proceed with the project activity is documented in all project related contracts project documents.

Step 1: Identification of alternatives to the project activity:

Because of the similarity of both approaches used to determine the baseline scenario and the additionality tool, step1 of the tool for demonstration and assessment of additionality can be ignored.

Step 2. Investment analysis:**Sub-step 2a. Determine appropriate analysis method:**

As the catalytic N₂O destruction facility generates no financial or economical benefits other than CDM related income, Option I as stated in the applied baseline methodology (simple cost analysis) has been chosen.

**Sub-step 2b. – Apply simple cost analysis**

Project scenario: No income from any kind of potential product or by-product except CERs are able to pay back investment costs as well as running costs for the installation of the EnviNOx®-System as no marketable product or by-product exists.

The investment costs of several million Euros (excluding potential financing costs) consists of the engineering, construction, shipping, erection, installation and commissioning of the EnviNOx®-System and the measurement equipment. The running costs consist of the regular change of the catalysts, hydrocarbon and ammonia inputs as well as personnel costs for the supervision of the EnviNOx®-System and the measurement equipment.

Confidential information on investment and operation costs will be provided to the validator.

Baseline scenario: The baseline scenario “The continuation of the current situation” will neither cause any additional investments costs nor any additional running costs.

Therefore, the proposed CDM project activity is, without the revenues from the sale of certified emission reductions, obviously less economically and financially attractive than the baseline scenario.

Step 4. Common practice analysis

As described above, AFC is the biggest fertilizer company in Africa. Currently, there are three fertilizer companies in operation in Egypt. AFC is the market leader with a market share of close to two thirds of the local Egyptian fertilizer market and the only one having a DeNO_x-unit installed. The other two companies in Egypt neither have a DeNO_x-unit nor a N₂O destruction or abatement technology installed. Similar project activities are not observed and therefore the proposed project activity is not common practice.

Step 5. Impact of CDM registration

The financial benefits of the revenues obtained by selling CERs from the project activity will lead to the implementation of the project activity.

Based on the ex-ante estimation of N₂O emission reductions over the first crediting period, it is expected that the income from selling of CERs of the registered CDM project activity is at least as high as the investment, financing and running costs. Therefore CARBON is willing to finance the project activity under the condition of the registration of the project activity.

Conclusion: The proposed CDM project activity is undoubtedly additional, since it passes all the steps of the tool for the demonstration and assessment of additionality. No income from any kind of potential product or by-product except CERs are able to pay back investment costs as well as running costs for the installation of the proposed project activity as no marketable product or by-product exists.

The registration of the project activity as a CDM Project and corresponding CER revenues are the single source of project revenues. CDM registration is therefore the decisive factor for the realization of the proposed project activity.

**B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:**

N₂O is a by-product of the manufacture of nitric acid. It is formed alongside the main, desired product nitric oxide during the catalytic oxidation of ammonia over platinum/rhodium gauzes. On leaving the gauzes some of the N₂O may be destroyed in the part of the plant upstream of the absorption tower by high temperature homogeneous gas phase decomposition and by catalytic decomposition on platinum deposits formed from metal lost from the gauzes. Since platinum dust carryover into the tail gas section of the plant is prevented by the absorption tower, which acts as a very efficient scrubber, and the temperatures encountered in the tail gas section of the plant are lower than those leading to homogeneous gas phase N₂O decomposition there is no loss of N₂O in the tail gas section unless nitrous oxide destruction facility is installed. Nitrous oxide that has reached the tail gas section is thus discharged to atmosphere in the tail gas, and has no economic value.

The project boundary encompasses all anthropogenic emissions by sources of greenhouse gases under the control of the project participants that are significant and reasonable attributable to the project activity. More specifically, the project boundary comprises the N₂O destruction facility including the auxiliary natural gas input. According to AM0028 the auxiliary ammonia input will be considered equal to ammonia input of the baseline scenario. Note, in case of Abu Qir II a SCR DeNO_x unit is already installed prior to the starting date of the project activity.

For monitoring purposes however, the project boundary encompasses the nitric acid plant, to measure the nitric acid production and the operating parameters at the ammonia oxidation reactor.

The possibility that in the future some national, provincial or local regulation governing the emissions of N₂O or NO_x may occur has been taken into account in the baseline methodology. Accordingly, the baseline scenario will be re-assessed according to AM0028. If new or modified NO_x emission regulations are introduced after the project start, determination of the baseline scenario will be re-assessed at the start of the following crediting period.

For the purpose of determining project activity emissions, the following emission sources are included:

- N₂O emissions in the tail gas downstream the project activity;
- CO₂ emissions associated with the use of natural gas as reducing agent (converted CH₄);
- CH₄ emissions associated with the use of natural gas as reducing agent (un-converted CH₄).

For the purpose of determining baseline emissions, the following emission sources are included:

- N₂O emissions in the tail gas upstream the project activity.



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

Table: Overview on emission sources included or excluded from the project boundary

Baseline Emissions

<i>Source</i>	<i>Gas</i>		<i>Justification/Explanation</i>
Emissions of N ₂ O as a result of side reaction to the nitric acid production process	N ₂ O	Included	Main emission source, taking national N ₂ O emission regulations into account.
Emissions related to the production of ammonia used for NO _x reduction (Attention: Ammonia used for NO _x -reduction does not cause GHG emissions, only the production of ammonia causes GHG emissions)	CO ₂ CH ₄ N ₂ O	Excluded according to AM0028	In case of Abu Qir II a SCR DeNO _x unit is already installed prior to the project start: ammonia input for SCR is considered to be of the same magnitude to project related ammonia input for NO _x reduction. Baseline emissions and project emissions are similar and therefore not considered for calculation.
N ₂ O emissions from SCR DeNO _x unit	N ₂ O	Excluded according to AM0028	The presence of a SCR DeNO _x unit tends to increase the N ₂ O emissions. Therefore the ex-post measurement of the baseline emissions at the inlet of the N ₂ O destruction facility represents a conservative determination of the baseline N ₂ O emissions.

Project Emissions

<i>Source</i>	<i>Gas</i>		<i>Justification/Explanation</i>
Emissions of N ₂ O as a result of side reaction to the nitric acid production process	N ₂ O	Included	Main emission source that remains in the tail gas after the N ₂ O destruction facility
Emissions related to the production of ammonia input used for NO _x reduction (Attention: Ammonia used for NO _x -reduction doesn't cause GHG emissions, only production causes GHG emissions)	CO ₂ CH ₄ N ₂ O	Excluded according to AM0028	In case of Abu Qir II a SCR DeNO _x unit is already installed prior to the project start: ammonia input for SCR is considered of the same order as project related ammonia input for NO _x -reduction. Baseline emissions and project emissions are similar and therefore not considered for calculation.

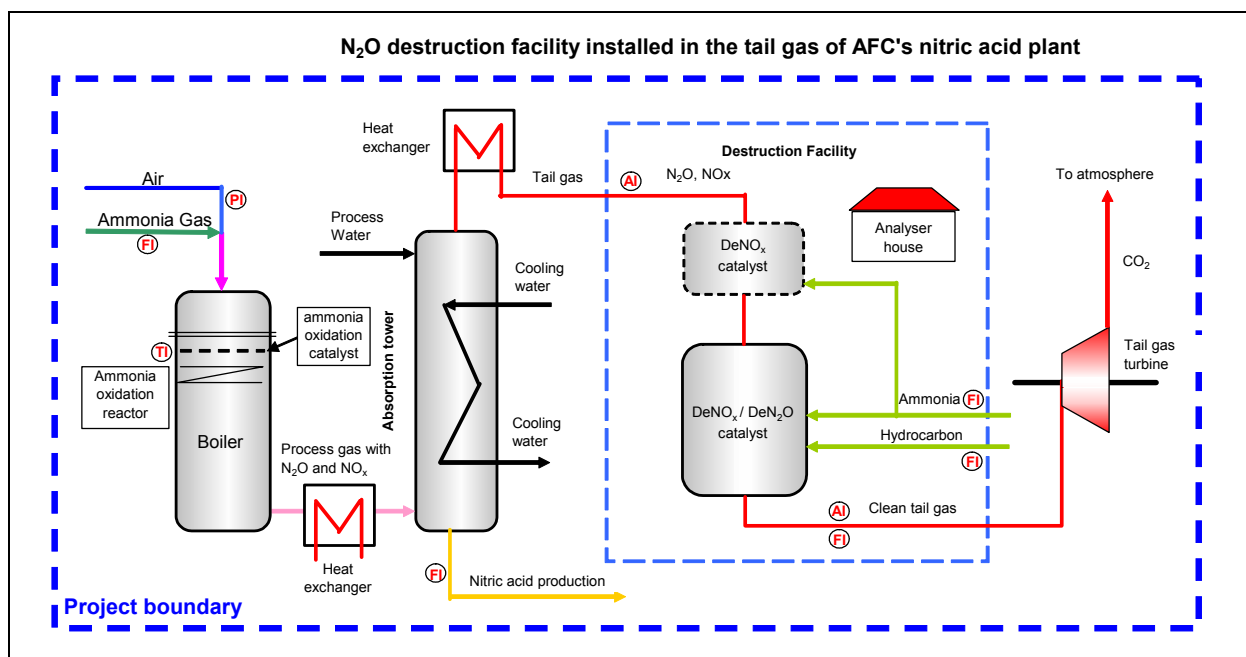


In case of N ₂ O reduction process installed: Emissions at the project site resulting from hydrocarbons used as reducing agent	CH ₄ and/or CO ₂	Included	At Abu Qir II a N ₂ O reduction process will be installed and natural gas will be used as reducing agent. Natural gas is used to enhance the efficiency of a N ₂ O catalytic reduction facility. Hydrocarbons are mainly converted to CO ₂ , while some hydrocarbons may remain intact. Fractions of unconverted methane will be measured (monitored online). All other hydrocarbons are assumed to be completely converted to CO ₂ .
Emissions from electricity demand	CO ₂ CH ₄ N ₂ O	Excluded	GHG emissions related to the electricity consumption are insignificant (< 0.005%) and are excluded as monitoring would lead to unreasonable costs.
Emissions related to the production of the hydrocarbons	CO ₂ CH ₄ N ₂ O	Excluded	GHG emissions related to the production of hydrocarbons used as reducing agent represent less than 0.001% of expected emission reductions and will not be taken into account due to unreasonable costs for monitoring.

As shown in the following figure, the *spatial extent* of the project boundary comprises:

- The catalytic N₂O destruction facility including hydrocarbon input, and
- for monitoring purposes only, the nitric acid plant, to measure the nitric acid output and operating parameters of the ammonia oxidation reactor.

Figure 2: Project boundary Abu Qir II



At Abu Qir II nitric acid plant the EnviNOx[®]-Systems will be installed between the tail gas heaters and the tail gas turbine. The existing DeNO_x-unit will be removed.

The regular measurement equipment consists of the following components:

- Flow volume measurement equipment for tail gas flow rate (venturi tube);
- Temperature and pressure monitoring equipment in the tail gas;
- Analyser for N₂O and NO_x concentration monitoring upstream and downstream of the N₂O destruction facility;
- Flow measurement equipment for natural gas input to the N₂O destruction facility (natural gas to act as reducing agent);
- Analyser for CH₄ monitoring in the tail gas.

To avoid gambling (deliberate attempt to increase baseline N₂O emissions) the following measuring devices are already installed:

- Measuring device for temperature of the ammonia oxidation reactor,
- Measuring device for pressure upstream of the ammonia oxidation reactor,
- Measuring device for ammonia flow rate to the ammonia oxidation reactor,
- Measuring device for nitric acid output;

Furthermore, composition of the ammonia oxidation catalysts at the start of each campaign will be recorded.

**B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:**

Detailed baseline information is provided in Annex 3 to this PDD.
This baseline study was completed 19/06/2006.

The baseline study was prepared by:

<i>Name</i>	<i>Project Participant Yes / No</i>
CARBON Projektentwicklung GmbH A-3485 Grunddorf 68 AUSTRIA Tel. +43 2735 77 135 Fax. +43 2735 20 531 Gerald Dunkel Ferdinand Heilig Email: dunkel@carbon-austria.com Email: heilig@carbon-austria.com	NO

**SECTION C. Duration of the project activity / Crediting period****C.1 Duration of the project activity:****C.1.1. Starting date of the project activity:**

Starting date of the project activity:
09/10/2004

C.1.2. Expected operational lifetime of the project activity:

25 years

C.2 Choice of the crediting period and related information:**C.2.1. Renewable crediting period****C.2.1.1. Starting date of the first crediting period:**

Expected starting date of first crediting period: 15/09/2006

C.2.1.2. Length of the first crediting period:

7 years, 0 months

C.2.2. Fixed crediting period:**C.2.2.1. Starting date:**

Not chosen

C.2.2.2. Length:

Not chosen

**SECTION D. Application of a monitoring methodology and plan****D.1. Name and reference of approved monitoring methodology applied to the project activity:**

Approved monitoring methodology **AM0028** “Catalytic N₂O destruction in the tail gas of Nitric Acid Plants”

This monitoring methodology shall be used in conjunction with the approved baseline methodology AM0028 “Catalytic N₂O destruction in the tail gas of Nitric Acid Plants”.

D.2. Justification of the choice of the methodology and why it is applicable to the project activity:

The proposed project activity will be implemented at the existing Abu Qir II nitric acid plant. The project comprises the installation of a catalytic N₂O destruction facility in the tail gas of Abu Qir II nitric acid plant. There is no indication that legal regulations and obligations regarding N₂O emissions will be implemented in the Arab Republic of Egypt. Nevertheless observation of national regulations on N₂O emissions will be part of the monitoring.

The use of the methodology is justified because the following statements are true:

- The methodology will be applied to the existing production capacity installed no later than 31 December 2005.
- The Abu Qir II nitric acid plant has currently *not* installed any N₂O destruction or abatement technology. The project activity will not result in any shut down of an existing N₂O destruction or abatement facility at Abu Qir II nitric acid plant.
- The project activity will not cause a nitric acid production increase.
- DeNO_x-unit is already installed at Abu Qir II nitric acid plant. The project activity will result in NO_x emission reductions that are at least as effective as the existing DeNO_x-unit.
- The DeNO_x-unit installed at Abu Qir II nitric acid plant is a SCR DeNO_x-unit.
- The N₂O concentrations will be measured in real time at the inlet and the outlet of the N₂O destruction facility.
- Relevant historical data and manufacturer information are available.
- The monitoring methodology will be used in conjunction with the “Baseline Methodology for Catalytic N₂O destruction in the tail gas of Nitric Acid Plants”.

The accuracy of the N₂O emissions monitoring results will be ensured by installing a monitoring system that has been certified to meet (or exceeds) the requirements of the prevailing best industry practice or monitoring standards in terms of operation, maintenance and calibration.

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

The monitoring methodology follows Option 1.

In order to calculate the baseline and project emissions the project AFC and CARBON will provide data on:

- Legal regulations on N₂O and NO_x;
- The production capacities of Abu Qir II nitric acid plant measured in tonnes of nitric acid;
- Composition of the ammonia oxidation catalyst of Abu Qir II nitric acid plant;
- The ammonia flow rate to the ammonia oxidation reactor of Abu Qir II nitric acid plant;
- The natural gas input to the EnviNOx®-Systems.
- Composition of the ammonia oxidation catalyst.
- The operating temperature and pressure range of the ammonia oxidation reactor of Abu Qir II nitric acid plant;
- Concentration of N₂O and NO_x at EnviNOx®-Systems inlet of Abu Qir II nitric acid plant;
- Concentration of N₂O, NO_x, O₂ and CH₄ at EnviNOx®-Systems outlet of Abu Qir II nitric acid plant;
- Tail gas flow rate (adjusted to standard temperature and pressure) of Abu Qir II nitric acid plant;

Measurement of tail gas flow:

The tail gas flow is measured by using a venturi tube, which is designed and manufactured in accordance with ISO 5167-4:2003. The venturi tube is of rough welded sheet iron type with annular pressure tapping chambers. Differential pressure is measured with two (redundant) differential pressure transmitters. For calculation of the volume flow rate at standard conditions or (with known molecular weight) the mass flow, the system is equipped with two (redundant) pressure transmitters and two (redundant) temperature measurements.

On-line analysis of tail gas feed:

In the feed of the EnviNOx®- system, the concentrations of nitrous oxide (N₂O), nitric oxide (NO) and nitrogen dioxide (NO₂) are analysed continuously. Analysis is done by using non-dispersive infrared photometry in a combined analyser device. Sample handling includes provisions for pressure reduction, separation of residual solids, sample flow adjustment, and supply with test gases. The analyser is, as far as technically possible, corrected for any applicable cross sensitivity.

On-line analysis of tail gas effluent:

In the effluent of the EnviNOx®- system, the concentrations of nitrous oxide (N₂O), nitric oxide (NO) plus nitrogen dioxide (NO₂), oxygen (O₂) and methane (CH₄) are analysed continuously. Analysis is done by using non-dispersive infrared photometry for NO₂ and CH₄, paramagnetic measurement for O₂, and



chemoluminescence for NO and NO₂. Sample handling includes provisions for pressure reduction, separation of residual solids, sample flow adjustment, and supply with test gases. The analysers are, as far as technically possible, corrected for any applicable cross sensitivity.

Actual production of Nitric Acid:

The actual nitric acid production is measured according to the already installed instruments. The instrument signals will be recorded in the instrument container of the EnviNOx[®]-System and used to determine whether the nitric acid production is within the historical designed capacity (daily basis). Recorded nitric acid production data considers concentration and density.

Actual temperature and pressure of the ammonia oxidation reactor:

The actual temperature and pressure of the ammonia oxidation reactor is monitored using the existing instruments in the nitric acid plant Abu Qir II. The instrument signals will be recorded in the instrument container of the EnviNOx[®]-System and used to determine whether the nitric acid plant is being operated within the normal range of operation (daily basis).

Actual ammonia input to the ammonia oxidation reactor:

The actual ammonia flow to the ammonia oxidation reactor is monitored using the existing instruments in the nitric acid plant Abu Qir II. The instrument signals will be recorded in the instrument container of the EnviNOx[®]-System and used to determine whether the nitric acid plant is being operated within the normal range of operation (daily basis). Ammonia flow is converted to standard conditions based on temperature and pressure measurement.

Composition of the ammonia oxidation catalyst:

The composition of the ammonia oxidation catalyst will be monitored according to catalyst supplier information.

Natural gas input:

The natural gas used as reducing agent will be measured by flow meters manufactured by Krohne. Flow is converted to standard conditions based on temperature and pressure measurement by Rosemount.

Operation and data storage:

The monitoring system is designed for automatic operation, so that activities by operation personnel are not required during normal operation. However, it is required to observe the system for possible failures, and to perform required maintenance activities on a regular basis. The measured values are transferred to a digital process control system (Delta V, M/s. process management), where they are displayed, evaluated, and stored. Evaluation includes calculation of flow rate at standard conditions and mass flow rates of N₂O. Based on raw data the system also performs calculation of daily mean values and generates reports. Data storage for raw data as well as for evaluated data is done on a computer network which is directly connected to the process control system. Data storage is designed redundantly on two separate computers, located at different locations, each equipped with a redundant array of hard disks. Network connections are redundant fibre optic links. The software for data storage is designed in a way that manipulation of data is excluded, and that any change of configuration is recorded. Time stamps are generated by a GPS clock.

In addition, a shift report on the operation of the EnviNOx[®]-System and emission reductions will be prepared by AFC nitric acid process team.

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.



Information and data mentioned above are integrated part of the monitoring reports. Data collected to monitor emissions of the project scenario and the baseline scenario are given below:

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number	Data Variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	For how long is achieved data to be kept	Comment
P1	PE_y Project emissions	Monitoring system	tCO ₂ e	Calculated	Annual	100%	Electronic	Crediting period +2yrs	
P2	PE_ND,y Project emissions from N ₂ O not destroyed	Monitoring system	tCO ₂ e	Calculated	Annual	100%	Electronic	Crediting period +2yrs	
P3	PE_DF,y Project emissions from destruction facility	Monitoring system	tCO ₂ e	Calculated	Annual	100%	Electronic	Crediting period +2yrs	



P4	PE_N2O,y N ₂ O not destroyed by facility	Monitoring system	tN ₂ O	Calculated	Daily	100%	Electronic	Crediting period +2yrs	
P5	F_TG,I Volume flow tail gas at N ₂ O destruction facility	Flow meter	m ³ /h	Measured continuously	Daily	100%	Electronic	Crediting period +2yrs	Flow metering system will automatically record volume flow adjusted to standard temperature and pressure.
P6	CO_N2O,i N ₂ O concentration at destruction facility outlet	Monitoring system, measuring device	tN ₂ O/ m ³	Measured continuously	Daily	100%	Electronic	Crediting period +2yrs	
P7	M_i Measuring Interval	Measuring device, data management system	h	Measured continuously	Daily	100%	Electronic	Crediting period +2yrs	
P8	PE_HC,y Emissions from hydrocarbon use in destruction facility	Monitoring system	tCO ₂ e	Calculated	Annual	100%	Electronic	Crediting period +2yrs	
P9	HCE_C,y Converted hydrocarbon emissions	Monitoring system	tCO ₂ e	Calculated	Annual	100%	Electronic	Crediting period +2yrs	



P10	HCE_NC,y Non-converted hydrocarbon emissions	Monitoring system	tCO ₂ e	Calculated	Annual	100%	Electronic	Crediting period +2yrs	
P11	Q_HC,y Hydrocarbon input (reducing agent)	Measuring device	m ³	Measured	Daily	100%	Electronic	Crediting period +2yrs	
P12	ρ_HC Hydrocarbon density	Certificate hydrocarbon supplier or default value	t/m ³	Measured	Yearly	100%	Electronic	Crediting period +2yrs	
P13	EF_HC Hydrocarbon CO ₂ emission factor	IPCC	tCO ₂ /t	Calculated	Once	100%	Electronic	Crediting period +2yrs	Methane: 2.75 tCO ₂ /tCH ₄
P14	OXID_HC Hydrocarbon oxidation factor	Measuring device	%	Measured continuously	Daily	100%	Electronic	Crediting period +2yrs	
P15	Type_HC Type of hydrocarbon	Hydrocarbon supplier	-		Once	100%	Electronic	Crediting period +2yrs	

Note, in case of the catalytic N₂O destruction project at the nitric acid plant Abu Qir II a SCR DeNO_x-unit is already installed prior to the starting date of the project activity. Methane will be used as reducing agent.



D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO₂ equ.)

The direct emissions from the project activity are equivalent to the N₂O emissions not destroyed plus emissions related to the operation of the N₂O destruction facility (emissions from additional ammonia and hydrocarbon input).

Project Emissions

The emissions due to the project activity are composed of (a) the emissions of not destroyed N₂O and (b) emissions from auxiliary ammonia and hydrocarbons input resulting from the operation of the N₂O destruction facility. The procedure of determining the project N₂O emissions is similar to that used for determining baseline emissions. Project emissions are defined by the following equation:

$$PE_y = PE_{ND,y} + PE_{DF,y} \quad (25)$$

where:

PE _y	Project emissions in year y (tCO ₂ e)
PE _{ND,y}	Project emissions from N ₂ O not destroyed in year y (tCO ₂ e)
PE _{DF,y}	Project emissions related to the operation of the destruction facility in year y (tCO ₂ e)

N₂O emissions not destroyed by the project activity:

N₂O emissions not destroyed by the project activity are calculated based on the continuous measurement of the N₂O concentration in the tail gas of the N₂O destruction facility and the volume flow rate of the tail gas stream.

The emissions of non destroyed N₂O are given by:

$$PE_{ND,y} = PE_{N2O,y} \times GWP_{N2O} \quad (26)$$

where:

PE _{ND,y}	Project emissions from N ₂ O not destroyed in year y (tCO ₂ e)
PE _{N2O,y}	Project emissions of N ₂ O in year y (tN ₂ O)
GWP _{N2O}	Global warming potential of N ₂ O = 310

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.



$$PE_{N_2O,y} = \sum_{i=1}^n F_{TG,i} \times CO_{N_2O,i} \times M_i \quad (27)$$

where:

$PE_{N_2O,y}$	Project emissions of N_2O in year y (t N_2O)
$F_{TG,i}$	Volume flow rate tail gas at destruction facility during interval i (m ³ /h)
$CO_{N_2O,i}$	N_2O concentration in the tail gas of the N_2O destruction facility during interval i (t N_2O /m ³)
M_i	Length of measuring interval i (h)
i	interval
n	number of intervals during the year

Project emissions from the operation of the destruction facility:

The operation of the N_2O destruction facility at Abu Qir II requires the use of hydrocarbon (methane) as input streams.

The emissions related to the operation of the N_2O destruction facility are given by on-site emissions due to the hydrocarbons used as input to the N_2O destruction facility:

$$PE_{DF,y} = PE_{NH_3,y} + PE_{HC,y} \quad (28)$$

where:

$PE_{DF,y}$	Project emissions related to the operation of the destruction facility in year y (tCO ₂ e)
$PE_{NH_3,y}$	Project emissions related to ammonia input to destruction facility in year y (tCO ₂ e)
$PE_{HC,y}$	Project emissions related to hydrocarbon input to destruction facility in year y (tCO ₂ e)

Ammonia input:

In case of Abu Qir II, project emissions related to ammonia input to the destruction facility ($PE_{NH_3,y}$) are zero.

Hydrocarbon Input:

Methane is used as reducing agent at Abu Qir II to enhance the catalytic N_2O reduction efficiency. In this case hydrocarbons are completely converted to water, carbon monoxide and carbon dioxide. The fraction of the converted hydrocarbons is $OXID_{HC}$.

$$PE_{HC,y} = HCE_{C,y} + HCE_{NC,y} \quad (29)$$



where:

PE_HC,y	Project emissions related to hydrocarbon input to destruction facility in year y (tCO ₂ e)
HCE_C,y	Converted hydrocarbon emissions in year y (tCO ₂)
HCE_NC,y	Methane emissions in year y (tCO ₂ e)

For calculation of the GHG emissions related to the hydrocarbons converted and not converted, the following formulae are used:

$$HCE_C,y = \rho_HC \times Q_HC,y \times EF_HC \times OXID_HC/100 \quad (30)$$

where:

HCE_C,y	Converted hydrocarbon emissions in year y (tCO ₂ e)
ρ_HC	Hydrocarbon density (t/m ³)
Q_HC,y	Hydrocarbon input in year y (m ³)
OXID_HC	Oxidation factor of hydrocarbon (%)
EF_HC	Carbon emission factor of hydrocarbon (tCO ₂ /t HC)

$$HCE_NC,y = \rho_HNC \times Q_HNC,y \times GWP_CH4 \times (1-OXID_CH4/100) \quad (31)$$

where:

HCE_NC,y	Methane emissions in year y (tCO ₂ e)
ρ_HNC	Methane density (t/m ³)
Q_HNC,y	Methane used in year y (m ³)
GWP_CH4	Global warming potential of methane
OXID_CH4	Oxidation factor of methane (%)

The hydrocarbon CO₂ emission factor is given by the molecular weights and the chemical reaction when hydrocarbons are converted (carbon emission factor of methane is 2.75 tCO₂/tCH₄)

Project emissions are limited to the design capacity of the existing nitric acid plant Abu Qir II. If the actual production of nitric acid ($P_{HNO3,y}$) exceeds the design capacity ($P_{HNO3,max}$) then emissions related to the production above $P_{HNO3,max}$ will neither be claimed for the baseline nor for the project scenario.

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.



boundary and how such data will be collected and archived :

ID number	Data Variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	For how long is achieved data to be kept	Comment
B1	P_HNO3,y Plant output of HNO ₃	Production reports	tHNO ₃	Measured	Daily	100 %	Electronic	Crediting period + 2 yrs	
B2	QI_N2O,y Quantity of N ₂ O at inlet of destruction facility	Monitoring system	tN ₂ O	Calculated	Daily	100 %	Electronic	Crediting period + 2 yrs	
B3	CI_N2O,I N ₂ O concentration at N ₂ O destruction facility inlet	Monitoring system, measuring device	tN ₂ O/m ³	Measured continuous	Daily	100 %	Electronic	Crediting period + 2 yrs	
B4	QR_N2O,y Regulation I: annual quantity N ₂ O limited	National legislation	tN ₂ O	Calculated	Date of regulation	100 %	Electronic	Crediting period + 2 yrs	
B5	RSE_N2O,y Regulation II: N ₂ O emissions per unit of nitric acid	National legislation	tN ₂ O/t HNO ₃	Calculated	Date of regulation	100 %	Electronic	Crediting period + 2 yrs	

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.



B6	CR_N2O Regulation III: N ₂ O concentration in tail gas limited	National legislation	tN ₂ O/m ³	Calculated	Date of regulation	100 %	Electronic	Crediting period + 2 yrs	
B7	P_HNO3,hist Design capacity	Manufacturer's specifications / production reports	t	Measured / calculated	Once	100 %	Electronic	Crediting period + 2 yrs	
B8	T_g,hist Historical opera-ting temperature range of the ammonia oxidation reactor	Production reports / manufacturer's specification	°C	Measured / calculated	Once	100 %	Electronic	Crediting period + 2 yrs	
B9	P_g,hist Historical operating pressure range of the ammonia oxidation reactor	Production reports / manufacturer's specifications	Pa	Measured / calculated	Once	100 %	Electronic	Crediting period + 2 yrs	
B10	T_g Actual operating temperature ammonia oxidation reactor	Measuring device	°C	Measured	Continuous	100 %	Electronic	Crediting period + 2 yrs	
B11	P_g Actual operating pressure ammonia oxidation reactor	Measuring device	Pa	Measured	Continuous	100 %	Electronic	Crediting period + 2 yrs	
B12	Reg_NOx National regulation on NO _x emissions	National regulations, Ministry of Environment	tNO _x /m ³	Calculated	Date of regulation	100 %	Electronic	Crediting period + 2 yrs	

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.



B13	G_sup Supplier of the ammonia oxidation catalyst	Supplier's information	-					Crediting period + 2 yrs	
B14	G_com Composition of the ammonia oxidation catalyst	Annual reports, supplier's information	%		Date of changing gauze composition	100 %	Electronic	Crediting period + 2 yrs	
B15	G_sup,hist Historical supplier of ammonia oxidation catalyst	Annual reports, supplier's information	-		Once	100 %	Electronic	Crediting period + 2 yrs	
B16	G_com,hist Historical composition of the ammonia oxidation catalyst	Supplier's information	%		Date of start of use of catalyst	100 %	Electronic	Crediting period + 2 yrs	
B17	SE_N2O N ₂ O emission rate per ton of nitric acid	Monitoring reports	tN ₂ O/t HNO ₃	Calculated	Yearly	100 %	Electronic	Crediting period + 2 yrs	
B18	A_OR,hist Max. historical ammonia flow rate to the ammonia oxidation reactor	Production reports / manufacturer's specifications / literature	tNH ₃ /day	Measured / calculated	Once	100 %	Electronic	Crediting period + 2 yrs	
B19	A_OR,d Actual ammonia flow rate to the ammonia oxidation reactor	Measuring device	tNH ₃ /day	Measured	Continuous	100 %	Electronic	Crediting period + 2 yrs	

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.

**D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO₂ equ.)**

Baseline emissions of the project activity are determined based on the quantity of N₂O emitted in the baseline scenario, taking national regulations, production levels and operating conditions into consideration. The quantity of N₂O is determined based on the measurement of the N₂O at the inlet of the N₂O destruction facility (EnviNOx[®]-System), which results in a conservative estimation of baseline emissions.

The N₂O baseline emissions monitoring equipment will measure (1) the tail gas volume flow rate (temperature and pressure are also measured and the volume flow rate is automatically adjusted to standard temperature and pressure), (2) the N₂O concentration at the inlet of the EnviNOx[®]-System, (3) the output of nitric acid and (4) the operating conditions of the ammonia oxidation reactor (temperature, pressure, ammonia flow rate). The amount of N₂O baseline emissions can then directly be calculated by multiplying the tail gas volume flow rate and the N₂O concentration or if the actual operating parameters and pressure are outside the range of permitted operating parameters by applying conservative default values. The baseline emissions are limited to the historical production levels of the existing nitric acid plant.

Baseline Emissions

Baseline emissions are given by the following equation:

$$BE_y = BE_{N_2O} \times GWP_{N_2O} \quad (32)$$

where:

BE _y	Baseline emissions in year y (tCO ₂ e)
BE _{N₂O,y}	Baseline emissions of N ₂ O in year y (tN ₂ O)
GWP _{N₂O}	Global warming potential of N ₂ O = 310

Depending on the implementation of regulations on N₂O emissions and the character of the regulation, baseline N₂O emissions (BE_{N₂O,y}) are calculated as shown below:

Case 1: The most plausible baseline scenario is that no N₂O would be abated in the absence of the project activity (i.e. no secondary or tertiary reductions measures and no NSCR DeNO_x unit would be installed).

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.



$$BE_{N_2O,y} = QI_{N_2O,y} \quad (33)$$

where:

$BE_{N_2O,y}$ Baseline emissions of N_2O in year y (t N_2O)
 $QI_{N_2O,y}$ Quantity of N_2O supplied to the destruction facility in year y (t N_2O)

The quantity of N_2O supplied to the N_2O destruction facility (DF) is calculated based on continuous measurement of the tail gas volume flow rate and the N_2O concentration at the inlet of the N_2O destruction facility. Therefore the quantity of the N_2O at the inlet is given by:

$$QI_{N_2O,y} = \sum_{i=1}^n F_{TG,i} \times CI_{N_2O,i} \times M_i \quad (34)$$

where:

$QI_{N_2O,y}$ Quantity of N_2O emissions at the inlet of the destruction facility in year y (t N_2O)
 $F_{TG,i}$ Volume flow rate at the inlet of the destruction facility during interval i (m³/h)
 $CI_{N_2O,i}$ N_2O concentration at destruction facility inlet during interval i (t N_2O /m³)
 M_i Length of measuring interval i (h)
 i Interval
 n Number of intervals during the year

Baseline emissions are limited to the design capacity of the existing nitric acid plant. If the actual production of nitric acid ($P_{HNO_3,y}$) exceeds the design capacity ($P_{HNO_3,max}$) then emissions related to the production above $P_{HNO_3,max}$ will neither be claimed for the baseline nor for the project scenario.

$$\text{If, } P_{HNO_3,y} > P_{HNO_3,max} \quad (35)$$

then

$$BE_{N_2O,y} = SE_{N_2O,y} \times P_{HNO_3,max} \quad (36)$$

where:

$BE_{N_2O,y}$ Baseline emissions of N_2O in year y (t N_2O)
 $SE_{N_2O,y}$ Specific N_2O emissions per output nitric acid in year y (t N_2O /t HNO_3)
 $P_{HNO_3,max}$ Design capacity (t HNO_3)

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

$$SE_{N_2O,y} = QI_{N_2O,y} / P_{HNO_3,y} \quad (37)$$

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.



where:

SE _{N2O,y}	Specific N ₂ O emissions per output nitric acid in year y (tN ₂ O/tHNO ₃)
QI _{N2O,y}	Quantity of N ₂ O emissions at the inlet of the destruction facility in year y (tN ₂ O)
P _{HNO3,y}	Production of nitric acid in year y (tHNO ₃)

Case 2: Legal regulations for N₂O are implemented:

In case national regulations concerning N₂O emissions are implemented during the crediting period, the impact on baseline N₂O emissions is considered without any delay by adjusting the measured N₂O emissions at the time the regulation has to be implemented. Depending on the character of the regulation the adjustment is done as shown below:

Case 2.1: Regulation setting of a threshold for an absolute quantity of N₂O emissions per nitric acid plant over a given time period:

Baseline N₂O emissions are limited by the absolute quantity of N₂O emissions given by the regulation. If the measured baseline N₂O emissions are exceeding the regulatory limit, then measured baseline N₂O emissions are substituted by the regulatory limit.

This leads to the following condition:

$$\text{If,} \\ QI_{N2O,y} > QR_{N2O,y} \quad (38)$$

$$\text{then,} \\ BE_{N2O,y} = QR_{N2O,y} \quad (39)$$

$$\text{else,} \\ BE_{N2O,y} = \min \text{ of } [QI_{N2O,y}, SE_{N2O,y} \times P_{HNO3,max}] \quad (40)$$

where:

QI _{N2O,y}	Quantity of N ₂ O emissions at the inlet of the destruction facility in year y (tN ₂ O)
QR _{N2O,y}	Regulatory limit of N ₂ O emissions in year y (tN ₂ O)
BE _{N2O,y}	Baseline emissions of N ₂ O in year y (tN ₂ O)
SE _{N2O,y}	Specific N ₂ O emissions per output nitric acid in year y (tN ₂ O/tHNO ₃)
P _{HNO3,y}	Production of nitric acid in year y (tHNO ₃)

The quantity of N₂O emissions at the inlet of the N₂O destruction facility (DF) is calculated based on continuous measurement of the tail gas volume flow rate and the N₂O concentration at the inlet of the N₂O destruction facility (see equation 11).

Case 2.2: Regulation setting of a threshold for specific N₂O emissions per unit of product:

This leads to the following condition:

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.



If,

$$SE_N2O,y > RSE_N2O \quad (41)$$

then,

$$BE_N2O,y = \min \text{ of } [RSE_N2O \times P_HNO3,y, SE_N2O,y \times P_HNO3,max] \quad (42)$$

else,

$$BE_N2O,y = \min \text{ of } [QI_N2O,y, SE_N2O,y \times P_HNO3,max] \quad (43)$$

where:

SE_N2O,y	Specific N ₂ O emissions per output nitric acid in year y (tN ₂ O/tHNO ₃)
RSE_N2O	Regulatory limit of N ₂ O emissions per output nitric acid (tN ₂ O/tHNO ₃)
BE_N2O,y	Baseline emissions of N ₂ O in year y (tN ₂ O)
P_HNO3,y	Production of nitric acid in year y (tHNO ₃)
QI_N2O,y	Quantity of N ₂ O emissions at the inlet of the destruction facility in year y (tN ₂ O)

The specific N₂O emissions per unit of output nitric acid are defined as:

$$SE_N2O,y = QI_N2O,y / P_HNO3,y \quad (44)$$

where:

SE_N2O,y	Specific N ₂ O emissions per output nitric acid in year y (tN ₂ O/tHNO ₃)
QI_N2O,y	Quantity of N ₂ O emissions at the inlet of the destruction facility in year y (tN ₂ O)
P_HNO3,y	Production of nitric acid in year y (tHNO ₃)

The quantity of N₂O emissions at the inlet of the N₂O destruction facility is calculated based on continuous measurement of the tail gas volume flow rate and the N₂O concentration at the inlet of the N₂O destruction facility (see equation 11).

Case 2.3: Regulation setting of a threshold for N₂O concentration in the tail gas

This leads to the following condition:

If,

$$C_N2O,y > CR_N2O \quad (45)$$

then

$$BE_N2O,y = \sum_i^n C_N2O,i \times [F_TG,i \times M_i] \quad (46)$$

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.



where $C_{N_2O,i}$ is $\min [C_{N_2O,y}, CR_{N_2O}, \text{ and } \{(SE_{N_2O,y} \times P_{HNO_3,max})/(\sum(F_{TG,I} \times M_i))\}]$

else,

$$BE_{N_2O,y} = QI_{N_2O,y} \quad (47)$$

where:

$C_{N_2O,i}$	N_2O concentration at destruction facility inlet during interval i (tN_2O/m^3)
$CR_{N_2O,i}$	Regulatory limit for specific N_2O concentration during interval I (tN_2O/m^3)
$BE_{N_2O,y}$	Baseline emissions of N_2O in year y (tN_2O)
$F_{TG,i}$	Volume flow rate of tail gas at destruction facility during interval i (m^3/h)
M_i	Length of measuring interval i (h)
i	Interval
n	Number of intervals during the year
$QI_{N_2O,y}$	Quantity of N_2O emissions at the inlet of the destruction facility in year y (tN_2O)

The quantity of N_2O emissions at the inlet of the N_2O destruction facility is calculated based on continuous measurement of the tail gas volume flow rate and the N_2O concentration at the inlet of the N_2O destruction facility (see equation 11).

Change in N_2O regulations will automatically cause a re-assessment of the baseline scenario.

Procedures used to determine the permitted operating conditions of the nitric acid plants:

In order to avoid that the operation of the nitric acid production plant is manipulated in a way to increase the N_2O generation, thereby increasing the CERs, the following procedures relating to the operating temperature and pressure and the use of ammonia oxidation catalysts is applied.

1. Operating temperature and pressure of the ammonia oxidation reactor (AOR):

If the actual average daily operating temperature or pressure in the ammonia oxidation reactor (T_g and P_g) are outside a “permitted range” of operating temperatures and pressures ($T_{g,hist}$ and $P_{g,hist}$), the baseline emissions are calculated for the respective time period based on lower value between (a) the conservative IPCC default values of 4.05 kg N_2O /ton nitric acid, (b) $SE_{N_2O,y}$ and (c) any related value as a result of legal regulations (e.g. $RSE_{N_2O,y}$).

Required monitoring parameters:

$T_{g,d}$	Actual operating temperature AOR on day d ($^{\circ}C$)
$P_{g,d}$	Actual operating pressure AOR on day d (Pa)

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.



T_g,hist Historical operating temperature range AOR (°C)
P_g,hist Historical operating pressure range AOR (Pa)

The Abu Qir II nitric acid plant is equipped with two parallel and equally sized ammonia oxidation reactors 1201R001 and 2102R001. The gauze temperature in each burner is continuously measured by the sensors in burner 1 and burner 2. Since each burner is fed with the same mixture of ammonia and air, all temperature measurements should theoretically show the same value.

In fact, the historical data show rather large differences between the measured temperatures. In the year 2005 the difference between the indicated temperature of burner 1 (TRAHL21014) and burner 2 (TRAHL21020) was between 10K and 20K, with burner 2 apparently being hotter. These differences are most likely caused by loss of calibration or to deterioration of the thermoelements over time. Therefore it is very unlikely that the indicated temperatures correspond to the true gauze temperatures.

Since the gauze temperatures are important parameters in the operation of the nitric acid plant, AFC will either change the thermoelements in the burners or calibrate them prior to the starting date of the project activity (during the shutdown for project implementation), to obtain more accurate gauze temperature measurements.

After the calibration or exchange of the thermoelements the historical operating temperatures will not be directly related to the new, measured values, so an interpretation and definition of normal range of operation based on the values of the recalibrated / exchanged temperature elements will be uncertain. Therefore the permitted operating range of temperature in the ammonia oxidation reactor is based on the normal range of operating conditions for the ammonia oxidation reactors according to Uhde's operating manual for the Abu Qir II nitric acid plant, which is 850°C to 910°C.

Therefore the permitted range of operation temperature is determined by

T_g,hist Burner I: 850°C to 910°C from the operating manual provided by the technology provider Uhde
 Burner II: 850°C to 910°C from the operating manual provided by the technology provider Uhde

The operating pressure is continuously measured by pressure transmitter in the air compressor discharge line. In fact historical data are available for the Abu Qir II nitric acid plant, but due to loss of calibration or possible deterioration of the measuring device over time it is very unlikely that the indicated pressures correspond to the true gauze pressures.

Since also the gauze pressure is an important parameter in the operation of the nitric acid plant, AFC will either change the pressure measuring device or calibrate it prior to the starting date of the project activity (during the shutdown for project implementation), to obtain a more accurate pressure measurement.

After the calibration or exchange of the pressure measurement devices the historical operating pressures will not be directly related to the new, measured values, so an interpretation and definition of normal range of operation based on the values of the recalibrated / exchanged pressure elements will be incorrect. Therefore the permitted operating range of pressure is based on normal operating conditions for the ammonia oxidation reactors according to Uhde's operating manual for the Abu Qir II nitric acid plant.

The effect of pressure in the ammonia oxidation catalyst on N₂O generation in ammonia oxidation on gauzes:



Lower pressure in the burner leads to lower formation of N_2O . This can be concluded from the following. The effect of pressure on the amount of N_2O formed in the ammonia oxidation reactor is well-known and is the reason for monitoring this and other operating parameters that may influence N_2O formation according to AM0028 and applying a conservative default value if a parameter goes out of range.

- Kongshaug (1998)⁵ states, for example, that the N_2O concentration in nitric acid tail gases ranges from about 700 – 1300 ppm (corresponding to 4.4 to 8.1 kg N_2O / t HNO_3) and goes on to say in the next sentence that increasing the pressure slightly increases N_2O emission.
- Further support for the effect of pressure on N_2O generation is provided by the IPCC Guidelines. Given N_2O generation factors [kg N_2O / t HNO_3] clearly demonstrate that higher pressure in the burner leads to higher formation of N_2O .
- Hand in hand with reduced N_2O generation at lower pressures goes an increase in ammonia burner efficiency. That is, the proportion of the ammonia entering the burner which is converted to nitric oxide (NO) increases as the pressure is reduced. This is documented, for example, by Keleti (1985)⁶ The ammonia conversion efficiency ranges from 94%-95% for 10.5 bar burners up to 97%-98% for atmospheric pressure burners.
- The effect is also illustrated in Ullmann (1991)⁷ on page 298, which shows ammonia conversion efficiency (to NO) as a function of gauze temperature for pressures of 1 bar abs and 4 bar abs. The conversion efficiency is 2-3% points lower at 4 bar than at 1 bar.

It is therefore obvious to conclude that if the burner pressure is lower the amount of N_2O generated will decrease and the upper limit of permitted operating pressure is the deciding factor in order to avoid gaming.

The permitted operating range of pressure is based on normal operating conditions for the ammonia oxidation reactors according to Uhde's operating manual for the Abu Qir II nitric acid plant, which is 2.0 barg to 4.5 barg.

P_g,hist Burner I + II: 2.0 barg to 4.5 barg from the operating manual provided by the technology provider Uhde.

If the permissible operating limit recommended in Uhde's operating manual is exceeded for either temperature or pressure, the baseline N_2O emissions for the relevant period are capped at the conservative level of 4.05 kg N_2O /t HNO_3 .

⁵ Kongshaug (1998): Energy Consumption and Greenhouse Gas Emissions in Fertilizer Production. Kongshaug, G. IFA Technical Conference, Marrakech, Morocco, 1998. Available from the International Fertilizer Industry Association at <http://www.fertilizer.org/ifa/publicat/pdf/1998_biblio_65.pdf>

⁶ Keleti (1985): Nitric Acid and Fertilizer Nitrates", Cornelius Keleti (Ed.), p.67, Marcel Dekker Inc., New York, 1985 ISBN,0-8247-7332-2

⁷ Ullmann (1991): Ullmann's Encyclopedia of Industrial Chemistry, 5th Ed. Vol. A17, Naphthalene to Nuclear Technology, p.315 VCH Verlagsgesellschaft mbH, Weinheim, Germany, (1991), ISBN 3-527-20117-3

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.



2. Composition of ammonia oxidation catalyst:

The plant operator is allowed to use compositions of ammonia oxidation catalysts that are common practice in the region or have been used in the nitric acid plant during the last three years without limitation of N₂O baseline emissions.

In case the nitric acid plant operator wishes to change to a composition not used during the last three years, but is common practice in the region and supplied by a reputable manufacturer, or if it corresponds to a composition that is reported as being in use in the relevant literature, the plant operator is allowed to use these ammonia oxidation catalysts without limitation of N₂O baseline emissions.

In case the nitric acid plant operator changes the composition of ammonia oxidation catalysts and the composition is not common practice in the region and not reported as being in use in the relevant literature, the project applicant has to demonstrate (either by economic or other arguments) that the choice of the new composition was based on considerations other than an attempt to increase the rate of N₂O production. If the project applicant can demonstrate appropriate and verifiable reasons, the plant operator is allowed to use new ammonia oxidation catalysts without limitation of N₂O baseline emissions.

The first composition of ammonia oxidation catalyst used during the crediting period shall be of the same kind of catalyst composition already in operation in the specific nitric acid plant. This is to avoid gaming at the beginning of the project activity.

In case the nitric acid plant operator changes the composition of ammonia oxidation catalysts and the composition is not common practice in the region and not reported as being in use in the relevant literature, and the project applicant cannot demonstrate appropriate and verifiable reasons for this, baseline emissions are limited to the maximum specific N₂O emissions of previous periods (tN₂O/tHNO₃), documented in the verified monitoring reports.

Required monitoring parameters:

G _{sup}	Supplier of the ammonia oxidation catalyst
G _{sup,hist}	Historical supplier of the ammonia oxidation catalyst
G _{com}	Composition of the ammonia oxidation catalyst
G _{com,hist}	Historical composition of the ammonia oxidation catalyst
SE _{N2O,y}	Specific N ₂ O emissions per ton HNO ₃ in year y (tN ₂ O/tHNO ₃)

The specification for catalyst gauzes at AFC's Abu Qir II nitric acid plant is 90% Platinum and 10% Rhodium manufactured by the reputable manufacturer Umicore. It is AFC's intention to continue using a common ammonia oxidation catalyst produced by a reputable manufacturer during the crediting period. The composition of the ammonia oxidation catalyst to be used for the first campaign after project start will be of the same kind of catalyst composition as what is already in operation in AFC's nitric acid plant.



3. Ammonia flow rate to the ammonia oxidation reactor:

If the actual daily ammonia flow rate exceeds the (upper) limit on maximum historical daily permitted ammonia flow rate, the baseline emissions for this operating day are calculated based on the conservative IPCC default values and are limited by the legal regulations. The upper limit on ammonia flow is determined by plant specific historical operating data on the maximum daily average ammonia flow.

Required monitoring parameters on daily basis:

A_OR,d	Actual ammonia input to oxidation reactor (tNH ₃ /day)
A_OR,hist	Maximum historical ammonia input to oxidation reactor (tNH ₃ /day)

Analysis of the historical data for the years 2000-2005 documents the maximum ammonia input to the ammonia oxidation reactor of 545 tNH₃/day.

If the daily ammonia input to the oxidation reactor exceeds the limit on permissible ammonia input, baseline N₂O emissions are capped at conservative IPCC default values.

**D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).**

Not applicable, Option 1 is chosen.

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number (Please use numbers to ease cross-referencing to table D.3)	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/paper)	Comment

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO₂ equ.):

Not applicable, Option 1 is chosen.

**D.2.3. Treatment of leakage in the monitoring plan****D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity**

ID number (Please use numbers to ease cross-referencing to table D.3)	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/paper)	Comment

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO₂ equ.)

At the nitric acid plant Abu Qir II an energy converter (tail gas turbine) is installed at the end of the pipe. The installation of the N₂O destruction facility will therefore not result in significant additional energy consumption and no leakage is expected. Therefore no monitoring mechanism is being suggested.

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO₂ equ.)

The emission reduction (ER_y) by the project activity during a given year y is the difference between the baseline emissions (BE_y) and project emissions (PE_y), as follows:

$$ER_y = BE_y - PE_y - LE_y \quad . (48)$$

where:

ER_y emissions reductions of the project activity during the year y (tCO₂e)
 BE_y baseline emissions during the year y (tCO₂e)
 PE_y project emissions during the year y (tCO₂e)
 LE_y leakage emissions in year y (tCO₂e)

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.



D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored		
Data (Indicate table and ID number e.g. 3.-1.; 3.2.)	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
B.1	Low	<p><i>Meters used to measure the nitric acid production are already installed at Abu Qir II and are integrated in AFC's quality management system (ISO 9001/2000). The calculation of nitric acid production considers the daily average concentration and density.</i></p> <p><i>The measurement devices are subject to regular calibration, maintenance and testing regime to ensure accuracy (according to manufacturer instructions).</i></p> <p>Check at the beginning of the project:</p> <ul style="list-style-type: none"> <i>The nitric acid flow meter and the density meter will be checked by AFC's instrumentation technician to ensure it is operating in accordance with the manufactures' instructions.</i> <p>Regular check during the project lifetime:</p> <ul style="list-style-type: none"> <i>Maintenance and checking are carried out as specified by manufacturer. All work carried out will be documented.</i> <i>The acid density and concentration is measured regularly basis by AFC's laboratory and the results are compared with any online measurements. If the acid density / concentration measurement is made by means of a portable device the portable device is to be compared with laboratory results, or calibrated at supplier-specified intervals. All observations are to be recorded. If deviations are found appropriate remedial action is to be taken.</i> <i>AFC will also contact plausibility checks on a regular basis based on the ammonia nitrogen balance of the plant. The input of ammonia nitrogen is the ammonia flow to the ammonia oxidation reactor. The outputs are N₂O at the inlet of the N₂O destruction facility and NO_x at the inlet of the N₂O destruction facility. The major output is product acid. An assumption must be made about the amount of ammonia nitrogen converted to elemental nitrogen, N₂. Before carrying out a plausibility check of this kind, the nitric acid plant should be operated at constant conditions for several hours to minimise the effects of tower sump pumpout and time delays between the ammonia oxidation reactor and the product nitric acid.</i> <p><i>QA/QC program will be integrated in AFC management systems ISO 9001/2000 and ISO 14001.</i></p>



B.10 B11	Low	<p><i>The actual temperature and pressure at the ammonia oxidation catalyst will be measured with the already installed or exchanged measuring devices (see below). After temperature measurement maintenance and testing regime the following accuracies are expected:</i></p> <p><i>Temperature: Burner I: Degree of accuracy about +/- 0.1 %</i> <i>Temperature Burner II: Degree of accuracy about +/- 0.1 %</i></p> <p><i>Pressure: pressure transmitter in the air compressor discharge line: Degree of accuracy about +/- 0.1%</i></p> <p><i>Check at the beginning of the project:</i></p> <ul style="list-style-type: none"><i>Temperature measurement devices will be tested, calibrated and if required exchanged to ensure it is operating in accordance with the manufactures' instructions.</i><i>Pressure measurement device will be tested, calibrated and if required exchanged to ensure it is operating in accordance with the manufactures' instructions.</i> <p><i>Regular check during the project lifetime:</i></p> <ul style="list-style-type: none"><i>Maintenance and testing are carried out as specified by manufacturer. All work carried out will be documented.</i> <p><i>Temperature and pressure sensors, transmitters and recording devices will be subject to a regular maintenance and testing regime according to manufacturer instruction – unless it is seen from recorded data that the readings are abnormal.</i></p>
-------------	-----	---



P.5	Low	<p><i>The tail gas flow is measured by using a venturi tube, which is designed and manufactured in accordance with ISO 5167-4:2003. The venturi tube is of rough welded sheet iron type with annular pressure tapping chambers. Differential pressure is measured with two (redundant) differential pressure transmitters. For calculation of the volume flow rate at standard conditions or (with known molecular weight) the mass flow, the system is equipped with two (redundant) pressure transmitters and two (redundant) temperature measurements.</i></p> <p><i>The uncertainty of the mass flow measurement with the venturi tube is to be calculated with the formula given in ISO 5167-1:2003, chapter 8.2.2. Numerical evaluation of the formula given in ISO 5167 results in a total uncertainty of the flow measurement of 2,049 % of the actual value. Details are described in the Monitoring Plan.</i></p> <p><i>Standard Conditions:</i> <i>Temperature: 273.15 K</i> <i>Pressure: 1013.25 hPa</i></p> <p><i>Flow meter and associated transmitter and recoding devices will be subject to maintenance and testing regime to ensure accuracy (according to manufacturer instructions).</i></p>
-----	-----	--



<p>P6 B3</p>	<p>Low</p>	<p><i>In the feed of the EnviNOx®- system, the concentrations of nitrous oxide (N₂O), nitric oxide (NO) and nitrogen dioxide (NO₂) are analysed continuously. Analysis is done by using non-dispersive infrared photometry in a combined analyser device. Sample handling includes provisions for pressure reduction, separation of residual solids, sample flow adjustment, and supply with test gases. The analyser is, as far as technically possible, corrected for any applicable cross sensitivity.</i></p> <p><i>In the effluent of the EnviNOx®- system, the concentrations of nitrous oxide (N₂O), nitric oxide (NO) plus nitrogen dioxide (NO₂), oxygen (O₂) and methane (CH₄) are analysed continuously. Analysis is done by using non-dispersive infrared photometry for NO₂ and CH₄, paramagnetic measurement for O₂, and chemoluminescence for NO and NO₂. Sample handling includes provisions for pressure reduction, separation of residual solids, sample flow adjustment, and supply with test gases. The analysers are, as far as technically possible, corrected for any applicable cross sensitivity.</i></p> <p><i>The manufacturer specifies a relative accuracy of 1 % of the measuring range, assuming that zero and span adjustment is performed regularly as requested in instrument documentation. The analysis of N₂O downstream of the EnviNOx®- reactor, in particular, requires a daily zero adjustment to achieve this accuracy. This accuracy refers to the applied calibration standard, which again has an uncertainty. Best commercially available test gases for calibration have an uncertainty of 1 %. So, using the gaussian law of error propagation, the accuracy of the analysers is 1.41%.</i></p> <p><i>Both N₂O concentration measurement devices will be subject to regular maintenance and testing regime to ensure accuracy.</i></p>
<p>P7</p>	<p>Low</p>	<p><i>Time stamps are generated by a GPS clock module.</i></p>
<p>P11 B17</p>	<p>Low</p>	<p><i>The natural gas used as reducing agent will be measured by flow meters manufactured by Krohne (H250). Flow is converted to standard conditions based on temperature and pressure measurement by Rosemount RTD PT 100 and Rosemount 1151GP respectively.</i></p> <p><i>Flow meter FT 218002 (TAG): Degree of accuracy: +/- 1.6% of adjusted range Temperature TFT 218004: Degree of accuracy: +/- 0.1% of adjusted range Pressure PT 218004: Degree of accuracy: +/- 1.6% of adjusted range</i></p> <p><i>The actual ammonia flow to the ammonia oxidation reactor will be measured with the already installed measuring devices. Flow is converted to standard conditions based on temperature and pressure measurements.</i></p> <p><i>All meters will be subject to regular maintenance and testing regime once per year to ensure accuracy.</i></p>



On condition that 90% of the daily raw data are available, the measurement results for the certain day can be stated as valid. Procedures for determining emission reductions in cases that less than 90% of the raw data are available for a certain day are detailed in the Monitoring Plan (see trouble shooting procedures).

AFC has already established a set of internal procedures that ensures the utmost accuracy level from the installed instrumentation. Note, AFC is already ISO 9001/2000 and ISO 14001 certified.

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

AFC will operate the EnviNOx[®]-System and the measurement equipment. The company has been operating the nitric acid plant since the commissioning of the plant and has sufficient and well experienced staff to operate similar technologies (like the existing DeNO_x-unit) and is quite experienced in calibrating and maintaining monitoring equipment. The company is ISO 9001/2000 and ISO 14001 certified.

CARBON has concluded a contract with UHDE as well as with the provider of the measurement equipment for a continuously supervision and maintenance of the EnviNOx[®]-System as well as the measurement equipment. In case of any emergencies, such as failure of the EnviNOx[®]-System or failure of the measurement equipment, the technology provider Uhde and the supplier of the measurement equipment will be available.

The supplier of the measurement equipment will carry out an on-site training course for operation and maintenance of the measurement equipment prior to the start of the crediting period. Contents and procedures are detailed in the manufacturer's documentation. Uhde will also carry out an on-site training for operation and maintenance of the EnviNOx[®] system. Contents and procedures are also detailed in the manufacturer's documentation. For these purposes a training protocol will be prepared.

The EnviNOx[®]-System and the monitoring is designed for automatic operation, so that activities by operation personnel are not required during normal operation. However, it is required to observe the system for possible failures, and to perform required maintenance activities on a regular basis. All operational requirements are described the operating manuals for the EnviNOx[®]-System and the measurement equipment.

Malfunction of system components is indicated on the operator (AFC) console in the control room as an alarm. Occurrence of such an alarm requires the operator to immediately take measures to remedy the problem. This is normally done by informing the instrument department, which is then deciding whether the problem can be fixed immediately by themselves, or whether external support from manufacturer is required. In such a case it is important to act immediately in order to avoid loss of valuable data. The technology provider is also readily available for electronic consultations. Detailed instructions on how to proceed in such cases are given in manufacturer's documentation.

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.

**D.5 Name of person/entity determining the monitoring methodology:**

The following are not project participants.

<i>Name</i>	<i>Project Participant Yes / No</i>
CARBON Projektentwicklung GmbH A-3485 Grunddorf 68 AUSTRIA Tel. +43 2735 77 135 Fax. +43 2735 20 531 Gerald Dunkel Ferdinand Heilig Email: dunkel@carbon-austria.com Email: heilig@carbon-austria.com	NO

**SECTION E. Estimation of GHG emissions by sources****E.1. Estimate of GHG emissions by sources:**

The anthropogenic emissions of the proposed project activity within the project boundary consist of the emissions of non destroyed N₂O and emissions from hydrocarbon input related to the operation of the N₂O destruction facility.

Ex-ante estimation of project emissions is made by projecting nitric acid output, N₂O formation and efficiency of the catalytic N₂O destruction process as well as the demand of hydrocarbon. Estimation is for reference purposes only, actual project and baseline emissions will be determined on measurement results on an ex-post basis.

In case of the AFC's project a SCR DeNO_x-unit is already installed prior to the starting date of the CDM project at the nitric acid plant Abu Qir II. Therefore the operation of the project activity does not require additional ammonia inputs.

In case of Abu Qir II nitric acid plant additional hydrocarbon (methane) input will be required in order to enhance the catalytic N₂O destruction efficiency. Therefore additional hydrocarbon input will be taken into account and monitored.

Assuming a conservative 94% N₂O destruction rate and a conservative specific N₂O formation rate, ex-ante estimations will result in conservative estimation of project emissions (rather overestimation than underestimation).

Given the projected nitric acid production, volume flow rate of the tail gas, N₂O concentration in the tail gas at the outlet of the EnviNOx[®]-system, the efficiency of the EnviNOx[®]-System and the hydrocarbon input, total project emissions are estimated at about 77,800 tCO₂e per year.

The table below summarizes the project emissions by sources.

Year	Project Emissions from N₂O not destroyed (tonnes of CO₂e)	Project emissions from Hydrocarbons used (tonnes of CO₂e)	Project emissions from additional NH₃ used (tonnes of CO₂e)	Total Project Emissions (tonnes of CO₂e)
2006	20,014	2,675	0	22,690
2007	68,620	9,173	0	77,793
2008	68,620	9,173	0	77,793
2009	68,620	9,173	0	77,793
2010	68,620	9,173	0	77,793
2011	68,620	9,173	0	77,793
2012	68,620	9,173	0	77,793
2013	48,606	6,497	0	55,104
Total (tonnes of CO₂e)	480,343	64,210	0	544,553

**E.2. Estimated leakage:**

In case of the project activity no leakage is expected.

E.3. The sum of E.1 and E.2 representing the project activity emissions:

With no leakage overall emission of the project are described in chapter E.1. The table below summarizes the project emissions by sources.

Year	Project Emissions from N ₂ O not destroyed (tonnes of CO ₂ e)	Project emissions from Hydrocarbons used (tonnes of CO ₂ e)	Project emissions from additional NH ₃ used (tonnes of CO ₂ e)	Total Project Emissions (tonnes of CO ₂ e)
2006	20,014	2,675	0	22,690
2007	68,620	9,173	0	77,793
2008	68,620	9,173	0	77,793
2009	68,620	9,173	0	77,793
2010	68,620	9,173	0	77,793
2011	68,620	9,173	0	77,793
2012	68,620	9,173	0	77,793
2013	48,606	6,497	0	55,104
Total (tonnes of CO₂e)	480,343	64,210	0	544,553

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

Baseline emissions are estimated based on the quantity of N₂O emitted in the baseline scenario, taking national regulations into account.

Ex-ante estimation of baseline emission is made by projecting the nitric acid output and the N₂O formation. Estimations are for reference purposes only, actual baseline emissions will be determined on measurement results on an ex-post basis.

At present there are no national regulations on N₂O emissions in the Arab Republic of Egypt. Furthermore it is unlikely that any limits on N₂O emissions will be imposed in the near future. However, national regulations will be monitored and taken into account.

Given the projected nitric acid production, volume flow rate of the tail gas and the N₂O concentration in the tail gas, the baseline emissions are estimated at about 1,144,000 tCO₂e per year.



The table below summarizes the baseline emissions by sources.

Year	Baseline N ₂ O emissions (tonnes of N ₂ O)	Total Baseline Emissions (tonnes of CO ₂ e)
2006	1,076	333,572
2007	3,689	1,143,674
2008	3,689	1,143,674
2009	3,689	1,143,674
2010	3,689	1,143,674
2011	3,689	1,143,674
2012	3,689	1,143,674
2013	2,613	810,102
Total (tonnes of CO₂ e)	25,825	8,005,717

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

The GHG emission reduction achieved by the project activity during a given year is the difference between the total GHG emissions in the baseline and the project emissions. Please note, in case of the proposed project activity, leakage is zero.

The implementation of the project activity will result in GHG emission reductions of about 1.07 million tCO₂e per year. The global warming potential of N₂O is set at 310 according to the Kyoto Protocol rules.

These ex-ante emission reduction estimations are for reference purposes only, since emission reductions will be determined on an ex-post basis by monitoring the actual baseline and project emissions once the project activity is operational. Ex-post determination of baseline emissions generates the most accurate N₂O emission data and the most reliable monitoring system.

Table 1: Emission Reduction Summary

Emissions Summary		Unit	2007	% of BL GHG Emissions
Baseline emissions	BE_y	tCO₂e	1,143,674	100.00%
Project emissions related to the operation of the	PE_DF_y	tCO ₂ e	9,173	0.80%
Project emissions from N ₂ O not destroyed	PE_ND_y	tCO ₂ e	68,620	6.00%
Project emissions	PE_y	tCO₂e	77,793	6.80%
Total Leakage GHG Emissions	L_E_y	tCO₂e	0	0.00%
Total GHG Emissions Reduction	ER_y	tCO₂e	1,065,881	93.20%

**E.6. Table providing values obtained when applying formulae above:****Table:** Ex-ante emission reduction estimation crediting period (2006 – 2013)

Year	Estimation of Project Activity Emissions (tonnes of CO₂e)	Estimation of Baseline Emissions (tonnes of CO₂ e)	Estimation of Leakage (tonnes of CO₂e)	Estimation of Emission Reductions (tonnes of CO₂ e)
2006	22,690	333,572	0	310,882
2007	77,793	1,143,674	0	1,065,881
2008	77,793	1,143,674	0	1,065,881
2009	77,793	1,143,674	0	1,065,881
2010	77,793	1,143,674	0	1,065,881
2011	77,793	1,143,674	0	1,065,881
2012	77,793	1,143,674	0	1,065,881
2013	55,104	810,102	0	754,999
Total (tonnes of CO₂ e)	544,553	8,005,717	0	7,461,165

**SECTION F. Environmental impacts****F.1. Documentation on the analysis of the environmental impacts, including transboundary 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 7.46 million tons of CO₂e. Additionally, the EnviNO_x[®]-System takes over the function of the DeNO_x-unit at Abu Qir II 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 EnviNO_x[®]-System is at least as good as the existing DeNO_x-System (additional environmental benefit in expected). NO_x emissions will also be reduced. 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.

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

A mentioned above and 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 project was approved by the Egyptian Environmental Affair 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 G. Stakeholders' comments****G.1. Brief description how comments by local stakeholders have been invited and compiled:**

CARBON has carried out 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 & CARBON's Methodology AM0028 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.

**G.2. Summary of the comments received:**

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.

G.3. Report on how due account was taken of any comments received:

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 NO_x 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 will be created in the region especially during the construction work of the EnviNOx®-Systems.

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.

Annex 1**CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY**

Organization:	CARBON EGYPT Ltd.
Street/P.O.Box:	2 Simon Bolivar Square
Building:	Garden City
City:	Cairo
State/Region:	
Postfix/ZIP:	
Country:	Egypt
Telephone:	+20 (02) 79 20 100
FAX:	+20 (02) 79 20 200
E-Mail:	
URL:	
Represented by:	Mr. Hani Riskalla
Title:	
Salutation:	Executive Director
Last Name:	Riskalla
Middle Name:	
First Name:	Hani
Department:	
Mobile:	+20 (010) 599 99 21
Direct FAX:	+20 (02) 79 20 200
Direct Tel:	
Personal E-Mail:	

Organization:	KOMMUNALKREDIT PUBLIC CONSULTING GmbH
Street/P.O.Box:	Türkenstrasse 9
Building:	
City:	Vienna
State/Region:	
Postfix/ZIP:	A-1092
Country:	Austria
Telephone:	+43 1 31631-0,
FAX:	+43 1 31631-104
E-Mail:	kyoto@kommunalkredit.at
URL:	www.klimaschutzprojekte.at
Represented by:	Mrs. Alexandra AMERSTORFER
Title:	Dipl.-Ing.
Salutation:	
Last Name:	AMERSTORFER
Middle Name:	
First Name:	Alexandra
Department:	J1/CDM Program Manager



Mobile:	
Direct FAX:	+43 1 31 631 104
Direct Tel:	+43 1 31 631 240
Personal E-Mail:	a.amerstorfer@kommunalkredit.at



Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funds are available for the financing of the project activity. Therefore CARBON will finance the project investment and running out of its own private corporate funds and will bear all financial risks of the CDM Project activity.

Annex 3**BASELINE INFORMATION****Tables:** Baseline data

Data	Unit	Value	Data Source
Tail gas flow rate	Nm ³ /h	233,200	Uhde: EnviNOx® design parameter
Production days	d	350	AFC: average production days 1995-2005
Additional Ammonia demand by EnviNOx® System	kgNH ₃ /tHNO ₃	0	AM0028 Version 1; 03/03/2006
Efficiency DF	%	94%	Uhde: min. efficiency EnviNOx®
N ₂ O GWP	-	310	Kyoto Protocol rules
Hydrocarbon: Methane			
Methane Input	kg/h	52	Uhde: EnviNOx® design parameter
Carbon emission factor of hydrocarbon	tCO ₂ /tHC	2.75	AM0028: default factor
Oxidation factor of hydrocarbon	%	0	AM0028: Conservative assumption
Methane GWP	-	21	Kyoto Protocol rules
Historical data Abu Qir II:			
Historical supplier of ammonia oxidation catalyst (G _{sup} ,hist)	-	Umicore	AFC: plant operating record
Historical composition of the catalyst (G _{com} ,hist)	%	90% Pt; 10% Rh	Umicore: Catalyst supplier
Maximum historical ammonia input to AOR (A _{OR} ,hist)	tNH ₃ /day	545	AFC: plant operating record 2000-2005
Designed capacity per 31.12.2005 (P _{HNO3} , hist)	tHNO ₃ /a	700,800	Uhde
Historical operating temperature range of AOR I + II (T _g ,hist)	°C	850 - 910	Uhde: Manufacturer's Operating Manual
Historical operating pressure range of the AOR (P _g ,hist)	barg	2.0 - 4.5	Uhde: Manufacturer's Operating Manual
Standard Conditions:			
Temperature	K	273.15	ISO 10780
Pressure	hPa	1,013.25	ISO 10780



Annex 4

MONITORING PLAN

The “Catalytic N₂O destruction project in the tail gas of the Nitric Acid Plant of Abu Qir Fertilizer Co.” employs 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 Monitoring Plan describes the procedures for data collection and auditing required for the project in order to determine and verify the emission reductions achieved by the project activity. Historical data required for the project monitoring are already being collected and documented in this Project Design Document. All remaining required data are automatically transferred to the digital process control system where they are displayed, evaluated, and stored. Evaluation includes calculation of flow rate at standard conditions and mass flow rates of N₂O. The system also performs calculation of daily mean values and generates automated reports.

The monitoring methodology for the project is fully activity in compliance with the applied approved monitoring methodology AM0028. The monitoring procedures will be fully integrated in AFC’s quality and environmental management system. Please note, AFC is already ISO 9001/2000 and ISO 14001 certificated. All monitoring equipment will be serviced, calibrated and maintained according to the manufacturers’ instructions and international standards.

Parameters to be monitored are described in section D of the Project Design Document.

It is the responsibility of the Project Developer and Project Operator to ensure that required and experienced capacity is available and that their operational staffs participate in training to be enable to operate the monitoring system properly. Initial training will be provided to the staff before the project activity starts operation. It is also the responsibility of the Project Developer and Project Operator to organize and implement a quality management system that ensures the integrity of the data.

Monitoring equipment:

To permit the greenhouse gas emission reduction to be calculated accurately, a direct measurement of the quantity of tail gas flowing through the EnviNOx® reactor is necessary. A venturi tube located downstream of the reactor and designed and installed according to the international standard ISO 5167:2003 Part 4 provides the required flow rate. The measurement is temperature and pressure compensated.

As the tail gas flow rate is an important parameter for the greenhouse gas emission reduction calculation several special measures have been taken to ensure that the indicated flow rate is accurate.

These are:

- Before the venturi tube is installed the dimensions of the venturi tube will be checked and verified at the manufacturer’s factory.
- The differential pressure, temperature and pressure transmitters that provide the signals from which the tail gas flow rate is calculated are installed in duplicate. This enables problems with faulty transmitters to be identified at an early stage and rectifying action taken.
- Connections for independent measurement of the primary process parameters during normal operation are provided. Thus a thermowell and a connection for a manometer are installed



upstream of the venturi tube. The venturi tube is fitted with additional fittings for connecting a differential pressure gauge.

Tail gas is drawn off continuously from upstream of the tail gas / ammonia / natural gas mixer and downstream of the EnviNOx® reactor. The two analyser chains are independent of one another but located in a common instrument container. The concentrations of the components N₂O, NO_x (inlet and outlet) as well as CH₄ (outlet) are measured.

Measured data are stored and evaluated in a digital process control system, which also provides control functions for the EnviNOx®- system. Data storage is multiple redundant and manipulation-proof.

Measurement of tail gas flow:

The tail gas flow is measured by using a venturi tube, which is designed and manufactured in accordance with ISO 5167-4:2003. The venturi tube is of rough welded sheet iron type with annular pressure tapping chambers. Differential pressure is measured with two (redundant) differential pressure transmitters. For calculation of the volume flow rate at standard conditions or (with known molecular weight) the mass flow, the system is equipped with two (redundant) pressure transmitters and two (redundant) temperature measurements.

On-line analysis of tail gas feed (AT218001):

In the feed of the EnviNOx®- system, the concentrations of nitrous oxide (N₂O), nitric oxide (NO) and nitrogen dioxide (NO₂) are analysed continuously in the range of 0-2000 vpm, 0-200 vpm, and 0-200 vpm, respectively. Analysis is done by using non-dispersive infrared photometry in a combined analyser device. The analyzer will take readings of N₂O and NO_x concentration, temperature and pressure in the tail gas at least at 1 minute intervals. Readings of these raw data will be stored. Based on the raw data average daily figures will be calculated, reported and stored at the data storage system. Sample handling includes provisions for pressure reduction, separation of residual solids, sample flow adjustment, and supply with test gases. The analyser is, as far as technically possible, corrected for any applicable cross sensitivity.

On-line analysis of tail gas effluent (AT218002):

In the effluent of the EnviNOx®- system, the concentrations of nitrous oxide (N₂O), nitric oxide (NO) plus nitrogen dioxide (NO₂), oxygen (O₂) and methane (CH₄) are analysed continuously in the range of 0-50 vpm, 0-20 vpm, 0-5 % b.v., and 0-100 vpm, respectively. Analysis is done by using non-dispersive infrared photometry for NO₂ and CH₄, paramagnetic measurement for O₂, and chemoluminescence for NO and NO₂. The analyzer will take readings at least at 1 minute intervals. Readings of these raw data will be stored. Based on the raw data average daily figures will be calculated, reported and stored at the data storage system. Sample handling includes provisions for pressure reduction, separation of residual solids, sample flow adjustment, and supply with test gases. The analysers are, as far as technically possible, corrected for any applicable cross sensitivity.

Actual production of Nitric Acid:

The actual nitric acid production is measured according to the already installed instruments. The instrument signals will be recorded in the instrument container of the EnviNOx®-System and used to determine whether the nitric acid production is within the historical designed capacity. Recorded nitric acid production data considers concentration and density.

Actual temperature and pressure of the ammonia oxidation reactor:

The actual temperature and pressure of the ammonia oxidation reactor is monitored using the existing (or exchanged) instruments in the nitric acid plant Abu Qir II. The instrument signals will be recorded in the instrument container of the EnviNOx[®]-System and used to determine whether the nitric acid plant is being operated within the normal range of operation (daily basis).

Actual ammonia input to the ammonia oxidation reactor:

The actual ammonia flow to the ammonia oxidation reactor is monitored using the existing instruments in the nitric acid plant Abu Qir II. The instrument signals will be recorded in the instrument container of the EnviNOx[®]-System and used to determine whether the nitric acid plant is being operated within the normal range of operation (daily basis). Ammonia flow is converted to standard conditions based on temperature and pressure measurement.

Composition of the ammonia oxidation catalyst:

The composition of the ammonia oxidation catalyst will be monitored according to catalyst supplier information.

Natural Gas:

The natural gas used as reducing agent will be measured by flow meters manufactured by Krohne. Flow is converted to standard conditions based on temperature and pressure measurement by Rosemount.

Data acquisition and storage:

The measured values are transferred to a digital process control system (Delta V, M/s. process management), where they are displayed, evaluated, and stored. Evaluation includes calculation of flow rate at standard conditions and mass flow rates of N₂O. The system also performs calculation of daily mean values and generates reports. Data storage for raw data as well as for evaluated data is done automatically on a computer network which is directly connected to the process control system. Data storage is designed redundantly on two separate computers, located at different locations, each equipped with a redundant array of hard disks. Network connections are redundant fibre optic links. The software for data storage is designed in a way that manipulation of data is excluded, and that any change of configuration is recorded. Time stamps are generated by a GPS clock.

Instrument Container, DCS and data logging:

The instrument container houses the analysers and the sample gas handling equipment.

The DCS / data logging system is also located in the instrument container. Data logging is carried out with redundant storage on two computers. It controls the EnviNOx[®] system, generates alarm and trip signals as necessary and logs all process data in the EnviNOx[®] system area and, in addition, selected operating data from the rest of the nitric acid plant, as required by the relevant CDM methodology AM0028. These are mainly the operating parameters of the ammonia oxidation burners.

Operation of the Monitoring system:



The system is designed for automatic operation, so that activities by operation personnel are not required during normal operation. However, it is required to observe the system for possible failures, and to perform required maintenance activities on a regular basis.

Training:

As mentioned above the proposed project activity also includes training course for operation of the EnviNOx® system and also for accurate monitoring. It is AFC's responsibility to ensure that the required capacity and internal training is made available to assigned staff, to enable them to undertake the tasks required by the project operation and monitoring. All staff involved in any procedures will be trained before the start of the crediting period.

The supplier of the measurement equipment will carry out an on-site training course for operation and maintenance of the measurement equipment prior to the start of the crediting period. Contents and procedures of the training are detailed in the operating manual of the monitoring system.

Uhde will also carry out an on-site training for operation and maintenance of the EnviNOx® system. For these purposes a training protocol will be prepared.

Troubleshooting procedures:

Malfunction of system components is indicated on the operator console in the control room as an alarm. The occurrence of such an alarm requires the operator to immediately take measures to remedy the problem. This is normally done by informing the instrument department, which then decides whether the problem can be fixed immediately by themselves, or whether external support from manufacturer is required. In such a case it is important to act immediately in order to avoid loss of valuable data. Detailed instructions on how to proceed in such cases are given in the manufacturer's documentation.

The probability of downtime or malfunctions of the measuring instruments and/or data storage is very low. In those cases (data availability of raw data for certain day is less than 90%) the following procedures should be applied:

- Concentration measurements: If the plant operator can provide suitable operating parameters (e.g. nitric acid production, ammonia flow to ammonia oxidation gauzes) to demonstrate that the plant is operating under normal conditions, then the estimation of emission reduction will be based on correlation methods, applying the parameter with the highest historical correlation to the missing parameter (e.g. efficiency of the EnviNOx® system; the reactor inlet or outlet temperature; the flow of N₂O reducing agent to the reactor). Historical data on the last campaign shall provide evidence on correlation.
- Flow measurements: If the plant operator can provide suitable operating parameters (e.g. nitric acid production, ammonia flow to ammonia oxidation gauzes) to demonstrate that the plant is operating under normal conditions and the plant operator can demonstrate that the EnviNOx® reactor bypass was closed, then the estimation of emission reduction will be based on correlation methods, applying the parameter with the highest historical correlation to the missing parameter (e.g. specific tail gas flow per nitric acid output). Historical data on the last campaign shall provide evidence on correlation.

In such cases it is indispensable to act immediately in order to avoid further loss of valuable data.

Adjustment, calibration and maintenance:

The analysers need an adjustment ('calibration') on a regular basis (e.g. zero point: every 2 days). This adjustment procedure is done automatically, and can be triggered manually from the operating console or automatically on a time basis.



Since adjustment is done with test gases, it is essential that availability of test gases is ensured. AFC instrument technician are responsible for the availability of test gas. Stock of test gases will be controlled regularly, and spare supply is made available in proper time. Test gas consumption is approximately one cylinder per year of each type of span gas, and two cylinders per year of zero gas (nitrogen 99.999 %). A detail specification for the various test gases to be used will be available from analyser manufacturer.

A general revision of the system is advised to be performed once a year. Such a revision shall include (but not be limited to) following activities:

- Check of calibration and zero adjustment of all pressure transmitters, readjustment where required (as long as not required otherwise by manufacturer).
- Check of contamination of sample lines and impulse lines, cleaning if required.
- Check of correct function of analyser sampling system by applying test gas at the begin of the sample lines.

Further activities may be requested by manufacturer or other parties, also depending on results from test run.

Internal control process:

AFC will perform a visual inspection of system on a regular basis by the operating staff (e.g. once every week). Such an inspection can give indications on oncoming problems and allow to be prepared for them. Data export from the data storage is to be done manually upon operational requests, but at least once a month. Detailed instructions are given by the manufacturer.

AFC already conduct periodic plausibility checks based on the ammonia nitrogen balance of the plant. Such plausibility checks will be conducted and documented for nitric acid production during the crediting period.

Internal review of project performance and calculation of emission reductions will be executed by CARBON EGYPT with the support of AFC on a regular basis (e.g. daily). Weekly reports will be reviewed by CARBON Projektentwicklung GmbH. Note, compliance with operational requirements (e.g. temperature and pressure of ammonia oxidation reactor) is fully integrated in the digital process control system.

Verification:

Quarterly verification will be executed for this CDM project.

Uncertainties of measurement:

Analysers: The manufacturer specifies a relative accuracy of 1 % of the measuring range, assuming that zero and span adjustment is performed regularly as requested in instrument documentation. The analysis of N₂O downstream of the EnviNOx®- reactor, in particular, requires a regular (e.g. every second day) zero adjustment to achieve this accuracy.

This accuracy refers to the applied calibration standard, which again has an uncertainty. Best commercially available test gases for calibration have an uncertainty of 1 %. So, using the gaussian law of error propagation, the accuracy of the analysers is

$$\frac{\delta c}{c} = \sqrt{\left(\frac{\delta a}{a}\right)^2 + \left(\frac{\delta g}{g}\right)^2} = 1,41 \%$$



where $\delta a/a$ = uncertainty of analyser and $\delta g/g$ = uncertainty of test gas.

Flow: The uncertainty of the mass flow measurement with the venturi tube is to be calculated with the formula given in ISO 5167-1:2003, chapter 8.2.2:

$$\frac{\delta q_m}{q_m} = \sqrt{\left(\frac{\delta C}{C}\right)^2 + \left(\frac{\delta \varepsilon}{\varepsilon}\right)^2 + \left(\frac{2\beta^4}{1-\beta^4}\right)^2 \left(\frac{\delta D}{D}\right)^2 + \left(\frac{2}{1-\beta^4}\right)^2 \left(\frac{\delta d}{d}\right)^2 + \frac{1}{4} \left(\frac{\delta \Delta p}{\Delta p}\right)^2 + \frac{1}{4} \left(\frac{\delta \rho_1}{\rho_1}\right)^2}$$

where

$\delta C/C$ = uncertainty of discharge coefficient,

$\delta \varepsilon/\varepsilon$ = uncertainty of expansion factor,

$\delta D/D$ = uncertainty of tube entrance diameter,

$\delta d/d$ = uncertainty of throat diameter,

$\delta \Delta p/\Delta p$ = uncertainty of differential pressure,

$\delta \rho_1/\rho_1$ = uncertainty density.

β = ratio of diameters

The uncertainty of the mass flow $\delta q_m/q_m$ is mainly governed by the term $\delta C/C$, which is to be assumed to be 2 % according to ISO 5167-4:2003, chapter B.3.4, since the Reynolds number, at which the venturi tube is operated, is above 2×10^6 .

The other factors contribute only little: $\delta \varepsilon/\varepsilon = 0,046$ % acc. to ISO 5167-4:2003, chapter 5.8, $\delta D/D = 0,4$ % acc. to ISO 5167-4:2003, chapter 5.2.2., $\delta d/d = 0,1$ % acc. to ISO 5167-4:2003, chapter 5.2.4, $\delta \Delta p/\Delta p = 0,075$ % acc. to manufacturer's specification, $\delta \rho_1/\rho_1 = 0,14$ % acc. to manufacturer's specification. Numerical evaluation of the formula above results in a total uncertainty of the flow measurement of 2,049 % of the actual value.

The amount of N_2O and NO_x which is destructed by the EnviNOx® - system is calculated by subtracting the mass flows of the respective components downstream of the reactor from those upstream. The mass flows themselves are obtained by multiplying the measured concentration with the tail gas flow rate (described in more detail in the operating manual).

Since concentration and flow rate are independent variables, the total uncertainty of these destruction rates is to be calculated by using the gaussian law of error propagation, as described above.

**Annex 5****Approval of EIA by Egyptian Environmental Affairs Agency**

جمهورية مصر العربية
رئاسة مجلس الوزراء
وزارة الدولة لشؤون البيئة
جهاز شؤون البيئة
الإدارة المركزية لتقييم الآثار البيئية

رقم القيد: ٥٢٦٤١٦
التاريخ: ٢٠٠٦/١١/١٥
ترجمة تليم محتدا

السيد الأستاذ/ محمد أحمد بسيوني
سكرتير عام محافظة الإسكندرية
تحية طيبة وبعد

بالإشارة إلى كفيرو سيادتك الوارد لنا بتاريخ ٢٠٠٦/٩/١١ والمرفق به الدراسة المحددة بشأن مشروع إقامة
تأسيس التبريز من الفركام العائمة والمنبعة من حامض الفلوريك والخاص بشركة أبو قير للأسمدة والصناعات
الكيميائية.

يرجى التكرم بالإحاطة بأنه بعد مراجعة الدراسة المقدمة فإن جهاز شؤون البيئة يوافق من الناحية البيئية على
المشروع المقترح شريطة الالتزام بجميع القواعد والاشتراطات التي وردت بالترخيص المقدمة مع الالتزام بجميع
الاشتراطات التي نص عليها القانون رقم (٤) لسنة ١٩٩٤ بشأن حماية البيئة والالتحاشي للتنفيذ مع الالتزام
بالاشتراطات الآتية:

- اتخاذ الاحتياطات اللازمة للحد من أي آثار سلبية على البيئة المحيطة ناتجة عن عمليات الإنشاء
والتشغيل.
- الالتزام بجدولة الإدارة البيئية المذكورة كالتزام مع اتخاذ الاحتياطات اللازمة للحد من الإصابات الغازية
الناتجة عن المشروع.
- الالتزام بخطة المراقبة والرصد الدوري مع ضرورة تدوين القياسات في السجل البيئي وجعله متاحاً عند
التفتيش البيئي.
- الالتزام بإعادة تسليم العوامل الحفازة المستنفذة إلى المورد كما ورد بالترخيص.
- مراعاة صحة بيئة العمل وأمان العاملين وضروور توافيقها مع الشئق (٩) من اللائحة التنفيذية للقانون
رقم ٤ لسنة ١٩٩٤.
- هذه الموافقة من الناحية البيئية فقط دون الإخلال بأية قوانين أو قرارات أو قواعد أخرى منطبقه لهذا
النشاط.

وتفضلوا بقبول والاحترام
رئيس الإدارة المركزية لتقييم الآثار البيئية
(د. ك. غاطمة أبو شوك)

رئاسة مجلس الوزراء
جهاز شؤون البيئة
١٥ يونيو ٢٠٠٦
الإدارة المركزية لتقييم الآثار البيئية
صادر: ٥٢٦٤١٦

٣- طريق مصر حلوان الزراعي - خلف فندق سوفيتل المعادي - القاهرة - الرقم البريدي ١١٧٢٨ : ٥٢٦٤٥٢ : فاكس : ٥٢٦٤١٩
30 Mistr Heban El-Zyran Rd., Maadi - Cairo Egypt. P. O. 11728. Tel : 5256452 - Fax : 5256490