



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

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

Catalytic N<sub>2</sub>O destruction project in the tail gas of the Nitric Acid Plant of Abu Qir Fertilizer Co.

Version: 1

Date of Completion: 18/04/2006

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

Nitrous oxide (N<sub>2</sub>O) 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 (NH<sub>3</sub>) combustion to form nitric oxide (NO)<sup>1</sup>:

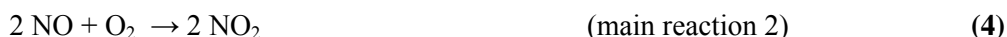


Simultaneously nitrous oxide (N<sub>2</sub>O), nitrogen (N) and water (H<sub>2</sub>O) are formed as well, in accordance with the following equations:



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 (NO<sub>2</sub>):



3. (According to the technical process) Absorption of NO<sub>2</sub> in water to form nitric acid (HNO<sub>3</sub>):



(NO is oxidised to NO<sub>2</sub> according to main reaction 2)

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<sup>1</sup> 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.

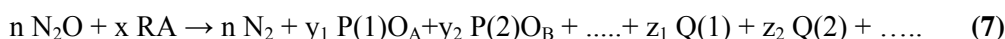
Overall reaction:



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:

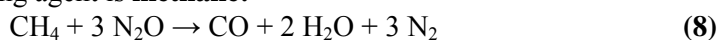


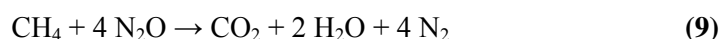
where RA is a molecule of the reducing agent,  $P(1)O_A$ ,  $P(2)O_B$  are the compound formed by reaction with the oxygen of the  $N_2O$  and Q(1), Q(2) represents further products of the oxidation reaction, n, x,  $y_1$ ,  $y_2$ ,  $z_1$ ,  $z_2$  are the appropriate stoichiometric coefficients.

#### Equations reduction $N_2O$ with hydrocarbons:

e.g.

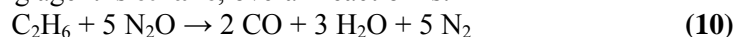
Reducing agent is **methane**:



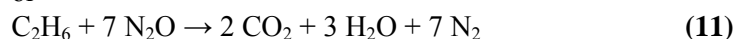


e.g.

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



or



e.g.:

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

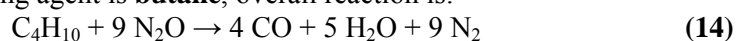


or



e.g.

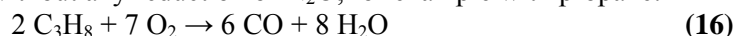
Reducing agent is **butane**, overall reaction is:



or



The definition does not exclude the possibility of side reactions resulting in consumption of reducing agent without any reduction of  $\text{N}_2\text{O}$ , for example with propane:



or



The world's nitric acid plants represent the single greatest industrial process source of  $\text{N}_2\text{O}$  emissions. Currently, approx. 700 nitric acid plants are operated globally with an estimated amount of  $\text{N}_2\text{O}$  emissions of 400,000 t  $\text{N}_2\text{O}$  p.a. (corresponding to 125 Mio t  $\text{CO}_2\text{e}$  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  $\text{N}_2\text{O}$  from nitric acid plant tail gas streams based on the catalytic decomposition or catalytic reduction of  $\text{N}_2\text{O}$ . 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.

CARBON Egypt Ltd. (see section A.3.) will invest in the most efficient catalytic destruction technology for  $\text{N}_2\text{O}$  emissions reduction in the tail gas of nitric acid plants (furthermore called "EnviNOx<sup>®</sup>-System") provided by the technology provider UHDE GmbH (see section A.3.). CARBON will have one EnviNOx<sup>®</sup>-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<sup>®</sup>-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)  $\text{N}_2\text{O}$  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  $\text{N}_2\text{O}$  destruction project activity is expected to reduce 98% of the  $\text{N}_2\text{O}$  emissions that would be emitted without the project activity. Under related project circumstances at the nitric acid of AMI in Austria, UHDE's EnviNOx<sup>®</sup>-System reduces more than 98% of all  $\text{N}_2\text{O}$  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:

| <b>Name of Party involved<br/>(*)<br/>(host) indicates a host<br/>Party)</b>  | <b>Private and/or public entity(ies)<br/>project participants (*)<br/>(as applicable)</b> | <b>Kindly indicate if<br/>the Party involved<br/>wishes to be<br/>considered as<br/>project participant<br/>(Yes/No)</b> |
|---|---|--|
| Arab Republic of Egypt<br>(Host)  | CARBON Egypt Ltd.   | No   |
| Republic of Austria   | KOMMUNALKREDIT PUBLIC<br>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 N<sub>2</sub>O 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 N<sub>2</sub>O from nitric acid tail gas streams.

|   |
|---|
| <b>A.4. Technical description of the <u>project activity</u>:</b> |
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|--|
| <b>A.4.1. Location of the <u>project activity</u>:</b> |
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|   |
|---|
| <b>A.4.1.1. <u>Host Party(ies)</u>:</b> |
|---|

Arab Republic of Egypt

|  |
|--|
| <b>A.4.1.2. <u>Region/State/Province etc.:</u></b> |
|--|

AI-Iskandariyah Provice (Alexandria Province)

|   |
|---|
| <b>A.4.1.3. <u>City/Town/Community etc:</u></b> |
|---|

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 km<sup>3</sup> out of 1,002,000 km<sup>3</sup>), 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  $N_2O$  emissions at nitric acid plants can be categorized into three groups:

- **Primary:**  $N_2O$  is prevented from forming. This requires modifications to the precious metal ammonia oxidation gauzes to reduce  $N_2O$  formation. Alternative materials can also be employed as the ammonia oxidation catalyst. Cobalt oxide, for example, does not generate any  $N_2O$  by-product, but suffers from being less selective for the production of  $N_2O$ .
- **Secondary:**  $N_2O$ , 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: N<sub>2</sub>O 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 N<sub>2</sub>O destruction facility is at the hottest position in the tail gas stream. In tertiary catalytic N<sub>2</sub>O destruction processes a hydrocarbon input may be necessary to achieve the highest available N<sub>2</sub>O 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 N<sub>2</sub>O (considered as project emissions).

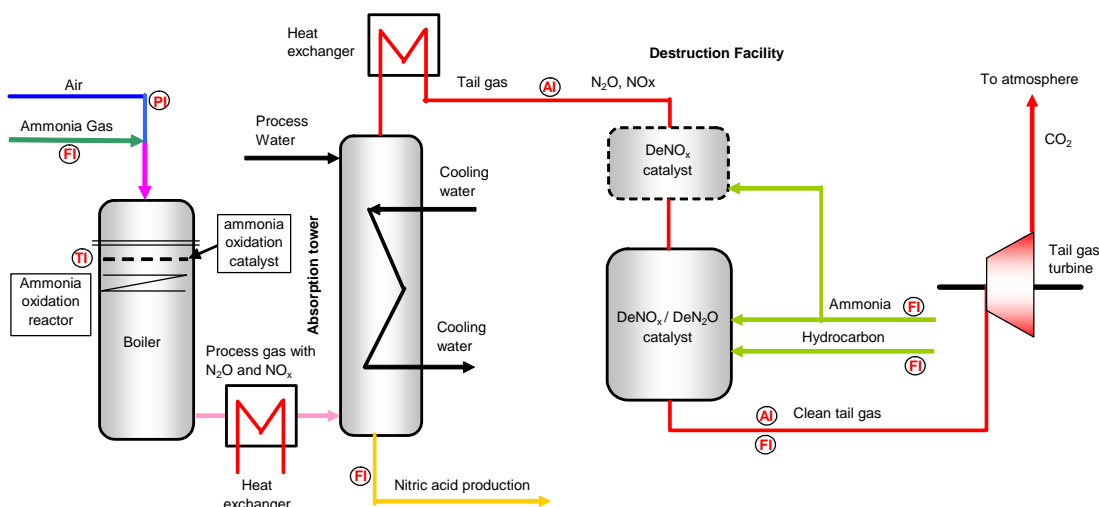
A tertiary approach offers a number of advantages:

- The tertiary approach, as an end-of-pipe technology, is analogous to the various well-established catalytic NO<sub>x</sub> 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 N<sub>2</sub>O 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 N<sub>2</sub>O and possibly also NO<sub>x</sub>, which can lead to additional environmental benefit.
- No technical possibility that relevant N<sub>2</sub>O will be destroyed downstream the tertiary N<sub>2</sub>O destruction facility. Consequently, an overestimation of N<sub>2</sub>O baseline emissions is not possible whenever tertiary N<sub>2</sub>O destruction facility will be installed.

The project technology provider has developed a most efficient and low risk catalytic N<sub>2</sub>O destruction process for nitric acid plants called the EnviNOx<sup>®</sup>-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<sup>®</sup>-System is an example of a tertiary measure for the destruction of N<sub>2</sub>O from nitric acid plant tail gas streams based on the catalytic decomposition or catalytic reduction of N<sub>2</sub>O. Therefore the EnviNOx<sup>®</sup>-System is located between the tail gas heaters and the tail gas turbine of the nitric acid plant. The reactor in an EnviNOx<sup>®</sup>-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  $\text{N}_2\text{O}$  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<sup>®</sup>-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 N<sub>2</sub>O 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 N<sub>2</sub>O destruction project at AFC involves that natural gas, a mixture of hydrocarbons of which the main constituent is methane (CH<sub>4</sub>), is employed as a reducing agent for N<sub>2</sub>O removal. The EnviNOx<sup>®</sup>-System reactor also incorporates NO<sub>x</sub> reduction using ammonia in order to lower the NO<sub>x</sub> concentration to a very low level. The tail gas temperature in the ABU QIR II nitric acid plant is around 420°C. A catalytic reduction process will be installed at AFC.

The existing SCR-DeNO<sub>x</sub>-unit reduces NO<sub>x</sub> (a mixture of nitric oxide (NO) and nitrogen dioxide (NO<sub>2</sub>)) to nitrogen and water vapour with ammonia over a vanadium pentoxide V<sub>2</sub>O<sub>5</sub>-based catalyst. The implementation of the proposed project activity involves the removal of the existing SCR DeNO<sub>x</sub>-unit (SCR = Selective Catalytic Reduction), whereas new EnviNO<sub>x</sub><sup>®</sup>-System takes over the function of the existing SCR DeNO<sub>x</sub>-unit as it too accomplishes the reduction of NO<sub>x</sub> with ammonia. As far as the amount of NO<sub>x</sub>-removal is concerned the performance of the EnviNO<sub>x</sub><sup>®</sup>-System is at least as good as the existing SCR DeNO<sub>x</sub>-unit.



**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<sup>®</sup>-System to catalytically reduce N<sub>2</sub>O emissions in the tail gas stream of the nitric acid plant Abu Qir II. The EnviNOx<sup>®</sup>-System itself includes a steel reactor containing two catalyst beds. The catalytic N<sub>2</sub>O destruction project activity is expected to reduce more than 94% of the N<sub>2</sub>O 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<sup>®</sup>-System reduced more than 98% of all N<sub>2</sub>O emissions of the nitric acid plant. As far as the amount of NO<sub>x</sub> removal is concerned the performance of the EnviNOx<sup>®</sup>-System is at least as good as the SCR DeNO<sub>x</sub>-unit.

The implementation of the project activity will result in an ex-ante estimation of GHG emission reductions of conservatively calculated 1.18 million t CO<sub>2</sub>e 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 N<sub>2</sub>O is set at 310 according to the Kyoto Protocol rules.

Due to the already installed SCR DeNO<sub>x</sub>-unit, no significant change in the ammonia input is expected. To achieve the best available N<sub>2</sub>O destruction rate, hydrocarbon as a reducing agent will be injected to the EnviNOx<sup>®</sup>-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 N<sub>2</sub>O emissions. It is unlikely that any such limits on N<sub>2</sub>O emissions will be imposed in the near future. In fact, given the cost and complexity of suitable N<sub>2</sub>O 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 N<sub>2</sub>O emissions will be monitored. If legal regulations on N<sub>2</sub>O 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 N<sub>2</sub>O 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 N<sub>2</sub>O destruction technology without the revenues from the sales of the CERs. Although the production of nitric acid generates N<sub>2</sub>O as a by-product, N<sub>2</sub>O is typically released into the atmosphere as it does not have any economic value.
- National regulations on NO<sub>x</sub> emissions are more than fulfilled at AFCs 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 8.27 million t CO<sub>2</sub>e 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 N<sub>2</sub>O is set at 310 according to the Kyoto Protocol rules.

**Table:** Summary Emission Reduction 2007-2013

| <b>Years<br/>(First Crediting Period)</b>  | <b>Annual estimation of emission<br/>reductions in<br/>tonnes of CO<sub>2</sub> e</b> |
|--|---|
| <b>09/ 2006</b>  | 344.612   |
| <b>2007</b>  | 1.181.525   |
| <b>2008</b>  | 1.181.525   |
| <b>2009</b>  | 1.181.525   |
| <b>2010</b>  | 1.181.525   |
| <b>2011</b>  | 1.181.525   |
| <b>2012</b>  | 1.181.525   |
| <b>01-08/ 2013</b>   | 836.914   |
| <b>Total estimated reductions<br/>(tonnes of CO<sub>2</sub> e)</b>   | <b>8.270.677</b>  |
| <b>Total number of crediting years</b>   | <b>7 years<sup>2</sup></b>  |
| <b>Annual average over the crediting<br/>period of estimated reductions<br/>(tonnes of CO<sub>2</sub> e)</b> | <b>1.181.525</b>  |

**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.

<sup>2</sup> 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 N<sub>2</sub>O 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 N<sub>2</sub>O at AFCs 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 N<sub>2</sub>O destruction or abatement technology. The project activity will not result in any shut down of an existing N<sub>2</sub>O destruction or abatement facility at Abu Qir II.
- The project activity will not cause a nitric acid production increase.
- DeNO<sub>x</sub>-unit is already installed at Abu Qir II. The project activity will result in NO<sub>x</sub> emission reductions that are at least as effective as the existing DeNO<sub>x</sub>-unit.
- The DeNO<sub>x</sub>-unit installed at Abu Qir II is a SCR DeNO<sub>x</sub>-unit.
- The N<sub>2</sub>O concentrations will be measured in real time at the inlet and the outlet of the N<sub>2</sub>O destruction facility.

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

The approved baseline methodology “Catalytic N<sub>2</sub>O destruction in the tail gas of Nitric Acid Plants “ is applied to the “Catalytic N<sub>2</sub>O 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 N<sub>2</sub>O 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 N<sub>2</sub>O
- ☐ Alternative use of N<sub>2</sub>O:
  - o Recycling of N<sub>2</sub>O as a feedstock for the plant;
  - o The use of N<sub>2</sub>O for external purposes.
- ☐ Installation of a Non-Selective Catalytic Reduction (NSCR) DeNO<sub>x</sub> unit<sup>3</sup>

<sup>3</sup> NSCR: As NSCR DeNO<sub>x</sub> unit will reduce N<sub>2</sub>O emissions as a side reaction to the NO<sub>x</sub>-reduction. Consequently, new NSCR installation can be seen as alternative N<sub>2</sub>O reduction technology.



- ☐ The installation of a N<sub>2</sub>O destruction or abatement technology
  - o Tertiary measure for N<sub>2</sub>O destruction (proposed project activity)
  - o Primary or secondary measures for N<sub>2</sub>O destruction or abatement.

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

Technologically not feasible options:

The use of N<sub>2</sub>O 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 N<sub>2</sub>O 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 N<sub>2</sub>O for external purposes is neither in the region/country nor in any other nitric acid plant applied.

The recycling of N<sub>2</sub>O as a feedstock for the plant is technically not practicable, as N<sub>2</sub>O is not a feedstock for nitric acid production. The recycling of N<sub>2</sub>O 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 N<sub>2</sub>O as a feedstock for the plant;
- The use of N<sub>2</sub>O 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<sub>x</sub> emissions should be considered. The installation of a NSCR DeNO<sub>x</sub> unit could also cause N<sub>2</sub>O emission reduction. Therefore NO<sub>x</sub> 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<sub>x</sub> unit is installed;
- ☐ Installation of new Selective Catalytic Reduction (SCR) DeNO<sub>x</sub> unit;
- ☐ Installation of new Non-Selective Catalytic Reduction (NSCR) DeNO<sub>x</sub> unit;
- ☐ Installation of new tertiary measures combining NO<sub>x</sub> and N<sub>2</sub>O emission reductions. (project scenario).

The national Environment Law number 4 of Egypt (year 1994) limits NO<sub>x</sub> emissions at nitric acid plants only:

| Type of Nitric Acid Plant | Limit of NO <sub>x</sub> -emissions from exhaust |
|---------------------------|--|
| Existing plant (old)      | 3000 mg/m <sup>3</sup>                           |
| New plant                 | 400 mg/m <sup>3</sup>                            |

At AFC's nitric acid plant national legal regulations on NO<sub>x</sub> emissions are more than fulfilled. AFC already operates a SCR DeNO<sub>x</sub>-unit with an average 40 ppmv, which is far below the legal limit of 3000 mg/m<sup>3</sup> NO<sub>x</sub> from exhaust for existing nitric acid plants. As there is already a SCR DeNO<sub>x</sub> unit installed at Abu Qir II nitric acid plant, the installation of an NSCR DeNO<sub>x</sub> unit, which is not state of the art<sup>4</sup>, is not conceivable as baseline alternative. Therefore it is obvious that AFC will not install another DeNO<sub>x</sub> unit.

Therefore the following alternatives are technically not feasible:

<sup>4</sup> 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.



- Installation of a new Selective Catalytic Reduction (SCR) DeNO<sub>x</sub> unit;
- Installation of a new Non-Selective Catalytic Reduction (NSCR) DeNO<sub>x</sub> unit;

**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 N<sub>2</sub>O emissions. All named baseline alternatives are in compliance with all relevant legal and regulatory requirements on N<sub>2</sub>O and NO<sub>x</sub> 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 N<sub>2</sub>O 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 N<sub>2</sub>O 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 N<sub>2</sub>O destruction or abatement technology as no marketable product or by-product exists. As national regulations on NO<sub>x</sub> 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 N<sub>2</sub>O emissions exists, investment barriers are clearly identified for all baseline options which require significant investments (primary, secondary and tertiary N<sub>2</sub>O destruction or abatement).
- **Technological barriers:**  
In addition to investment barriers identified above, technological barriers are identified as primary and secondary N<sub>2</sub>O 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, N<sub>2</sub>O 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 N<sub>2</sub>O 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 N<sub>2</sub>O destruction or abatement
- Tertiary measure for N<sub>2</sub>O 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<sub>x</sub> unit is installed at AFC's nitric acid plant and national legal regulations on NO<sub>x</sub> emissions are more than fulfilled. No N<sub>2</sub>O destruction or abatement technology will be installed. As national regulations on NO<sub>x</sub> 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 N<sub>2</sub>O emissions exist, 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 N<sub>2</sub>O to the atmosphere, without the installation of N<sub>2</sub>O 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<sub>x</sub> or N<sub>2</sub>O emission regulations should be executed as follows:

**Sub Step 5a:** New or modified NO<sub>x</sub> emission regulations:

If new or modified NO<sub>x</sub> 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 N<sub>2</sub>O and NO<sub>x</sub> 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 <sub>x</sub> regulation) | Consequence (adjusted baseline scenario)  |
|---|---|
| SCR DeNO <sub>x</sub> installation  | Continuation of original (N <sub>2</sub> O) baseline scenario   |
| NSCR DeNO <sub>x</sub> installation   | The N <sub>2</sub> O emissions outlet of NSCR become adjusted baseline N <sub>2</sub> O emissions, as NSCR may reduce N <sub>2</sub> O emissions as well as NO <sub>x</sub> . |
| Tertiary measure that combines NO <sub>x</sub> and N <sub>2</sub> O emission reduction                            | Adjusted baseline scenario results in zero N <sub>2</sub> O emissions reduction   |
| Continuation of original baseline scenario  | Continuation of original baseline scenario  |

Note, Abu Qir II has already installed a SCR DeNO<sub>x</sub> unit. New or modified NO<sub>x</sub> emission regulations introduced after the project start will be taken into account for the next crediting period.

**Sub Step 5b:** New or modified N<sub>2</sub>O-regulation:

If legal regulations on N<sub>2</sub>O 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 <sub>2</sub> O emissions                     | No regulation   | Egyptian Environment Law No. 4  |
| Current legal regulation on NO <sub>x</sub> 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 <sub>2</sub> O destruction efficiency is considered significantly lower at primary or secondary measures. |
| Investment and running costs for the N <sub>2</sub> 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 N<sub>2</sub>O emissions are not reduced by any N<sub>2</sub>O destruction or abatement technology at AFC. Therefore the baseline emissions are measured at the inlet of the EnviNOx<sup>®</sup>-System.

The baseline scenario consists of the continuation of the currently installed SCR DeNO<sub>x</sub>-unit in which only NO<sub>x</sub> (nitric oxide NO, and nitrogen dioxide NO<sub>2</sub>) 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<sup>®</sup>-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<sub>x</sub> reduction processes.
- There is no interference with the nitric acid production process itself. The tertiary N<sub>2</sub>O destruction technology will neither cause a nitric acid production increase nor decrease.
- A tertiary process incorporates a selective catalyst suitable for destroying N<sub>2</sub>O and NO<sub>x</sub>, 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<sub>x</sub> unit,
- the expected N<sub>2</sub>O 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<sup>®</sup>-System is a tertiary technology for destruction of N<sub>2</sub>O 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 N<sub>2</sub>O emissions that would be emitted without the project activity (under related project circumstances at the nitric acid plant of AMI in Austria, the EnviNOx<sup>®</sup>-System reduces more than 98% of N<sub>2</sub>O emissions).

Abu Qir II:

A catalytic N<sub>2</sub>O 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<sub>x</sub> unit, with the new EnviNO<sub>x</sub><sup>®</sup> reactor taking on the function of the existing SCR DeNO<sub>x</sub> unit as it too accomplishes the reduction of NO<sub>x</sub> with ammonia. As far as the degree of NO<sub>x</sub> removal is concerned the performance of the EnviNO<sub>x</sub><sup>®</sup> reactor is superior to the existing SCR DeNO<sub>x</sub> unit.

GHG emission reductions achieved by the project activity will only be claimed for the destruction of N<sub>2</sub>O emissions, taking national regulations on N<sub>2</sub>O emissions into account. If legal regulations on N<sub>2</sub>O 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.

The project activity’s planned starting date is after 31 December 2005 and so no early credits are claimed, instead the start of the crediting period for the project activity is therefore at the date of registration and Step 0 is omitted.

Because of the similarity of both approaches used to determine the baseline scenario and the additionality tool, step 1 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 N<sub>2</sub>O 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 EnviNO<sub>x</sub><sup>®</sup>-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 EnviNO<sub>x</sub><sup>®</sup>-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 EnviNO<sub>x</sub><sup>®</sup>-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<sub>x</sub>-unit installed. The other two companies in Egypt neither have a DeNO<sub>x</sub>-unit nor a N<sub>2</sub>O 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 N<sub>2</sub>O 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:**

N<sub>2</sub>O 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 N<sub>2</sub>O 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 N<sub>2</sub>O decomposition there is no loss of N<sub>2</sub>O 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.

For the purpose of determining project activity emissions, project participants shall include:

- N<sub>2</sub>O concentration in the flow stream of the tail gas;
- In case no SCR DeNO<sub>x</sub> unit has been installed prior to the start of the project activity, GHG emissions related to the production of ammonia used for the NO<sub>x</sub> reduction will be considered as project emissions. In case a SCR DeNO<sub>x</sub> unit has been installed prior to the start of the project activity, GHG



emissions related to the production of ammonia used for NO<sub>x</sub> reduction will not be considered as project emissions.

- Hydrocarbons as a reducing agent to enhance the efficiency of a N<sub>2</sub>O catalytic reduction facility.

For the purpose of determining *baseline emissions*, project participants shall include the following emission sources:

- N<sub>2</sub>O concentration in the flow stream of the tail gas;
- In case no SCR DeNO<sub>x</sub> unit has been installed prior to the start of the project activity, GHG emissions related to the production of ammonia used for NO<sub>x</sub> reduction will be considered zero in the baseline. In case SCR DeNO<sub>x</sub> unit has been installed prior to the start of the project activity, GHG emissions related to the production of ammonia used for NO<sub>x</sub> reduction will not be considered.

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 <sub>2</sub> O as a result of side reaction to the nitric acid production process  | N <sub>2</sub> O                                       | Included | Main emission source, taking national N <sub>2</sub> O emission regulations into account.  |
| Emissions related to the production of ammonia used for NO <sub>x</sub> reduction<br><br>(Attention: Ammonia used for NO <sub>x</sub> -reduction does not cause GHG emissions, only the production of ammonia causes GHG emissions) | CO <sub>2</sub><br>CH <sub>4</sub><br>N <sub>2</sub> O | Included | In case SCR DeNO <sub>x</sub> 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 <sub>x</sub> reduction. Baseline emissions and project emissions are similar and therefore not considered for calculation.<br><br>In case no SCR DeNO <sub>x</sub> unit is already installed prior to the project start: ammonia input for NO <sub>x</sub> reduction is considered 0 for baseline emissions. |
| N <sub>2</sub> O emissions from SCR DeNO <sub>x</sub> unit  | N <sub>2</sub> O                                       | Excluded | The presence of a SCR DeNO <sub>x</sub> unit tends to increase the N <sub>2</sub> O emissions. Therefore the ex-post measurement of the baseline emissions at the inlet of the N <sub>2</sub> O destruction facility represents a conservative determination of the baseline N <sub>2</sub> O emissions.   |

#### Project Emissions

| <i>Source</i>  | <i>Gas</i>       |          | <i>Justification/Explanation</i>  |
|--|------------------|----------|---|
| Emissions of N <sub>2</sub> O as a result of side reaction to the nitric acid production process | N <sub>2</sub> O | Included | Main emission source that remains in the tail gas after the N <sub>2</sub> O destruction facility |

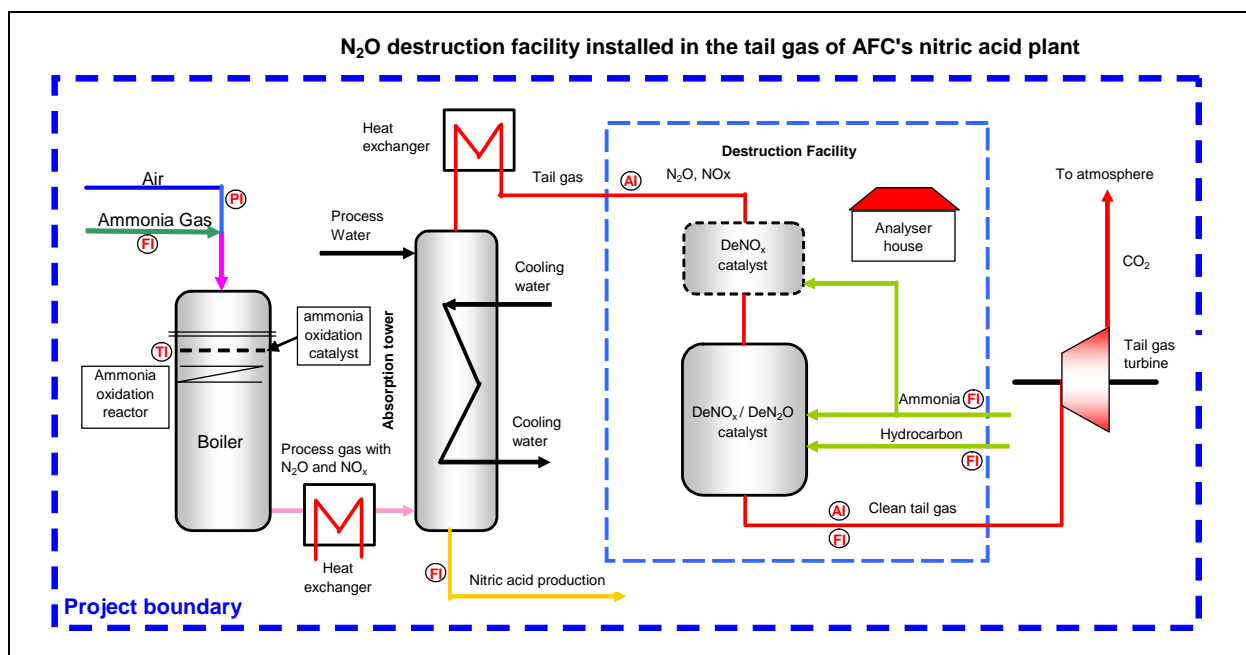


|   |  |          |  |
|---|--|----------|--|
| Emissions related to the production of ammonia input used for NO <sub>x</sub> reduction<br><br>(Attention: Ammonia used for NO <sub>x</sub> -reduction doesn't cause GHG emissions, only production causes GHG emissions) | CO <sub>2</sub><br>CH <sub>4</sub><br>N <sub>2</sub> O | Included | In case SCR DeNO <sub>x</sub> 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 <sub>x</sub> -reduction. Baseline emissions and project emissions are similar and therefore not considered for calculation.<br><br>In case no SCR DeNO <sub>x</sub> unit is already installed prior to the project start: ammonia input for NO <sub>x</sub> reduction is monitored and considered for project emissions. |
| In case of N <sub>2</sub> O reduction process installed: Emissions at the project site resulting from hydrocarbons used as reducing agent   | CH <sub>4</sub><br>and/or<br>CO <sub>2</sub>           | Included | Hydrocarbons are used as reducing agent to enhance the efficiency of a N <sub>2</sub> O catalytic reduction facility.<br><br>In this case hydrocarbons are mainly converted to CO <sub>2</sub> , while some hydrocarbons may remain intact.<br><br>Fractions of unconverted methane are either measured (monitored online) or all methane used as reducing agent is assumed as completely intact. All other hydrocarbons are assumed to be completely converted to CO <sub>2</sub> .                       |
| Emissions from electricity demand   | CO <sub>2</sub><br>CH <sub>4</sub><br>N <sub>2</sub> 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 <sub>2</sub><br>CH <sub>4</sub><br>N <sub>2</sub> 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 Figure 1, the *spatial extent* of the project boundary comprises:

- The catalytic N<sub>2</sub>O destruction facility including auxiliary ammonia and/or 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<sup>®</sup>-Systems will be installed between the tail gas heaters and the tail gas turbine. The existing DeNO<sub>x</sub>-unit will be removed.

The regular measurement equipment consists of the following components:

- Flow volume measurement equipment for tail gas flow rate;
- Analyser for N<sub>2</sub>O and NO<sub>x</sub> concentration monitoring upstream and downstream of the N<sub>2</sub>O destruction facility;
- Flow measurement equipment for auxiliary ammonia and hydrocarbon input to the N<sub>2</sub>O destruction facility;

To avoid gambling (deliberate attempt to increase baseline N<sub>2</sub>O emissions) the following measuring devices will be or 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 18/04/2006.

The baseline study was prepared by:



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



**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:  
03/03/2006

**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 N<sub>2</sub>O destruction in the tail gas of Nitric Acid Plants”

This monitoring methodology shall be used in conjunction with the approved baseline methodology AM0028 “Catalytic N<sub>2</sub>O 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 N<sub>2</sub>O destruction facility in the tail gas of Abu Qir II nitric acid plant. There is no indication that legal regulations and obligations regarding N<sub>2</sub>O emissions will be implemented in the Arab Republic of Egypt. Nevertheless observation of national regulations on N<sub>2</sub>O 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 N<sub>2</sub>O destruction or abatement technology. The project activity will not result in any shut down of an existing N<sub>2</sub>O destruction or abatement facility at Abu Qir II nitric acid plant.
- The project activity will not cause a nitric acid production increase.
- DeNO<sub>x</sub>-unit is already installed at Abu Qir II nitric acid plant. The project activity will result in NO<sub>x</sub> emission reductions that are at least as effective as the existing DeNO<sub>x</sub>-unit.
- The DeNO<sub>x</sub>-unit installed at Abu Qir II nitric acid plant is a SCR DeNO<sub>x</sub>-unit.
- The N<sub>2</sub>O concentrations will be measured in real time at the inlet and the outlet of the N<sub>2</sub>O destruction facility.

The accuracy of the N<sub>2</sub>O 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 applicant/operator will provide data on:

- Legal regulations on N<sub>2</sub>O and NO<sub>x</sub>;
- The production capacities of the respective nitric acid plant measured in tonnes of nitric acid;
- Composition of the ammonia oxidation catalyst of the respective nitric acid plant;
- The ammonia flow rate to the ammonia oxidation reactor of the respective nitric acid plant;
- The operating temperature and pressure range of the ammonia oxidation reactor of the respective nitric acid plant;
- Concentration of N<sub>2</sub>O and NO<sub>x</sub> at EnviNOx®-Systems inlet and outlet of the respective nitric acid plant;
- Tail gas Flow rates of the respective nitric acid plant;

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<br>Project emissions  | Monitoring system | tCO <sub>2</sub> e | Calculated                                    | Annual              | 100%                               | Electronic   | Crediting period +2yrs                   |         |
| P2        | PE_ND,y<br>Project emissions from N <sub>2</sub> O not destroyed | Monitoring system | tCO <sub>2</sub> e | Calculated                                    | Annual              | 100%                               | Electronic   | Crediting period +2yrs                   |         |
| P3        | PE_DF,y<br>Project emissions from destruction facility           | Monitoring system | tCO <sub>2</sub> e | Calculated                                    | Annual              | 100%                               | Electronic   | Crediting period +2yrs                   |         |
| P4        | PE_N2O,y<br>N <sub>2</sub> O not destroyed by facility           | Monitoring system | tN <sub>2</sub> O  | Calculated                                    | Daily               | 100%                               | Electronic   | Crediting period +2yrs                   |         |



|     |   |  |                                   |                       |        |      |            |                        |   |
|-----|---|--|-----------------------------------|-----------------------|--------|------|------------|------------------------|---|
| P5  | F_TG,I<br>Volume flow tail gas at N <sub>2</sub> O destruction facility   | Flow meter                               | m <sup>3</sup> /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<br>N <sub>2</sub> O concentration at destruction facility outlet | Monitoring system, measuring device      | tN <sub>2</sub> O/ m <sup>3</sup> | Measured continuously | Daily  | 100% | Electronic | Crediting period +2yrs |   |
| P7  | M_i<br>Measuring Interval   | Measuring device, data management system | h                                 | Measured continuously | Daily  | 100% | Electronic | Crediting period +2yrs |   |
| P8  | PE_HC,y<br>Emissions from hydrocarbon use in destruction facility         | Monitoring system                        | tCO <sub>2</sub> e                | Calculated            | Annual | 100% | Electronic | Crediting period +2yrs |   |
| P9  | HCE_C,y<br>Converted hydrocarbon emissions                                | Monitoring system                        | tCO <sub>2</sub> e                | Calculated            | Annual | 100% | Electronic | Crediting period +2yrs |   |
| P10 | HCE_NC,y<br>Non-converted hydrocarbon emissions                           | Monitoring system                        | tCO <sub>2</sub> e                | Calculated            | Annual | 100% | Electronic | Crediting period +2yrs |   |



|     |   |  |                     |                              |        |      |            |                              |   |
|-----|---|--|---------------------|------------------------------|--------|------|------------|------------------------------|---|
| P11 | Q_HC,y<br>Hydrocarbon input<br>(reducing agent)         | Measuring<br>device  | m <sup>3</sup>      | Measured                     | Daily  | 100% | Electronic | Crediting<br>period<br>+2yrs |   |
| P12 | ρ_HC<br>Hydrocarbon density                             | Certificate<br>hydrocarbon<br>supplier or<br>default value | t/m <sup>3</sup>    | Measured                     | Yearly | 100% | Electronic | Crediting<br>period<br>+2yrs |   |
| P13 | EF_HC<br>Hydrocarbon CO <sub>2</sub><br>emission factor | IPCC   | tCO <sub>2</sub> /t | Calculated                   | Once   | 100% | Electronic | Crediting<br>period<br>+2yrs | Methane:<br>2.75 tCO <sub>2</sub> /tCH <sub>4</sub> |
| P14 | OXID_HC<br>Hydrocarbon<br>oxidation factor              | Measuring<br>device  | %                   | Measured<br>continuousl<br>y | Daily  | 100% | Electronic | Crediting<br>period<br>+2yrs |   |
| P15 | Type_HC<br>Type of<br>hydrocarbon                       | Hydrocarbon<br>supplier                                    | -                   |                              | Once   | 100% | Electronic | Crediting<br>period<br>+2yrs |   |

Note, in case of the catalytic N<sub>2</sub>O destruction project at the nitric acid plant Abu Qir II a SCR DeNO<sub>x</sub>-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 CO<sub>2</sub> equ.)**

The direct emissions from the project activity are equivalent to the N<sub>2</sub>O emissions not destroyed plus emissions related to the operation of the N<sub>2</sub>O 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 N<sub>2</sub>O and (b) emissions from auxiliary ammonia and hydrocarbons input resulting from the operation of the N<sub>2</sub>O destruction facility. The procedure of determining the project N<sub>2</sub>O emissions is similar to that used for determining baseline emissions. Project emissions are defined by the following equation:

$$PE_y = PE_{ND,y} + PE_{DF,y} \quad (18)$$

where:

|                    |   |
|--------------------|---|
| PE <sub>y</sub>    | Project emissions in year y (tCO <sub>2</sub> e)  |
| PE <sub>ND,y</sub> | Project emissions from N <sub>2</sub> O not destroyed in year y (tCO <sub>2</sub> e)                  |
| PE <sub>DF,y</sub> | Project emissions related to the operation of the destruction facility in year y (tCO <sub>2</sub> e) |

### N<sub>2</sub>O emissions not destroyed by the project activity:

N<sub>2</sub>O emissions not destroyed by the project activity are calculated based on the continuous measurement of the N<sub>2</sub>O concentration in the tail gas of the N<sub>2</sub>O destruction facility and the volume flow rate of the tail gas stream.

The emissions of non destroyed N<sub>2</sub>O are given by:

$$PE_{ND,y} = PE_{N2O,y} \times GWP_{N2O} \quad (19)$$

where:

|                     |  |
|---------------------|--|
| PE <sub>ND,y</sub>  | Project emissions from N <sub>2</sub> O not destroyed in year y (tCO <sub>2</sub> e) |
| PE <sub>N2O,y</sub> | Project emissions of N <sub>2</sub> O in year y (tN <sub>2</sub> O)                  |
| GWP <sub>N2O</sub>  | Global warming potential of N <sub>2</sub> O = 310                                   |

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$$PE_{N_2O,y} = \sum_{i=1}^n F_{TG,i} \times CO_{N_2O,i} \times M_i \quad (20)$$

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 <sup>3</sup> /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 <sup>3</sup> ) |
| $M_i$         | 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:

$$PE_{DF,y} = PE_{NH_3,y} + PE_{HC,y} \quad (21)$$

where:

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

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Hydrocarbons are used as reducing agent at Abu Qir II to enhance the catalytic N<sub>2</sub>O 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.

$$PE_{HC,y} = HCE_{C,y} + HCE_{NC,y} \quad (22)$$

where:

PE<sub>HC,y</sub> Project emissions related to hydrocarbon input to destruction facility in year y (tCO<sub>2</sub>e)  
HCE<sub>C,y</sub> Converted hydrocarbon emissions in year y (tCO<sub>2</sub>)  
HCE<sub>NC,y</sub> Methane emissions in year y (tCO<sub>2</sub>e)

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

$$HCE_{C,y} = \rho_{HC} \times Q_{HC,y} \times EF_{HC} \times OXID_{HC}/100 \quad (23)$$

where:

HCE<sub>C,y</sub> Converted hydrocarbon emissions in year y (tCO<sub>2</sub>e)  
ρ<sub>HC</sub> Hydrocarbon density (t/m<sup>3</sup>)  
Q<sub>HC,y</sub> Hydrocarbon input in year y (m<sup>3</sup>)  
OXID<sub>HC</sub> Oxidation factor of hydrocarbon (%)  
EF<sub>HC</sub> Carbon emission factor of hydrocarbon (tCO<sub>2</sub>/t HC)

$$HCE_{NC,y} = \rho_{HNC} \times Q_{HNC,y} \times GWP_{CH4} \times (1-OXID_{CH4}/100) \quad (24)$$

where:

HCE<sub>NC,y</sub> Methane emissions in year y (tCO<sub>2</sub>e)  
ρ<sub>HNC</sub> Methane density (t/m<sup>3</sup>)  
Q<sub>HNC,y</sub> Methane used in year y (m<sup>3</sup>)  
GWP<sub>CH4</sub> Global warming potential of methane  
OXID<sub>CH4</sub> Oxidation factor of methane (%)

The hydrocarbon CO<sub>2</sub> emission factor is given by the molecular weights and the chemical reaction when hydrocarbons are converted (carbon emission factor of methane is 2.75 tCO<sub>2</sub>/tCH<sub>4</sub>)

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<sub>HNO<sub>3</sub>,y</sub>) exceeds the design capacity (P<sub>HNO<sub>3</sub>,max</sub>) then emissions related to the production above P<sub>HNO<sub>3</sub>,max</sub> will neither be claimed for the baseline nor for the project scenario.

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**D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project 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<br>Plant output of HNO <sub>3</sub>  | Production reports                  | tHNO <sub>3</sub>                | Measured                                      | Daily               | 100 %                              | Electronic   | Crediting period + 2 yrs                 |         |
| B2        | QI_N2O,y<br>Quantity of N <sub>2</sub> O at inlet of destruction facility                 | Monitoring system                   | tN <sub>2</sub> O                | Calculated                                    | Daily               | 100 %                              | Electronic   | Crediting period + 2 yrs                 |         |
| B3        | CI_N2O,I<br>N <sub>2</sub> O concentration at N <sub>2</sub> O destruction facility inlet | Monitoring system, measuring device | tN <sub>2</sub> O/m <sup>3</sup> | Measured continuous                           | Daily               | 100 %                              | Electronic   | Crediting period + 2 yrs                 |         |
| B4        | QR_N2O,y<br>Regulation I: annual quantity N <sub>2</sub> O limited                        | National legislation                | tN <sub>2</sub> O                | Calculated                                    | Date of regulation  | 100 %                              | Electronic   | Crediting period + 2 yrs                 |         |



|     |   |   |   |                          |                       |       |            |                                |  |
|-----|---|---|---|--------------------------|-----------------------|-------|------------|--------------------------------|--|
| B5  | RSE_N2O,y<br><br>Regulation II:<br>N <sub>2</sub> O emissions per<br>unit of nitric acid          | National<br>legislation                                     | tN <sub>2</sub> O/t<br>HNO <sub>3</sub> | Calculated               | Date of<br>regulation | 100 % | Electronic | Crediting<br>period + 2<br>yrs |  |
| B6  | CR_N2O<br><br>Regulation III:<br>N <sub>2</sub> O concentration in<br>tail gas limited            | National<br>legislation                                     | tN <sub>2</sub> O/m <sup>3</sup>        | Calculated               | Date of<br>regulation | 100 % | Electronic | Crediting<br>period + 2<br>yrs |  |
| B7  | P_HNO3,hist<br><br>Design capacity  | Manufacturer's<br>specifications /<br>production<br>reports | t                                       | Measured /<br>calculated | Once                  | 100 % | Electronic | Crediting<br>period + 2<br>yrs |  |
| B8  | T_g,hist<br><br>Historical opera-ting<br>temperature range of<br>the ammonia<br>oxidation reactor | Production<br>reports /<br>manufacturer's<br>specification  | °C                                      | Measured /<br>calculated | Once                  | 100 % | Electronic | Crediting<br>period + 2<br>yrs |  |
| B9  | P_g,hist<br><br>Historical operating<br>pressure range of the<br>ammonia oxidation<br>reactor     | Production<br>reports /<br>manufacturer's<br>specifications | Pa                                      | Measured /<br>calculated | Once                  | 100 % | Electronic | Crediting<br>period + 2<br>yrs |  |
| B10 | T_g<br><br>Actual operating<br>temperature ammonia<br>oxidation reactor                           | Measuring<br>device   | °C                                      | Measured                 | Continuous            | 100 % | Electronic | Crediting<br>period + 2<br>yrs |  |
| B11 | P_g<br><br>Actual operating<br>pressure ammonia<br>oxidation reactor                              | Measuring<br>device   | Pa                                      | Measured                 | Continuous            | 100 % | Electronic | Crediting<br>period + 2<br>yrs |  |

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|     |   |   |                                      |                       |                                    |       |            |                          |  |
|-----|---|---|--------------------------------------|-----------------------|------------------------------------|-------|------------|--------------------------|--|
| B12 | Reg_NOx<br><br>National regulation on NO <sub>x</sub> emissions                     | National regulations, Ministry of Environment                   | tNO <sub>x</sub> /m <sup>3</sup>     | Calculated            | Date of regulation                 | 100 % | Electronic | Crediting period + 2 yrs |  |
| B13 | G_sup<br><br>Supplier of the ammonia oxidation catalyst                             | Supplier's information  | -                                    |                       |                                    |       |            | Crediting period + 2 yrs |  |
| B14 | G_com<br><br>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<br><br>Historical supplier of ammonia oxidation catalyst                 | Annual reports, supplier's information                          | -                                    |                       | Once                               | 100 % | Electronic | Crediting period + 2 yrs |  |
| B16 | G_com,hist<br><br>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<br><br>N <sub>2</sub> O emission rate per ton of nitric acid                 | Monitoring reports  | tN <sub>2</sub> O/t HNO <sub>3</sub> | Calculated            | Yearly                             | 100 % | Electronic | Crediting period + 2 yrs |  |
| B18 | A_OR,hist<br><br>Max. historical ammonia flow rate to the ammonia oxidation reactor | Production reports / manufacturer's specifications / literature | tNH <sub>3</sub> /day                | Measured / calculated | Once                               | 100 % | Electronic | Crediting period + 2 yrs |  |

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|     |   |                  |                       |          |            |       |            |                          |  |
|-----|---|------------------|-----------------------|----------|------------|-------|------------|--------------------------|--|
| B19 | A_OR,d<br><br>Actual ammonia flow rate to the ammonia oxidation reactor | Measuring device | tNH <sub>3</sub> /day | Measured | Continuous | 100 % | Electronic | Crediting period + 2 yrs |  |
|-----|---|------------------|-----------------------|----------|------------|-------|------------|--------------------------|--|

#### D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO<sub>2</sub> equ.)

Baseline emissions of the project activity are determined based on the quantity of N<sub>2</sub>O emitted in the baseline scenario, taking national regulations, production levels and operating conditions into consideration. The quantity of N<sub>2</sub>O is determined based on the measurement of the N<sub>2</sub>O at the inlet of the N<sub>2</sub>O destruction facility (EnviNOx<sup>®</sup>-System), which results in a conservative estimation of baseline emissions.

The N<sub>2</sub>O 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 N<sub>2</sub>O concentration at the inlet of the EnviNOx<sup>®</sup>-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 N<sub>2</sub>O baseline emissions can then directly be calculated by multiplying the tail gas volume flow rate and the N<sub>2</sub>O 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:

$$BE_y = BE_{N_2O} \times GWP_{N_2O} \quad (25)$$

where:

|                                |  |
|--------------------------------|--|
| BE <sub>y</sub>                | Baseline emissions in year y (tCO <sub>2</sub> e)                    |
| BE <sub>N<sub>2</sub>O,y</sub> | Baseline emissions of N <sub>2</sub> O in year y (tN <sub>2</sub> O) |
| GWP <sub>N<sub>2</sub>O</sub>  | Global warming potential of N <sub>2</sub> O = 310                   |



Depending on the implementation of regulations on N<sub>2</sub>O emissions and the character of the regulation, baseline N<sub>2</sub>O emissions (BE<sub>N2O,y</sub>) are calculated as shown below:

**Case 1:** The most plausible baseline scenario is that no N<sub>2</sub>O would be abated in the absence of the project activity (i.e. no secondary or tertiary reductions measures and no NSCR DeNO<sub>x</sub> unit would be installed).

$$BE_{N2O,y} = QI_{N2O,y} \quad (26)$$

where:

BE<sub>N2O,y</sub> Baseline emissions of N<sub>2</sub>O in year y (tN<sub>2</sub>O)

QI<sub>N2O,y</sub> Quantity of N<sub>2</sub>O supplied to the destruction facility in year y (tN<sub>2</sub>O)

The quantity of N<sub>2</sub>O supplied to the N<sub>2</sub>O destruction facility (DF) is calculated based on continuous measurement of the tail gas volume flow rate and the N<sub>2</sub>O concentration at the inlet of the N<sub>2</sub>O destruction facility. Therefore the quantity of the N<sub>2</sub>O at the inlet is given by:

$$QI_{N2O,y} = \sum_{i=1}^n F_{TG,i} \times CI_{N2O,i} \times M_i \quad (27)$$

where:

QI<sub>N2O,y</sub> Quantity of N<sub>2</sub>O emissions at the inlet of the destruction facility in year y (tN<sub>2</sub>O)

F<sub>TG,i</sub> Volume flow rate at the inlet of the destruction facility during interval i (m<sup>3</sup>/h)

CI<sub>N2O,i</sub> N<sub>2</sub>O concentration at destruction facility inlet during interval i (tN<sub>2</sub>O/m<sup>3</sup>)

M<sub>i</sub> 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<sub>HNO3,y</sub>) exceeds the design capacity (P<sub>HNO3,max</sub>) then emissions related to the production above P<sub>HNO3,max</sub> will neither be claimed for the baseline nor for the project scenario.

$$\text{If, } P_{HNO3,y} > P_{HNO3,max} \quad (28)$$

then

$$BE_{N2O,y} = SE_{N2O,y} \times P_{HNO3,max} \quad (29)$$

where:

BE<sub>N2O,y</sub> Baseline emissions of N<sub>2</sub>O in year y (tN<sub>2</sub>O)

SE<sub>N2O,y</sub> Specific N<sub>2</sub>O emissions per output nitric acid in year y (tN<sub>2</sub>O/tHNO<sub>3</sub>)

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P\_HNO3,max      Design capacity (tHNO<sub>3</sub>)

The specific N<sub>2</sub>O emissions per unit of output nitric acid is defined as:

$$SE_{N_2O,y} = QI_{N_2O,y} / P_{HNO_3,y} \quad (30)$$

where:

SE<sub>N<sub>2</sub>O,y</sub>      Specific N<sub>2</sub>O emissions per output nitric acid in year y (tN<sub>2</sub>O/tHNO<sub>3</sub>)  
 QI<sub>N<sub>2</sub>O,y</sub>      Quantity of N<sub>2</sub>O emissions at the inlet of the destruction facility in year y (tN<sub>2</sub>O)  
 P<sub>HNO<sub>3</sub>,y</sub>      Production of nitric acid in year y (tHNO<sub>3</sub>)

**Case 2:** Legal regulations for N<sub>2</sub>O are implemented:

In case national regulations concerning N<sub>2</sub>O emissions are implemented during the crediting period, the impact on baseline N<sub>2</sub>O emissions is considered without any delay by adjusting the measured N<sub>2</sub>O 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 N<sub>2</sub>O emissions per nitric acid plant over a given time period:

Baseline N<sub>2</sub>O emissions are limited by the absolute quantity of N<sub>2</sub>O emissions given by the regulation. If the measured baseline N<sub>2</sub>O emissions are exceeding the regulatory limit, then measured baseline N<sub>2</sub>O emissions are substituted by the regulatory limit.

This leads to the following condition:

If,

$$QI_{N_2O,y} > QR_{N_2O,y} \quad (31)$$

then,

$$BE_{N_2O,y} = QR_{N_2O,y} \quad (32)$$

else,

$$BE_{N_2O,y} = \min \text{ of } [QI_{N_2O,y}, SE_{N_2O,y} \times P_{HNO_3,max}] \quad (33)$$

where:

QI<sub>N<sub>2</sub>O,y</sub>      Quantity of N<sub>2</sub>O emissions at the inlet of the destruction facility in year y (tN<sub>2</sub>O)  
 QR<sub>N<sub>2</sub>O,y</sub>      Regulatory limit of N<sub>2</sub>O emissions in year y (tN<sub>2</sub>O)  
 BE<sub>N<sub>2</sub>O,y</sub>      Baseline emissions of N<sub>2</sub>O in year y (tN<sub>2</sub>O)  
 SE<sub>N<sub>2</sub>O,y</sub>      Specific N<sub>2</sub>O emissions per output nitric acid in year y (tN<sub>2</sub>O/tHNO<sub>3</sub>)  
 P<sub>HNO<sub>3</sub>,y</sub>      Production of nitric acid in year y (tHNO<sub>3</sub>)





The quantity of N<sub>2</sub>O emissions at the inlet of the N<sub>2</sub>O destruction facility (DF) is calculated based on continuous measurement of the tail gas volume flow rate and the N<sub>2</sub>O concentration at the inlet of the N<sub>2</sub>O destruction facility (see equation 11).

**Case 2.2:** Regulation setting of a threshold for specific N<sub>2</sub>O emissions per unit of product:

This leads to the following condition:

If,

$$SE\_N2O,y > RSE\_N2O \quad (34)$$

then,

$$BE\_N2O,y = \min \text{ of } [RSE\_N2O \times P\_HNO3,y, SE\_N2O,y \times P\_HNO3,max] \quad (35)$$

else,

$$BE\_N2O,y = \min \text{ of } [QI\_N2O,y, SE\_N2O,y \times P\_HNO3,max] \quad (36)$$

where:

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

The specific N<sub>2</sub>O emissions per unit of output nitric acid are defined as:

$$SE\_N2O,y = QI\_N2O,y / P\_HNO3,y \quad (37)$$

where:

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

The quantity of N<sub>2</sub>O emissions at the inlet of the N<sub>2</sub>O destruction facility is calculated based on continuous measurement of the tail gas volume flow rate and the N<sub>2</sub>O concentration at the inlet of the N<sub>2</sub>O destruction facility (see equation 11).

**Case 2.3:** Regulation setting of a threshold for N<sub>2</sub>O concentration in the tail gas

This leads to the following condition:

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If,  
 $C_{N_2O,y} > CR_{N_2O}$  (38)  
 then

$$BE_{N_2O,y} = \sum_i^n C_{N_2O,i} \times [F_{TG,i} \times M_i] \quad (39)$$

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

else,  
 $BE_{N_2O,y} = QI_{N_2O,y}$  (40)

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 plant s:

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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 shall be 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)                |
| $T_{g,hist}$ | Historical operating temperature range AOR ( $^{\circ}C$ ) |
| $P_{g,hist}$ | Historical operating pressure range AOR (Pa)               |

In order to determine the “permitted range” of the operating temperature and pressure in the ammonia oxidation reactor, the project applicant has the obligation to determine the operating temperature and pressure range by:

- Firstly, data on historical temperature and pressure ranges; or, if no data on historical temperatures and pressures are available, then
- Secondly, by range of temperature and pressure stipulated in the operating manual for the existing equipment; or, if no operating manual is available or the operating manual gives insufficient information, then
- Thirdly, by literature reference (e.g. from Ullmann’s Encyclopedia of Industrial Chemistry, Fifth, completely revised edition, Volume A 17, VCH, 1991, P. 298, Table 3. or other standard reference work or literature source).

If historical data on daily operating temperatures and pressures are available (i.e. case a), statistical analysis shall be used for determining the permitted range of operating temperature and pressure. To exclude the possibility of manipulating the process, outliers of historical operating temperature and pressure shall be eliminated by statistical methods. Therefore, the time series data are interpreted as a sample from a stochastic variable. All data that are part of the 2.5% Quantile or that are part of the (100-2.5)% Quantile of the sample distribution are defined as outliers and shall be eliminated. The permitted range of operating temperature and pressure is then calculated based on the remaining historical minimum and maximum operating conditions.

If a permissible operating limit is exceeded, the baseline  $N_2O$  emissions for that period are capped at the conservative IPCC default value of 4.05 kg  $N_2O$ /tHNO<sub>3</sub>.

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  $N_2O$  baseline emissions.

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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 N<sub>2</sub>O 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 N<sub>2</sub>O 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 N<sub>2</sub>O 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 N<sub>2</sub>O emissions of previous periods (tN<sub>2</sub>O/tHNO<sub>3</sub>), documented in the verified monitoring reports.

Required monitoring parameters:

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

### 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 should be determined based on:

- historical operating data on maximum daily average ammonia flow; or, if not existing, on
- calculation of the maximum ammonia flow rate allowed as specified by ammonia oxidation catalyst manufacturer or on typical catalyst loadings; or, if not existing,
- based on the literature.

If the daily ammonia input to the oxidation reactor exceeds the limit on permissible ammonia input, baseline N<sub>2</sub>O emissions are capped at conservative IPCC default values.



Required monitoring parameters on daily basis:

A\_OR,d Actual ammonia input to oxidation reactor (tNH<sub>3</sub>/day)

A\_OR,hist Maximum historical ammonia input to oxidation reactor (tNH<sub>3</sub>/day)

**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<br>(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 CO<sub>2</sub> 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<br>(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 CO<sub>2</sub> equ.)**

At the nitric acid plant Abu Qir II a energy converter (tail gas turbine) is installed at the end of the pipe. The installation of the N<sub>2</sub>O 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 CO<sub>2</sub> equ.)**

The emission reduction (ER<sub>y</sub>) by the project activity during a given year y is the difference between the baseline emissions (BE<sub>y</sub>) and project emissions (PE<sub>y</sub>), as follows:

$$ER_y = BE_y - PE_y - LE_y \quad . \quad (41)$$

where:

ER<sub>y</sub> emissions reductions of the project activity during the year y (tCO<sub>2</sub>e)  
 BE<sub>y</sub> baseline emissions during the year y (tCO<sub>2</sub>e)  
 PE<sub>y</sub> project emissions during the year y (tCO<sub>2</sub>e)  
 LE<sub>y</sub> leakage emissions in year y (tCO<sub>2</sub>e)

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| <b>D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored</b> |  |  |
|--|--|--|
| Data<br>(Indicate table and ID number e.g. 3.-1.; 3.2.)  | Uncertainty level of data<br>(High/Medium/Low) | Explain QA/QC procedures planned for these data, or why such procedures are not necessary.   |
| B.1  | Low  | <p>Measurement devices will be subject to regular calibration, maintenance and testing regime to ensure accuracy (according to manufacturer instructions)</p> <p><b>Check at the beginning of the project, e.g.</b></p> <ul style="list-style-type: none"> <li>The product acid flow meter (and online density meter, if installed) has been calibrated at the manufacturer's works; the calibration certificate shall be documented.</li> <li>The product acid flow meter (and online density meter, if installed) has been installed and is being operated in accordance with the manufacturer's instruction.</li> </ul> <p><b>Regular check during the project lifetime, e.g.</b></p> <ul style="list-style-type: none"> <li>Maintenance and checking are carried out as specified by the flow meter (and online density meter, if applicable) manufacturer. All work carried out is to be documented.</li> <li>The acid density and concentration is measured regularly and 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.</li> <li>Plausibility checks may be made on a regular basis based on the ammonia nitrogen balance of the plant. (e.g. the input of ammonia nitrogen is the ammonia flow to the ammonia oxidation reactor. The outputs are N<sub>2</sub>O at the inlet of the N<sub>2</sub>O destruction facility and NO<sub>x</sub> at the inlet of the N<sub>2</sub>O destruction facility if no SCR is installed, otherwise an estimate can be made of the NO<sub>x</sub> at the inlet of the SCR. The major output is product acid. An assumption must be made about the amount of ammonia nitrogen converted to elemental nitrogen, N<sub>2</sub>. Before carrying out a plausibility check of this kind, the nitric acid plant should be operated at constant conditions for several hours or a day to minimise the effects of tower sump pumpout and time delays between the ammonia oxidation reactor and the product nitric acid.)</li> </ul> <p>QA/QC shall be integrated in companies' quality management systems (e.g. ISO, EMAS)</p> |
| B.10<br>B11  | Low  | Regular calibration, maintenance and testing regime according to manufacturer instruction  |



|            |     |   |
|------------|-----|---|
| P.5        | Low | Flow meter will be subject to regular calibration, maintenance and testing regime to ensure accuracy (according to manufacturer instructions) |
| P6<br>B3   | Low | N <sub>2</sub> O concentration measurement devices will be subject to regular calibration, maintenance and testing regime to ensure accuracy. |
| P7         | Low | Meters for measuring intervals will be subject to regular calibration, maintenance and testing regime to ensure accuracy.                     |
| P11<br>B17 | Low | Meters will be subject to regular calibration, maintenance and testing regime to ensure accuracy.   |

**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<sup>®</sup>-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<sub>x</sub>-unit). The company is ISO 9001/2000 and ISO 14001 certified.

The measurement equipment will be calibrated on regular intervals as recommended by the manufacturers. Additionally, selected staff of AFC will be trained to operate the EnviNOx<sup>®</sup>-System as well as the measurement equipment.

CARBON will conclude a contract with UHDE as well as the providers of the measurement equipment for a continuously supervision and maintenance of the EnviNOx<sup>®</sup>-System as well as the measurement equipment. In case of any error the technology providers have the contractual obligations to set activities on site.



**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<br>A-3485 Grunddorf 68<br>AUSTRIA<br>Tel. +43 2735 77 135<br>Fax. +43 2735 20 531<br><br>Gerald Dunkel, Ferdinand Heilig<br><br>Email: dunkel@carbon-austria.com<br>Email: heilig@carbon-austria.com | <b>NO</b>                           |

**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 N<sub>2</sub>O and emissions from hydrocarbon input related to the operation of the N<sub>2</sub>O destruction facility.

Ex-ante estimation of project emissions is made by projecting nitric acid output, N<sub>2</sub>O formation, efficiency of the catalytic N<sub>2</sub>O 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<sub>x</sub>-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 N<sub>2</sub>O destruction efficiency. Therefore additional hydrocarbon input will be taken into account and monitored.

Assuming a conservative 94% N<sub>2</sub>O destruction rate and a conservative specific N<sub>2</sub>O 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, N<sub>2</sub>O concentration in the tail gas at the outlet of the EnviNO<sub>x</sub><sup>®</sup>-system, the efficiency of the EnviNO<sub>x</sub><sup>®</sup>-System and the hydrocarbon input, total project emissions are estimated at about 85,000 tCO<sub>2</sub>e per year.

**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.

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

Baseline emissions are estimated based on the quantity of N<sub>2</sub>O 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 N<sub>2</sub>O 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 N<sub>2</sub>O emissions in the Arab Republic of Egypt. Furthermore it is unlikely that any limits on N<sub>2</sub>O 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 N<sub>2</sub>O concentration in the tail gas, the baseline emissions are estimated at about 1,267,000 tCO<sub>2</sub>e per year.

#### **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 1.18 million tCO<sub>2</sub>e per year. The global warming potential of N<sub>2</sub>O 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 N<sub>2</sub>O emission data and the most reliable monitoring system.

**Table 1: Emission Reduction Summary**

| Emissions Summary                                     |              | Unit                    | 2007             | % of BL GHG Emissions |
|---|--------------|-------------------------|------------------|-----------------------|
| <b>Baseline emissions</b>                             | <b>BE_y</b>  | <b>tCO<sub>2</sub>e</b> | <b>1.266.561</b> | <b>100,00%</b>        |
| Project emissions related to the operation of the     | PE_DF_y      | tCO <sub>2</sub> e      | 9.042            | 0,71%                 |
| Project emissions from N <sub>2</sub> O not destroyed | PE_ND_y      | tCO <sub>2</sub> e      | 75.994           | 6,00%                 |
| <b>Project emissions</b>                              | <b>PE_y</b>  | <b>tCO<sub>2</sub>e</b> | <b>85.035</b>    | <b>6,71%</b>          |
| <b>Total Leakage GHG Emissions</b>                    | <b>L_E_y</b> | <b>tCO<sub>2</sub>e</b> | <b>0</b>         | <b>0,00%</b>          |
| <b>Total GHG Emissions Reduction</b>                  | <b>ER_y</b>  | <b>tCO<sub>2</sub>e</b> | <b>1.181.525</b> | <b>93,29%</b>         |

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

| <b>Year</b>                              | <b>Estimation of Project Activity Emissions<br/>(tonnes of CO<sub>2</sub>e)</b> | <b>Estimation of Baseline Emissions<br/>(tonnes of CO<sub>2</sub>e)</b> | <b>Estimation of Leakage (tonnes of CO<sub>2</sub>e)</b> | <b>Estimation of Emission Reductions<br/>(tonnes of CO<sub>2</sub>e)</b> |
|--|---|---|--|--|
| 2006                                     | 24.802  | 369.414   | 0  | 344.612  |
| 2007                                     | 85.035  | 1.266.561   | 0  | 1.181.525  |
| 2008                                     | 85.035  | 1.266.561   | 0  | 1.181.525  |
| 2009                                     | 85.035  | 1.266.561   | 0  | 1.181.525  |
| 2010                                     | 85.035  | 1.266.561   | 0  | 1.181.525  |
| 2011                                     | 85.035  | 1.266.561   | 0  | 1.181.525  |
| 2012                                     | 85.035  | 1.266.561   | 0  | 1.181.525  |
| 2013                                     | 60.233  | 897.147   | 0  | 836.914  |
| <b>Total (tonnes of CO<sub>2</sub>e)</b> | <b>595.248</b>  | <b>8.865.925</b>  | <b>0</b>   | <b>8.270.677</b>   |

**SECTION F. Environmental impacts****F.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:**

The catalytic N<sub>2</sub>O destruction project in the tail gas of the Nitric Acid Plant Abu Qir II is a sustainable project that contributes to the environmental, economic and social benefits in the Arab Republic of Egypt.

*Environmental Impacts:*

The ex-ante GHG emission reduction is estimated to be about 8.27 million tons of CO<sub>2</sub>e. Additionally, the EnviNO<sub>x</sub><sup>®</sup>-System takes over the function of the DeNO<sub>x</sub>-unit at Abu Qir II as it too accomplishes the reduction of NO<sub>x</sub> with ammonia. As far as the amount of NO<sub>x</sub> removal is concerned the performance of the EnviNO<sub>x</sub><sup>®</sup>-System is at least as good as the existing DeNO<sub>x</sub>-System (additional environmental benefit in expected). NO<sub>x</sub> emissions will also be reduced. No further environmental impacts are expected.

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:**

Not applicable.

**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. 83 participants attended the stakeholder conference, questionnaires were distributed and 32 had been returned.

Local public stakeholders were invited to the stakeholder meeting via public announcement and personal invitation to the neighbours and companies around the area of Abu Qir. Furthermore local governmental and non-governmental organizations and the DNA were invited.

**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 Questionnaire**

| <i>Classification</i>                | <i>Number</i> |
|--------------------------------------|---------------|
| Local Governmental Organisations     | 4             |
| Local Non-Governmental Organisations | 1             |
| Austrian Embassy                     | 2             |
| Private                              | 3             |
| Neighbouring companies               | 2             |
| Promotrade                           | 1             |
| Abu Qir Fertilizer Co.               | 10            |
| UHDE Engineering Egypt Ltd.          | 7             |
| Carbon GmbH                          | 1             |
| Carbon Egypt Ltd.                    | 1             |
| <b>Total</b>                         | <b>32</b>     |

**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 83 guests) filled out the questionnaires

| Questions to the Stakeholders   | Yes | No |
|---|-----|----|
| Do you think that the region and the Korean 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?                                     |     |    |

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<sub>x</sub> 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:    | <b>CARBON Projektentwicklung GmbH</b>   |
| Street/P.O.Box:  | Hauptstrasse 68   |
| Building:        |   |
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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 for ex-ante estimations

| Data   |                                  |             |
|--|----------------------------------|-------------|
| Tail gas flow rate   | Nm <sup>3</sup> /h               | 262.000     |
| Production days  | d                                | 345         |
| EnviNOx® add. ammonia demand   | tHNO <sub>3</sub>                | -           |
| N <sub>2</sub> O concentration in the tail gas of the N <sub>2</sub> O DF during inter | tN <sub>2</sub> O/m <sup>3</sup> | 1,13001E-07 |
| Efficiency DF  | %                                | 94%         |
| <b>Hydrocarbon: Methane</b>  |                                  |             |
| Methane Input  | kg/h                             | 52          |
| Carbon emission factor of hydrocarbon  | tCO <sub>2</sub> /tHC            | 2,75        |
| Oxidation factor of hydrocarbon  | %                                | 0           |
| Hydrocarbon GWP  | -                                | 21          |



#### Annex 4

### MONITORING PLAN

The “Catalytic N<sub>2</sub>O 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 will involve the volume flow rate of the tail gas and the N<sub>2</sub>O concentration in the tail gas upstream and downstream of the EnviNOx<sup>®</sup>-System. The volume flow rate will be measured by using an international standard method (e.g. venture tube according to ISO 5167-4:2003; ISO 5267-4:2003). The monitoring system will automatically record volume under conditions of standard temperature and pressure. Also part of the volume flow rate monitoring system is the measurement of the tail gas temperature and tail gas pressure.

The flow rate and the N<sub>2</sub>O concentration upstream and downstream of the EnviNOx<sup>®</sup>-System are recorded on the emission monitoring computer. Data is automatically stored and can be recorded and displayed in trends and charts.

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 able 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.

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. Monitoring principles such as monitoring frequencies and reporting will be implemented in accordance with international standards.

Parameters to be monitored are described in section D.

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